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MACHINE FOR MANUFACTURE OF GLOSSY COATED SHEETS

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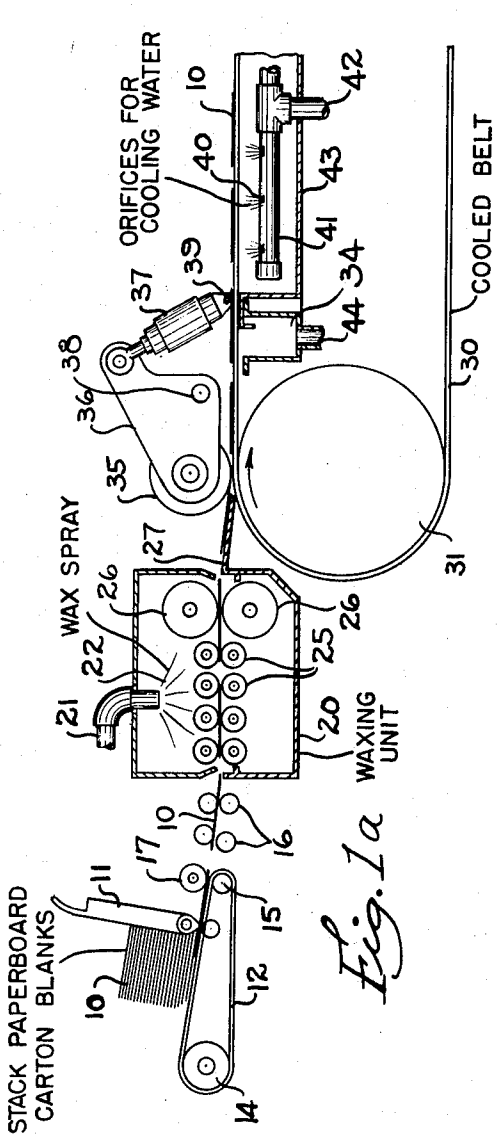


Fig. 1a

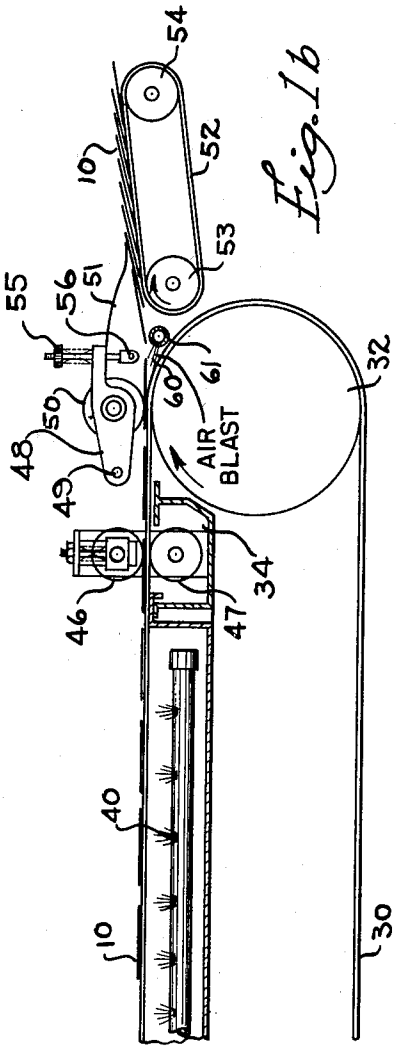


Fig. 1b

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MACHINE FOR MANUFACTURE OF GLOSSY COATED SHEETS

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Original application Oct. 2, 1956, Ser. No. 613,539, now Patent No. 2,892,735, dated June 30, 1959. Divided and this application Apr. 10, 1959, Ser. No. 805,536

6 Claims. (Cl. 118—69)

This invention relates to a process and apparatus for coating paperboard sheet materials in discreate units or pieces and particularly for producing a wax composition coating having a remarkable brilliance, smoothness and specular gloss on paperboard carton blanks.

This application is a division of application Serial No. 613,539, filed October 2, 1956, and now Patent No. 2,892,735, issued June 30, 1959.

Paperboard cartons have long been coated with petroleum-derived hydrocarbon waxes and wax blends to impart waterproofness and grease resistance to the carton, particularly for use in the packaging of foodstuffs. Paraffin wax has been of major importance in this use. Paraffin wax is a hard, brittle, crystalline wax commonly obtained from petroleum distillate derived from crude oils of mixed or paraffin base types. The wax is removed from the paraffin distillate by chilling and filtering, after which it is commonly refined by sweating, acid treatment and by percolation through clay. Generally, commercially available paraffin waxes have melting points from about 110° F. to 145° F. and tensile strengths ranging from 60 lbs./sq inch up to about 200 lbs./sq. inch.

Paraffin wax has been applied to paper and paperboard products in various ways, depending on the end use properties which are desired. For example, a moderate degree of waterproofness may be obtained very economically by a process known as "paraffining," in which a carton is passed between heated rolls which dip into a bath of molten paraffin wax. This process applies a relatively small amount of wax to the carton and, due to the rapid removal of heat from the wax by the cooling action of the carton, a portion of the wax is solidified as a surface film on the carton, while a further portion of wax remains fluid long enough to penetrate into the inner structure of the paperboard. Cartons waxed in this manner are satisfactory for use as ice cream containers and similar items.

A higher degree of waterproofness, as well as increased stiffness of the carton, may be obtained by a process known as "saturating," in which a carton is flooded with molten wax and the waxed cartons are stacked while still hot. This procedure allows rather large amounts of wax to penetrate into the pores and fibers of the paperboard, leaving little or no surface film of wax on the carton.

A considerable amount of surface wax is desirable on cartons used for packaging butter, bacon, lard and margarine. Cartons satisfactory for these uses are prepared by flooding the carton with molten wax, removing excess wax by passing the carton between steel or cloth covered rollers, and immediately dipping the carton in a cold water bath to solidify the wax while a major portion of it is still on the surface of the carton. Cartons prepared in this manner have a considerable amount of

surface wax coating, and exhibit better protective properties against moisture and grease penetration than cartons waxed by either of the previously described methods. Cartons of this type have a dull, waxy surface appearance which is frequently marred by surface irregularities, pimples, smears and so-called "crow's feet," or water marks. Nevertheless, these cartons, prior to the advent of our invention, remained the standard of quality in appearance in the industry.

Due to the widespread recognition of the importance of visual impact in stimulation of sales in many fields, many attempts have been made to increase the "eye appeal" of waxed paperboard cartons by increasing the glossiness and sheen of the wax coating while retaining or enhancing all of the economy and protective properties associated therewith. Hitherto, these efforts have met with only nugatory success.

We have now found that certain wax composition coatings may be applied to paperboard sheets or carton blanks in such manner as to obtain thereon a surface coating with startling gloss and mirrorlike sheen, unmarred by any surface irregularity. This high degree of specular gloss is obtained by providing on the surface of the paperboard blank a uniform coating of a suitable molten wax composition having predetermined adhesive and cohesive properties. Then, while the coating composition is in the molten or plastic state, the entire coated surface of the paperboard is pressed into fixed intimate and overall contact with a highly polished surface which is cooled to facilitate the solidification of the wax composition. When the coating is completely solidified, the paperboard blank is then suitably removed from the polished surface, and will be found to possess a surface of high specular gloss unmarred by surface imperfections, whether the blank is plain or provided with suitable score lines for subsequent folding.

The polished supporting surface against which the wax composition coating surface is pressed may be of metal or other suitable smooth-surfaced material capable of accepting a high polish. To facilitate the high-speed production of gloss-surfaced paperboard blanks, we prefer to use for this purpose a highly polished belt which, for example, may be of stainless steel or chromium plated steel having a specular surface. A metallic surface coated with a suitably glossy lacquer, resin or plastic coating would serve a similar purpose. It is to be understood that the reference hereinafter to a belt in describing the novel features of our invention is intended to be illustrative of the means used for supporting and contacting the plastic wax composition surface coating on the blanks and that other suitable means may be used.

Our invention may be carried out by the apparatus illustrated in the accompanying drawing wherein,

Fig. 1*a* is a schematic side elevation of the apparatus, and

Fig. 1*b* is a continuation of the view shown in Fig. 1*a*.

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 roller **14** and drive roller **15** with a device **11** for restraining the blanks 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 pumping unit not shown in the drawing. An excess of molten wax is applied to the surfaces of the paperboard blank by the wax spray and 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, travelling, flexible, metallic belt 30 which is supported on the drum 31 and the driving sheaves 32 (Fig. 1*b*), the drum and sheaves each being about 24" in diameter. It is obvious that Fig. 1*a* and Fig. 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. The carton blank is pressed firmly into complete and intimate fixed contact with the belt surface by a rotating squeeze roll 35 held by pivotally mounted arms 36. These arms are pivoted at 33 to the frame which, for clarity of illustration, is omitted from the drawing. The pressure exerted by the squeeze roll on the carton blanks and travelling belt is controlled by air cylinders 37, also pivotally mounted to the frame at 39. The squeeze roll 35 is preferably provided with a yieldable surface and is placed slightly back of the point of tangency of the belt with the drum 31; that is, at a point where the belt is held firmly against the drum. The squeeze roll 35 is slightly larger in diameter at the extreme end portions of the roll than over the remainder of the roll length. This allows only the extreme end portions to contact the belt surface, the central portion of the roll being gapped by, for example, about .010 inch from the belt surface. When blanks of about .017 inch thickness are fed through this gap, the yieldable roll surface is then depressed by about .007 inch. Under these conditions, a roll having a surface hardness giving a plastometer reading of about 25 or less has been found to provide sufficient pressure to affix the coated blank to the belt with the desired intimate contact. This gapping of the roll also prevents wax transfer to the belt and damage to the polished belt surface by scratching or marring. Cooling water for holding the belt surface 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 recirculated. 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 to temperature equilibrium with the water.

Continuing, with reference to Fig. 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 travelling 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 travelling 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.

In carrying out our invention the wax composition used must be selected so as to have predetermined critical properties of adhesion and cohesion. It is, of course, of primary importance that the entire coating surface remain in fixed intimate and continuous contact with the highly polished cooling belt until the coating is completely solidified, since any area of the coating surface which solidifies while not in contact with the belt will not attain the desired specular surface gloss. It is, then, necessary that the adhesion between the wax composition and the belt be at least as great as the minimum value which is sufficient to maintain the desired intimate contact. It is also necessary, however, that the coated paperboard blank be readily removable from the belt after the coating has solidified. To this end, the adhesion between the solid coating and the belt must be less than a predetermined maximum permissible value to enable the coated paperboard blank to strip cleanly from the belt, leaving no wax composition adhering to the belt surface.

In addition to the above limitations on the adhesion of the wax composition to the belt, it is also necessary for the wax composition to adhere more strongly to the paperboard than to the belt and to have greater cohesive strength than the adhesion of the composition to the belt.

The adhesion of various wax compositions to a highly polished metallic surface was measured in the following way:

A 2" wide sheet of a 30 lb. per ream bleached sulfite paper stock was surface-coated with about 5 lbs. per ream of the wax composition to be tested. While the wax composition was still molten, the coated surface was pressed into intimate contact with the exposed metallic surface of a 2" wide sheet of aluminum foil which had previously been glue-laminated to 30 lb. per ream paper stock to increase the strength of the aluminum web. The finished wax lamination was cooled by an air blast at room temperature to solidify the wax composition. A centrally-disposed 1" wide strip was then cut from the laminated web and the strength of the wax composition seal bonding the wax coated paper to the foil was measured on a Socony-Vacuum Oil Company seal strength tester at 73° F. and 50% relative humidity. The Socony-Vacuum seal strength tester determines in grams per inch of width of the sheet tested the yield force of 2 sheets adhered in face to face relation.

The relation between the adhesive seal strength measured according to the above method, and the adaptability of various wax compositions for the production of a high degree of specular gloss on paperboard carton blanks by our method is shown in the following Table I, wherein column 1 gives the specific wax composition used in percent by weight, column 2 gives the seal strength as tested by the foregoing procedure, and column 3 states the char-

acter of the surface gloss produced when using the particular wax composition indicated by applying such composition to carton blanks according to our invention.

Table I

Column 1 Wax Composition [1]	Column 2 Seal Strength at 73° F., gm./inch	Column 3 Gloss Waxing Comments
10% DYLT Polyethylene, 5% 145/47 Amber Micro Wax, 85% 135/37 Paraffin.	3.3	Exceptional Gloss, Strips Clean.
5% DYLT Polyethylene, 20% Shell 700 Wax, 75% 135/37 Paraffin.	3.4	Exceptional Gloss, Strips Clean.
20% AC 6 Polyethylene, 5% 145/47 Amber Micro Wax, 75% 135/37 Paraffin.	3.8	Exceptional Gloss, Strips Clean.
25% Shell 700, 75% 135/37 Paraffin.	13.7	Good Gloss, Slight Wax Pick-Off, Marginal.
5% DYLT Polyethylene, 95% 135/37 Paraffin.	10.7	Good Gloss, Slight Wax Pick-Off at Score Lines.
10% Shell 700, 90% 135/37 Paraffin.	23.7	Considerable Wax Pick-Off, Unsatisfactory.

[1] All compositions contain 0.1% of DC 200, which is dimethyl siloxane sold by Dow-Corning Co. of Midland, Michigan.

DYLT Polyethylene has a m.w. of about 12,000. It is sold by the Bakelite Company, a Division of Union Carbide and Carbon Corporation.

145/47 Amber Micro Wax is a microcrystalline wax having an m.p. of about 145° and is sold by Quaker State Oil Company.

135/37 Paraffin is a fully refined paraffin sold by Standard Oil Company of Indiana.

Shell 700 is a high melting hydrocarbon wax sold by Shell Oil Company.

AC 6 Polyethylene has a m.w. of 2000. It is sold by Semet-Solvay Corporation.

The data in Table I indicate that, to be satisfactory in the process of our invention, the adhesion of a wax composition to the polished surface, as measured by the test previously described, must be not more than about 15 gm./inch, and preferably not more than about 10 gm./inch. Adhesion values greater than about 15 gm./inch result in wax picking off the carton and remaining on the belt.

On the other hand, the adhesion of the wax composition to the belt must not have too low a value or the paperboard blank will not maintain a sufficiently intimate contact with the belt during the cooling process. If intimate, continuous fixed contact is not maintained during the process of solidification of the composition, the surface will not attain the desired highly glossy, mirrorlike appearance. It has been found that if the adhesion of the wax composition to the belt is less than about 1.5 gm./inch, as measured by the test procedure described above, the desired surface gloss will not be obtained. Preferably, we adjust the adhesiveness of the wax composition and/or the adhesiveness of the polished belt surface so that the adhesion of the wax composition to the belt is above about 2 gm./inch but not in excess of about 10 gm./inch. Adhesion within these limits may be attained by modifying either the wax composition or the surface characteristics of the supporting polished surface. For example, increasing the content of a soft, ductile microcrystalline wax in the composition increases its adhesive quality. Increasing the polyethylene content generally has the opposite effect. The adhesion may also be decreased by the addition of small amounts of silicones to the wax composition formulation, or by applying a very thin coating of a silicone release agent to the belt surface. All of the compositions in Table I contain 0.1% of DC 200, which is a dimethyl siloxane sold by thet Dow-Corning Company of Midland, Michigan. A small amount of this material serves to control the adhesion of the composition to the belt while not materially affecting the cohesive qualities or the adhesion of the composition to the carton. The

effect of silcones in the composition may be shown in the following Table II, in which the adhesion of a selected wax composition is tabulated both with and without the addition of 0.1% of DC 200 silicone oil.

Table II

Wax Composition	Adhesion in gm./inch
20% DYDT Polyethylene, 30% 145/47 Amber Micro Wax, 50% 160/65 Aristowax	136
20% DYDT Polyethylene, 30% 145/47 Amber Micro Wax, 50% 160/65 Aristowax, 0.1% DC 200 Added	6.5

DYDT Polyethylene has a m.w. of about 4000. It is sold by the Bakelite Company, a Division of Union Carbide and Carbon Corporation.

160/65 Aristowax is a crystalline wax melting at about 160° F. It is sold by the Union Oil Co. of California.

The effect of treating the polished belt surface with a thin coating of a silicone release agent is shown in the following Table III, in which the adhesion of a wax composition to an untreated aluminum foil surface is compared to the adhesion of the same composition to a foil surface previously treated with about 0.1 lb. per ream of DC 200 silicone oil.

Table III

Wax Composition	Foil Surface	Adhesion in gm./inch
10% Shell 700 Wax, 90% 135/37 Paraffin, 0.1% DC 200 Silicone Added.	Untreated	23.7
10% Shell 700 Wax, 90% 135/37 Paraffin, 0.1% DC 200 Silicone Added.	Silicone Treated.	3

From the data given in Tables II and III, it is evident that the addition of a silicone in the composition or on the belt surface may have a profound influence on the adhesion of the wax composition to a polished surface. By such modification of the adhesive quality of either the wax composition or the belt, the adhesion of a wide variety of wax compositions to a polished surface may be brought within the preferred operable range of from about 2 gm./inch to about 10 gm./inch.

The temperature at which the polished belt surface is maintained is also of importance in obtaining the desired degree of adhesion. The surface is cooled by suitable means to a temperature substantially below the melting point of the wax composition, and the optimum temperature is dependent not only on the melting point of the composition, but also on the temperature dependence of the adhesive and cohesive qualities of the particular composition in question. The adhesion of certain wax blends varies considerably with temperature, while other blends are relatively unaffected. The same is true of the cohesive properties.

The temperature dependence of the adhesion and cohesion of various wax compositions is shown in the following Table IV, in which the seal strength values of coated paper to foil and coated paper to coated paper are tabulated as determined at 73° F. and 100° F. on the Socony-Vacuum seal strength tester. Samples were prepared in the manner previously described. In the paper to foil seals, the test measures the adhesion between coating and metal surface. In the paper to paper seals, since the adhesion of the wax composition to paper is greater than the cohesion of the composition, seal failure occurs in the composition, and the test thus measures cohesive force.

Table IV

Wax Composition	Adhesion in gm./in. (Paper to Foil)		Cohesion in gm./in. (Paper to Paper)	
	73° F.	100° F.	73° F.	100° F.
1. 5% DYLT Polyethylene, 95% 135/37 Paraffin, 0.1% DC 200 Added	11	3	10	13
2. 20% AC 6 Polyethylene, 5% Amber Micro Wax, 75% 135/37 Paraffin, 0.1% DC 200 Added	9.8	1.6	10	6.7
3. 10% DYLT Polyethylene, 90% 135/37 Paraffin, 0.1% DC 200 Added	3	1.6	22	16
4. 25% Shell 700, 75% 135/37 Paraffin, 0.1% DC 200 Added	13.7	9.8	6	13

It will be noted from Table IV that the adhesion values of compositions 1 and 2 are notably decreased by an increase in temperature, while the comparable property of compositions 3 and 4 is appreciably less affected by temperature change. The cohesive values of compositions 1 and 4 are increased with increasing temperature, while the comparable property in compositions 2 and 3 is affected in the reverse manner.

It is apparent from a consideration of these values that it is desirable to maintain the temperature of the polished cooling surface at a point commensurate with the most desirable adhesion and cohesion values of a given composition. For example, the values for these properties for composition 1 at 73° F. indicate that it would be impossible to satisfactorily operate the process with this blend if the polished surface were maintained at 73° F. since the cohesion is no greater than the adhesion value. This has proven to be the case on commercial equipment. The data at 100° F. for this composition, however, indicate that if the polished cooling surface is maintained at this temperature, adhesion will be in the desired optimum range and the cohesion is sufficiently high to prevent any wax pick-off on the polished surface. Under these conditions, satisfactory results are obtained. The data in this table also indicate that composition 2 will perform satisfactorily with the polished surface maintained at 100° F. but not at 73° F. Composition 3 performs satisfactorily at either temperature, while composition 4 will not be satisfactory at 73° F. but will show improved performance at 100° F. In any case, the belt should be maintained at a temperature above the dew point of the surrounding atmosphere to avoid condensation of moisture on the belt which impairs the surface gloss of cartons pressed against its surface.

On the other hand, the temperature of the belt surface must be sufficiently lower than the melting point of the wax composition to thoroughly harden the wax composition coating on the paperboard blanks. If the coating is not cooled sufficiently below its melting point before removal from the belt, the coating surface is relatively soft and is readily scuffed, marred or scratched by the subsequent necessary handling operations. In general, we prefer to maintain the belt at a temperature at least 40° F. below the melting point of the wax composition. The operable belt temperatures, then, range from just above the dew point of the surrounding atmosphere (generally between 60 and 80° F.) to a temperature about 40° F. below the melting point of the wax composition. The optimum operating temperature will depend on the characteristics of the wax composition, as previously indicated, and it is necessary that the adhesion of the composition to the belt surface, as measured at the same temperature as the belt surface, exhibit a value between 1.5 gm./inch and 15 gm./inch and preferably between 2 gm./inch and 10 gm./inch.

Having now disclosed and described in detail preferred forms of our invention, it is obvious that many modifications are possible without departing from the spirit thereof. Therefore, no limitations on our invention are intended except as specifically set forth in the appended claims.

We claim:

1. A machine for providing a highly polished specular wax composition surface on a succession of paperboard sheets, comprising means for applying a molten wax composition coating to at least one surface of the sheets, a flexible endless planar conveyor means having a highly polished smooth exterior surface, means for maintaining said conveyor surface at a temperature substantially lower than the solidification temperature for the wax composition, means for successively applying the wax coated surface of said sheets in intimate overall and fixed adhered contact with said conveyor surface, means for moving said conveyor in a substantially horizontal plane while maintaining said coated sheets in fixed adhered contact with the planar surface thereof until the coating is solidified, means to effect separation of the successive sheets from said conveyor, and means for guiding said conveyor through a curvilinear return path.

2. A machine for providing a highly polished specular wax composition surface on a succession of paperboard sheets, comprising means for applying a molten wax composition coating to at least one surface of the sheets, a flexible endless planar conveyor means having a highly polished smooth exterior surface, means for maintaining said conveyor surface at a temperature substantially lower than the solidification temperature for the wax composition, means for successively applying the wax coated surface of said sheets in intimate overall and fixed adhered contact with said conveyor surface, means for moving said conveyor in a substantially horizontal plane while maintaining said coated sheets in fixed adhered contact with the planar surface thereof until the coating is solidified, means for guiding said conveyor through a curvilinear return path to effect progressive and complete separation therefrom of the successive leading coated sheets, and means adjacent said guiding means to maintain contact of the unseparated portions of the successive leading sheets with the conveyor surface while separating the forward edge of the leading sheets from the conveyor.

3. A machine for providing a highly polished specular wax composition surface on a succession of paperboard sheets, comprising means for successively feeding a plurality of spaced paperboard sheets into a waxing zone, means for applying a molten wax composition coating, to at least one surface of said sheets while passing through said waxing zone, a flexible endless planar conveyor means having a highly polished smooth exterior surface, means for maintaining said conveyor surface at a temperature substantially lower than the solidification temperature for such a wax composition, means for successively presenting the wax coated surface of said coated sheets in intimate overall and fixed adhered contact with said conveyor surface, means for maintaining continuous horizontal travel of said conveyor and coated sheets adhered thereto until the coating on said adhered sheets is solidified, means for guiding said conveyor through a curvilinear return path to effect progressive and complete separation therefrom of the successive leading coated sheets subsequent to solidification of the coating while continuing horizontal travel of the leading sheets, and means adjacent said guiding means to maintain contact of the unseparated portions of the leading sheets with the conveyor surface during the separating action.

4. A machine for providing a highly polished specular wax composition surface on a succession of separate sheets comprising means to support a stack of separate sheets, means for successively feeding in spaced relation individual sheets from said stack, a waxing chamber, means for

conveying said spaced sheets to said waxing chamber, means in said waxing chamber for applying a molten wax coating composition to at least one surface of said sheets, means in said chamber for successively feeding the coated sheets from said waxing chamber, a flexible endless conveyor having a highly polished smooth exterior surface the upper reach of which travels in a planar path, means for successively applying the coated surface of said sheets in intimate overall and fixed adhered contact with said planar surface, means for maintaining the surface of said conveyor at a temperature substantially lower than the solidification temperature of the wax coating composition, means for maintaining continuous travel of said conveyor and coated sheets adhered thereto until the coating on said adhered sheets is solidified, conveyor guiding means for guiding said conveyor through a curvilinear return path to effect progressive and complete separation therefrom of the successive leading coated sheets subsequent to solidification of the coating on said leading sheets while continuing travel of the leading sheets in the direction of initial travel, means adjacent said conveyor guiding means to maintain contact of the unseparated portion of the leading sheets with the conveyor surface during the separating action, means for providing an air blast against the separated forward edge of the leading sheets for assisting removal of the coated sheets from the conveyor surface, guides adjacent said air blast to guide the separated leading sheets, and means for supporting and stacking the separated sheets in a shingled pile.

5. A machine for providing a highly polished specular wax composition surface on a succession of separate sheets comprising means to support a stack of separate sheets, means for successively feeding in spaced relation individual sheets from said stack, a waxing chamber, means for conveying said spaced sheets to said waxing chamber, means in said waxing chamber for applying a molten wax coating composition to at least one surface of said sheets, means in said chamber for successively feeding the coated sheets from said waxing chamber, a flexible endless conveyor having a highly polished smooth exterior surface the upper reach of which travels in a planar path, means for successively applying the coated surface of said sheets in intimate overall and fixed adhered contact with said planar surface, means for maintaining the surface of said conveyor at a temperature substantially lower than the solidification temperature of the wax coating composition, means for maintaining continuous travel of said conveyor and coated sheets adhered thereto until the coating on said adhered sheets is solidified, conveyor guiding means for guiding said conveyor through a curvilinear return path to effect progressive and complete separation therefrom of the successive leading coated sheets subsequent to solidification of the coating on said leading sheets.

6. A machine for providing a highly polished specular wax composition surface on a succession of separate sheets comprising means to support a stack of separate sheets, means for successively feeding in spaced relation individual sheets from said stack, a waxing chamber, means for conveying said spaced sheets to said waxing chamber, means in said waxing chamber for applying a molten wax coating composition to at least one surface of said sheets, means in said chamber for successively feeding the coated sheets from said waxing chamber, a flexible endless conveyor having a highly polished smooth exterior surface the upper reach of which travels in a planar path, means for successively applying the coating surface of said sheets in intimate overall and fixed adhered contact with said planar surface, means to impinge a refrigerating fluid against the inner surface of the upper reach of said conveyor for maintaining the surface of said conveyor at a temperature substantially lower than the solidification temperature of the wax coating composition, means for maintaining continuous travel of said conveyor and coated sheets adhered thereto until the coating on said adhered sheets is solidified, conveyor guiding means for guiding said conveyor through a curvilinear return path to effect progressive and complete separation therefrom of the successive leading coated sheets subsequent to solidification of the coating on said leading sheets while continuing travel of the leading sheets in the direction of initial travel, a pressure roller adjacent said conveyor guiding means to maintain contact of the unseparated portion of the leading sheets with the conveyor surface during the separating action, means for providing an air blast against the separated forward edge of the leading sheets for assisting removal of the coated sheets from the conveyor surface, guides adjacent said air blast to guide the separated leading sheets, and means for supporting and stacking the separated sheets in a shingled pile.

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