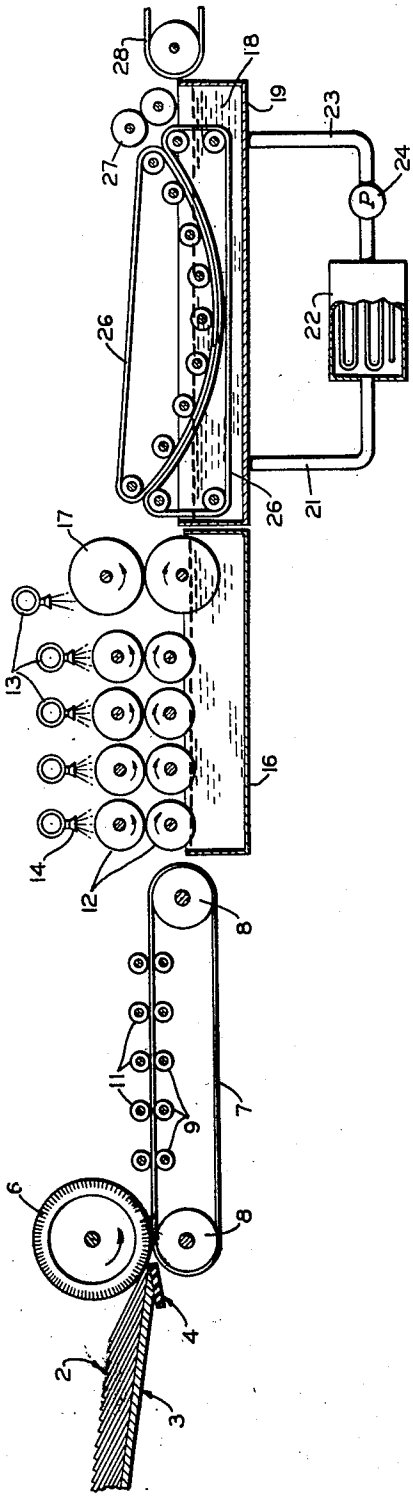
Jan. 14, 1958 D. G. EDWARDS ET AL 2,819,986

LOW FRICTIONAL DRAG COATED PAPER PRODUCTS
AND METHOD OF PREPARATION THEREOF
Filed July 26, 1954



INVENTOR.
DAVID G. EDWARDS
MELVIN C. EDLUND
BY Fryer & Johnson
ATTORNEYS

United States Patent Office 2,819,986 Patented Jan. 14, 1958

2,819,986

LOW FRICTIONAL DRAG COATED PAPER PRODUCTS AND METHOD OF PREPARATION THEREOF

David G. Edwards, Concord, and Melvin C. Edlund, Berkeley, Calif., assignors to Fibreboard Paper Products Corporation, a corporation of Delaware

Application July 26, 1954, Serial No. 445,726

5 Claims. (Cl. 117—92)

This invention relates to the reduction of frictional resistance between coated paper products and surfaces in contact therewith, and more particularly to the formation of a film of drag reducing agent on the surface of paper products having protective or decorative coatings of wax or the like.

Coated paper products are extensively employed for wrapping and packaging numerous articles. Usually the setting up of paperboard containers, and the wrapping or packaging of articles is accomplished by means of automatic machinery. Although paper products coated with unmodified low melting paraffin waxes generally have a sufficiently low frictional drag to be readily handled by such machinery, the low melting unmodified waxes have undesirable properties, such as a greasy feeling, a tendency to seal to adjacent wax surfaces in hot weather, and a limited resistance to penetration by grease. The high melting point unmodified waxes, and the improved modified wax coatings which contain additives overcome the disadvantages of the low melting paraffin waxes. However, such high melting point unmodified waxes and also the modified wax compositions have a relatively high amount of frictional resistance which renders paper products coated with such compositions difficult to separate from stacks of similar paper products by sliding motion when individual sheets in the stack are fed successively to equipment by the usual paper stack feeding devices, causes scuffing of the wax coating, and reduces the efficiency of the machinery as the coated paper products pass through the various setting up or packaging operations. Attempts to solve this frictional drag problem by modifying the coating composition have not been entirely successful since other desirable properties of the coating have usually been adversely affected or the economic aspects have been made such modifications unfeasible.

To summarize this invention, it comprises the reduction of the frictional surface resistance of coated paper products or the like without affecting the advantageous properties of the coatings by applying a thin film of a drag reducing agent to the surface of such coated products, which film remains on such surface as a discrete lubricating layer. The drag reducing agent may be any liquid compound that has the physical property of reducing frictional drag and in this connection, the liquid may be of relatively low viscosity or it may have the consistency of a relatively thick gel. The numerous compounds that have the property of reducing frictional resistance of coated paper products are readily determined by a simple comparison of frictional surface resistance of coated paper products with and without a film of the compound applied thereto, as indicated by the feel of the specimens, or by frictional measurements.

Although the drag reducing agent may be applied directly to the coated paper product in undiluted form, namely, without a solvent or other carrier agent, best results are obtained by incorporating the drag reducing

agent in a volatile liquid carrier, such as water, to form a liquid composition that may be either a solution or an emulsion. The volatile liquid carrier evaporates after the mixture is placed on the coated paper product leaving a thin discrete film of drag reducing agent on the surface of the coating. A surface active agent is desirably included in the mixture to provide improved wetting of the mixture on the coated paper product, and to provide a stable emulsion when the drag reducing agent employed is insoluble in the volatile liquid carrier.

Compounds that may be employed as drag reducing agents are organic compounds having the following properties: a viscosity which may vary from a low viscosity liquid to a viscous semi-liquid substance having the consistency of a gel; a low solubility in the coating of the paper product; the property of forming a film on the surface of the coating; the property of being softer than the coating so that they do not become embedded in the coating. Also, drag reducing agents generally should be non-volatile so that the film of drag reducing agent will remain on the coating in storage until the wrapping or packaging operations have been completed.

By applying the film of drag reducing agent to coated paper products in accordance with this invention, the frictional resistance between a coated paper product and surfaces in contact therewith is reduced to the point where frictional drag is no longer a problem, and scuffing of the coated surface is reduced. Furthermore, this lowered frictional resistance is obtained without affecting the remaining desirable properties of the paper coating. This invention may be employed with great advantage in reducing the frictional resistance of paperboard products, such as carton blanks, that have coatings of wax or modified wax compositions, both hereinafter generally designated as wax coatings. It may be employed with particular advantage when such wax coatings are applied in a cold water waxer. By merely incorporating a drag reducing agent in the cold water bath of the cold waxer, a film of a drag reducing agent is formed on the surface of the wax coating without the necessity of making alterations in existing equipment.

The accompanying drawing is a schematic sectional side elevation of a conventional cold waxer for paperboard products embodying a cold water bath in which the drag reducing agent of this invention may advantageously be incorporated. It is to be understood that the elements of the cold waxer are not shown in proportion to their actual relative sizes, but are drawn for purposes of illustration only.

In greater detail, the uncoated paperboard carton blanks 2 are stacked edgewise and inclined relative to inclined support table 3. The usual dam or choke member 4 is provided adjacent the discharge end of table 3 so as to insure that only the single outermost sheet or blank is fed at a time. A continuously rotating rubber covered feed roll 6 is provided adjacent choke 4, and the feed roll is driven in a counter-clockwise direction with reference to the drawing to effect feeding of the respective carton blanks 2 onto a continuously moving endless conveyor 7 mounted on conveyor rolls 8. Support rollers 9 support the central part of conveyor 7, and retainer rollers 11 serve to maintain the blanks 2 on the conveyor surface.

The blanks 2 are carried by conveyor 7 to conventional felt covered wax applicator rolls 12 where hot liquid wax is applied. The upper applicator rolls have hot wax applied to their surfaces by means of pipes 13 having nozzles 14 disposed therein for spraying wax. The lower applicator rolls have their lowermost portions disposed in hot molten wax contained in a tray 16, and carry wax to the blanks as the applicator rolls rotate. In this manner, molten wax is applied to both the top and bottom surfaces

of carbon blanks 2. The carton blanks 2 are conveyed by the rotation of the applicator rolls 12 to finishing rolls 17 where the excess wax is removed.

After the carton blanks 2 have been soaked with molten wax and passed through the finishing rolls, the blanks are plunged into the usual cold water bath 18 where the wax is solidified to form a coating on the carton blank; the water in the bath being usually continuously circulated at a temperature of about 40° F. The cold water bath 18 is contained in any suitable tank 19, and the water temperature is maintained by circulating the water in the cold water tank through pipe 21 into a coil cooled refrigerating tank 22 and back into the cold water tank 19 through pipe 23 by means of pump 24. The wax coated blanks 2 are conveyed through the cold water bath by upper and lower conveyor belts 26. After the wax coated blanks 2 have passed through the water bath and the wax coating has solidified, the excess water is removed from the wax coated blank surfaces by passing such blanks through wringer rolls 27. The wax coated blanks are removed by discharge conveyor belt 28.

By incorporating a drag reducing agent in the cold water bath of the cold waxer, a thin film of the drag reducing agent is produced on the surface of the wax coating as water is absorbed into the paperboard blank or evaporates. No changes need be made in existing equipment, and no additional steps need be performed when the drag reducing agent is added in this manner. Furthermore, the wringer rolls 27 automatically remove any excess of drag reducing agent appearing on the surface of the coated paper products, and a desirably thin film of the drag reducing agent is produced. In this connection, the moving conveyor belts 26 may serve as the means for forming an emulsion or mixing the solution of the drag reducing agent in the water.

Compounds suitable for use as drag reducing agents may readily be selected from the numerous available organic liquid compounds by a simple comparison in the feel of two specimens of coated paperboard rubbed together before, and after application of the drag reducing agent. If desired, the effectiveness of a compound as a drag reducing agent may be evaluated more quantitatively and with greater accuracy by employing a standard force to pull a standard size specimen of a coated paper product from between two similar pieces of the coated paper product under a constant pressure. The time required to withdraw the central specimen is an indication of the frictional resistance of the coating for the paperboard product. A comparison of the times for withdrawing such coated paperboard specimens before and after they are coated with a drag reducing agent readily illustrates the efficacy of the compound for lowering the surface frictional resistance of coated paper products.

The data in the following table effectively illustrates, for a few of the many drag reducing agents tested, the reduction in the surface frictional resistance of coated paper products obtained by employing a drag reducing agent in accordance with this invention. Samples of paperboard 5½ in. long and 1¼ in. wide coated with a modified wax composition containing 3% by weight polyethylene and 5% microcrystalline paraffin wax combined with 92% by weight paraffin wax having a melting point range of 143° F. to 150° F. (A. M. P.) were employed for the tests. Three of such specimens interleaved for 5 inches along their lengths were placed on a horizontal flat surface and subjected to a normal force of 1500 gms. applied to one square inch of the surface of the top specimen. The middle specimen was pulled from between the other similar specimens by subjecting it to an average force directed along its lengthwise horizontal axis of 1.68 lbs., and the time to completely withdraw the middle specimen was measured. In these tests, the indicated percent by weight of drag reducing agent was dissolved or emulsified in water as a carrier. One percent by weight, based upon the weight of drag reducing agent, of polyoxyethylene sorbitan monoleate, a surface active agent sold by Atlas Powder Company under the name "Tween 80," was employed in all cases, and it served as an emulsifying agent for drag reducing agents insoluble in water. In other words, 0.03% by weight of the surface active agent based upon the total weight of drag reducing agent, volatile liquid carrier and surface active agent was employed in the tests; except 0.06% by weight surface active agent based upon the total weight of the composition was employed in the test in which 6% drag reducing agent was used. The emulsions or solutions of the drag reducing agents were sponged on the surface of paperboard coated with the modified paraffin wax coating and the specimens were allowed to dry overnight at room temperature before the tests were made.

TABLE

Comparison of frictional surface resistance of coated paperboard with and without a film of drag reducing agent

Drag Reducing Agent	Percent by Weight of Drag Reducing Agt. in Carrier	Average Removal Time (Secs.)
None	0	226
Cottonseed Oil (Emulsion)	3	3
Mineral Oil (Emulsion)	3	34
Polyoxyethylene glycols (Average molecular weight 500 to 600) sold by Carbide and Carbon Chemicals Co. as "Carbowax 1500" (Solution)	6	2½
Polyoxyethylene glycols (Average molecular weight 500 to 600) sold by Carbide and Carbon Chemicals Co. as "Carbowax 1500" (Solution)	3	13
Polyoxyethylene glycols (Average molecular weight 285–315) sold by Carbide and Carbon Chemicals Co. as "Polyethylene Glycol 300" (Solution)	3	11
Glycerine (Solution)	3	80
Octadecanol-1 (Emulsion)	3	38

The foregoing table illustrates the appreciable lowering of the frictional surface resistance obtained by employment of a drag reducing agent in accordance with this invention. Also, the tests illustrate a simple manner of determining the efficacy of a compound as a drag reducing agent. Similar tests on paperboard coated with unmodified paraffin wax having the relatively low melting point range of between 133 and 135° F. (A. M. P.) gave a withdrawal time of 11 seconds without use of a drag reducing agent. Since the time for the modified wax coating was 226 seconds, the importance of employing a drag reducing agent in accordance with this invention is readily apparent.

The numerous drag reducing agents that have the property of reducing the frictional surface resistance of coated paper products have other common characteristics. They are all organic compounds with a viscosity which may vary from a low viscosity liquid to a viscous gel. In more quantitative terms, the viscosity of the drag reducing agent may vary from less than one centipoise up to 10,000 centipoises, or in other words, have a viscosity below 10,000 centipoises.

The solubility of the drag reducing agent in the coating is another factor in determining the usefulness of a compound for reducing the surface friction of coated paper products. If a compound is soluble to any substantial extent in the protective coating, it tends to lose its identity as a separate discrete film, and its function in lowering frictional surface resistance is impaired. Solubility of the coating in the lubricant, or lubricant in the coating, should be less than ½% by weight for best results. Solubilities of waxes in organic liquids may readily be determined experimentally or obtained from available literature, such as the book entitled "Commercial Waxes," by H. Bennett, Chemical Publishing Company, Brooklyn, New York. Deodorized kerosene is an example of a

liquid organic compound that is too soluble to serve as a drag reducing agent for an essentially wax coating.

In addition, suitable drag reducing agents have the property of forming a film on the surface of the coated paperboard although the film need not be absolutely continuous in order to perform its function. In other words, the compound employed as a drag reducing agent should wet the surface of the coated paperboard. Usually, compounds that have a contact angle with the coated surface of less than 103° are satisfactory. The angle is measured from the inside of the film to the tangent of the film where it intersects the coating.

Furthermore, the drag reducing agent should be softer than the coating to which it is applied so that the agent does not become embedded in the coating and increase the frictional resistance. This property of softness is usually inherently present if the drag reducing agent has the other properties specified.

The drag reducing agent is generally applied to the coated paper product long before the product is to be employed for wrapping or packaging various articles. Consequently, the drag reducing agent should be relatively non-volatile so that it will remain on the surface of the coating and not evaporate. The vapor pressure of a compound divided by the square root of its molecular weight provides a measure of the volatility of a compound. For the purposes of this invention, it is not usually desirable to employ a compound as a drag reducing agent if the ratio of the upper vapor pressure in millimeters of mercury to the square root of its molecular weight is greater than 0.1. For example, "Cellosolve" (2-ethoxyethanol) sold by Carbide and Carbon Chemicals Co. is too volatile to be employed as a drag reducing agent for most purposes, and the ratio of the vapor pressure in millimeters of mercury to the square root of the molecular weight is about 1. However, when the drag reducing agent is applied shortly before the coated paper product is to be employed, volatility of the drag reducing agent is not such a critical factor as long as the film has not completely evaporated.

In the course of numerous tests on drag reducing agents, an additional empirical factor has been discovered that provides an indication of the suitability of an organic compound as a drag reducing agent. It has been found that for all drag reducing agents, the product of the viscosity (in centipoises) by the molecular weight of a compound is between about 10,000 and 1,000,000. When the compound is very viscous at room temperatures, the viscosity of the compound at its melting point was employed in arriving at this result. Consequently, although the feel or drag time of a specimen having a film of drag reducing agent, compared to the feel or drag time of a coated specimen without a drag reducing agent, is the easiest method of determining the efficacy of a compound as a drag reducing agent, the foregoing physical properties may also be employed to select a drag reducing agent.

Examples of a few of the preferred drag reducing agents that may advantageously be applied to paperboard coated with wax or modified wax coatings are polyoxyethylene glycols sold by Carbide and Carbon Chemicals Co. as "Carbowax 1500" (average molecular weight 500–600), "Polyethylene Glycol 300" (average molecular weight 285–315) and "Polyethylene Glycol 600" (average molecular weight 570–630); glycerine; mineral oil; vegetable or animal shortening; cottonseed oil; vegetable fat; and castor oil. If the coated paper product is to be used for wrapping food, non-toxic drag reducing agents, such as polyoxyethylene glycols, should be employed.

The thin film of drag reducing agent is most advantageously applied to coated paper products by incorporating the drag reducing agent in a volatile liquid carrier and applying the mixture of drag reducing agent and carrier to the surface of the coated paper product. However, it

is not essential that the drag reducing agent be incorporated in a volatile carrier since the pure undiluted agent may be applied to the coated paperboard. The volatile carrier evaporates and leaves a thin almost imperceptible film of drag reducing agent on the coating of the paperboard.

Any volatile carrier for the drag reducing agent may be employed as long as it does not stain the paper product or dissolve the coating on the product. Water is the most practical volatile carrier since it is the most inexpensive and it does not harm the paper or coatings for the paper. Consequently, water soluble drag reducing agents are easier to employ with water as the volatile liquid carrier than agents insoluble in water, since insoluble agents must be emulsified. However, other volatile carriers including hydrocarbons such as benzene and xylene, halogenated hydrocarbons such as trichlorethylene, alcohols such as ethyl alcohol, and ketones such as methyl ethyl ketone may be employed if the coating of the paper product is not affected by the carrier.

It is usually desirable to incorporate a surface active agent in the mixture of drag reducing agent and volatile liquid carrier. The surface active agent improves the wettability of the mixture on the coated paper product, and provides improved retention of the film on the coating. Furthermore, when water is employed as the carrier and the drag reducing agent is insoluble in water, the surface active agent generally acts as an emulsifying agent to maintain the drag reducing agent dispersed throughout the carrier. Surface active agents of non-ionic, anionic, and cationic character have proven to be satisfactory for the purposes of this invention.

Examples of suitable surface active agents are polyoxyethylene sorbitan monoleate, a non-ionic compound, sold by Atlas Power Company under the name "Tween 80"; N-soya N-ethyl morpholinium ethosulfate, a cationic surface active agent, sold by Atlas Power Company under the name "G–271"; and naphthalene sulfonic acid condensate, an anionic surface active agent sold by Antara Chemicals as "Blancol"; as well as any of the other well known surface active agents.

When a high proportion of a water insoluble drag reducing agent is employed, it is sometimes necessary to employ a surface active agent that is particularly effective in maintaining a stable emulsion. A polyoxyethylated fatty acid sold by Antara Chemicals under the name "Emulfor VN–430" has proven to be effective in maintaining an emulsion, either when used alone or together with another surface active agent.

The proportional amount of drag reducing agent that may be advantageously employed to form a film on the surface of a coated paper product may vary from a fraction of a percent to one hundred percent by weight of the total weight of the drag reducing composition applied to the coating. Even a fraction of a percent of drag reducing agent incorporated in a volatile carrier serves to provide some improvement. However, best results in reducing frictional surface resistance of coated paper products as indicated by quantitative tests are obtained when the drag reducing agent comprises from 1% to 20% by weight of the mixture of drag reducing agent and carrier. The amount of volatile liquid carrier employed may accordingly vary from zero to over 99% by weight of the mixture. Best results are obtained by employing 80% to 99% by weight of carrier and from 1% to 20% by weight drag reducing agent in a composition of drag reducing agent and volatile liquid carrier.

Although it is not essential that a surface active agent be employed unless it is required to form an emulsion of a drag reducing agent that is insoluble in the volatile liquid carrier, a surface active agent is preferably included in the mixture of drag reducing agent and volatile liquid carrier for the reasons previously enumerated. Therefore, the amount of surface active agent may vary

from zero to about 10% by weight of the drag reducing agent, or in other words, from zero to about 2% by weight of the composition of volatile liquid carrier, drag reducing agent and surface active agent. The preferred amount of surface active agent is about 0.25% to 2.5% by weight based upon the weight of drag reducing agent. In other words, when a surface active agent is employed, the preferred range of the components of the composition base upon the weight of the entire composition is from 1% to 20% by weight drag reducing agent, 79.5% to almost 99% by weight volatile liquid carrier, and 0.0025% to 0.5% by weight surface active agent.

The preparation of a mixture of drag reducing agent, volatile liquid carrier and surface active agent does not present any particular problem regardless of whether or not the surface active agent is soluble in the volatile liquid carrier. Either an emulsion or a solution is readily prepared by vigorously mixing the components of the mixture.

The drag reducing agent or mixture of drag reducing agent, volatile liquid carrier and surface active agent may readily be applied to the coated paper product by dipping, by spraying, or by brushing the coated paper product in the drag reducing agent or mixture. Best results have been obtained, as previously related in greater detail, by incorporating the drag reducing agent and surface active agent in the cold water bath of the cold water waxer.

After the mixture of drag reducing agent, volatile carrier and surface active agent has been applied to the coated paper product, the volatile carrier evaporates leaving a discrete film of drag reducing agent on the surface of the coating, although this film need not be continuous over the entire coated surface of the paper. The desired film of drag reducing agent is very thin, and is almost imperceptible on the coated paper product. However, a comparison of the feel of the coated paper product with and without the film of drag reducing agent readily reveals the presence of the drag reducing agent due to the comparatively slippery feel when the film of the agent is present.

The amount of drag reducing agent required for forming a film on coated paperboard varies with the particular drag reducing agent employed and with the proportion of drag reducing agent mixed with the volatile liquid carrier. With an aqueous solution containing 2¼% by weight polyoxyethylene glycols (average molecular weight 500–600), sold by Carbide and Carbon Chemicals Co. under the name "Carbowax 1500," 1/40 lb. of the "Carbowax 1500" drag reducing agent was consumed on 1000 square feet of coated paperboard surface measuring the area on both sides of the paperboard, or 500 square feet of paperboard as conventionally measured on one side of the paperboard.

The drag reducing composition is maintained by adding amounts of make up solution mixed in the same proportion as the original composition to restore the original volume. The solutions or emulsions of drag reducing agent volatile liquid carrier and surface active agent are substantially uniform and the proportions of the components remain about the same as the paperboard carton blanks use up the drag reducing composition.

Although the film of drag reducing agent of this invention is particularly applicable to paper products having protective or decorative coatings of wax, a drag reducing agent may also be advantageously employed on other coatings for paper products, such as vinyl acetate coatings.

The following are typical working examples of the preparation of mixtures of drag reducing agent, volatile liquid carrier and surface active agent for application of a film of drag reducing agent in accordance with this invention. In all examples, the mixture was applied as the paper product passed through the cold water bath of the cold waxer.

EXAMPLE 1

A mixture of drag reducing agent, volatile liquid carrier and surface active agent was prepared from the following components:

	Amount
Polyoxyethylene glycols (drag reducing agent) (average molecular weight 500–600) sold by Carbide and Carbon Chemicals Co. as "Carbowax 1500"	350 lbs.
Polyoxyethylene sorbitan monoleate (surface active agent) sold by Atlas Powder Company as "Tween 80"	1¾ lbs.
Water (volatile liquid carrier)	15,600 lbs. (1880 gallons).

The polyoxyethylene glycol drag reducing agent was dissolved together with the surface active agent in 40 gallons of water at 120° C. in a steam jacketed stainless steel mixing tank with mixing for 30 minutes. The resultant mixture was added to the remaining 1840 gallons of water maintained by a refrigerating unit at about 40° F. in the cold water bath system of the cold water waxer of the type illustrated in the accompanying drawing. The cold waxing machine was allowed to run for one hour with the conveyor belts in motion in the cold water bath to provide complete mixing before sending paperboard blanks through the cold waxer.

Paperboard carton blanks were then sent through the cold waxer where they obtained a coating of modified wax comprising 3% by weight polyethylene and 5% microcrystalline paraffin wax combined with 92% by weight of paraffin wax having a melting point range of 143° F. to 150° F. (A. M. P.). A thin film of drag reducing agent was formed on the modified wax coating. 1/40 lb. of the "Carbowax 1500" drag reducing agent was consumed on each 1000 square feet of paperboard carton surface passed through the cold water bath.

The resultant individual blanks were readily separated from a stack of blanks and set up by automatic carton setting up machinery without chattering or loss of efficiency because of frictional drag.

EXAMPLE 2

A mixture of drag reducing agent, surface active agent and volatile liquid carrier was prepared from the following components employing the same procedure and modified wax coating as in Example 1:

	Amount
Glycerine (drag reducing agent)	780 lbs.
Polyoxyethylene sorbitan monoleate (surface active agent) sold by Atlas Powder Company as "Tween 80"	2 lbs.
Water (volatile liquid carrier)	15,600 lbs. (1880 gallons).

Paperboard carton blanks were passed through the cold water bath of the cold water waxer containing the above mixture. A thin film of drag reducing agent formed on the surface of the wax coating which greatly reduced the frictional resistance of the wax coated surface applied to the blanks, and enabled the blanks to be readily set up by automatic carton setting up machinery.

EXAMPLE 3

A mixture of the following components was prepared:

	Amount
Shortening, a hydrogenated cottonseed oil, sold by Swift and Company (drag reducing agent)	468 lbs.
Polyoxyethylene sorbitan monoleate (surface active agent) sold by Atlas Powder Company as "Tween 80"	4.7 lbs.
Water (volatile liquid carrier)	15,600 lbs. (1880 gallons).

The shortening was melted in a jacketed stainless steel kettle, and one-half (2.35 lbs.) of the surface active agent was stirred into the melted shortening. The other one-half (2.35 lbs.) of the surface active agent wax mixed with 125 gallons of water maintained at a temperature of 130° F. The hot water solution of the drag reducing agent was then added to the melted shortening while agitating vigorously. The agitation was continued until the temperature of the mixture was 30° C. (about 5° C. below the melting point of the shortening). The mixture was then placed in the remaining 1755 gallons of water in the cold water bath of the cold water waxer. 1880 gallons of water was the normal capacity of the cold water system, including the refrigerating unit and the cold water tank of the commercially employed cold water waxer in which the drag reducing compositions of the examples were applied. However, varying amounts and proportions of volatile liquid carrier and the other components may be employed as previously related.

Carton blanks were then waxed in the cold waxer with an unmodified high melting paraffin wax (160–165° F. A. M. P.). The film of the shortening drag reducing agent was applied to the wax coated blanks as they passed through the cold water bath containing the drag reducing agent mixture. The resultant coated carton blanks had a low frictional resistance to sliding movement.

We claim:

1. The method of reducing frictional resistance between a surface and an adjacent sheeted paper blank having a water insoluble substantially solid protective coating composed primarily of wax in order to enhance relative movement between said surface and said coating and to protect said coating against scuffing, which consists essentially in forming on such coating of said paper blank a film of a lubricating agent by applying to said coating an organic liquid compound which is essentially insoluble in and softer than said coating and which is substantially non-volatile, and retaining said organic liquid lubricating agent as a discrete film on such coating to provide reduced frictional resistance to movement between contacting areas of such coated paper blank and to reduce chattering and frictional resistance between said coated paper blank and machinery for handling such paper blank.

2. The method of reducing frictional resistance between a surface and an adjacent sheeted paper blank having a water insoluble substantially solid protective coating composed primarily of wax in order to enhance relative movement between said surface and said coating and to protect said coating against scuffing, which consists essentially in forming on such coating of said paper blank a film of a lubricating agent by applying to said coating a mixture comprising a volatile liquid carrier that is insoluble in said coating, and a substantially non-volatile organic liquid compound which is essentially insoluble in and softer than said coating, and retaining said organic liquid compound as a discrete film on such coating upon evaporation of said volatile liquid carrier, said retained film of such organic liquid compound providing reduced frictional resistance to movement between contacting areas of such coated paper blank and reducing chattering and frictional resistance between said coated paper blank and machinery for handling such paper blank.

3. The method of claim 2 in which the organic liquid compound is soluble in said volatile liquid carrier.

4. The method of claim 2 in which the mixture of volatile liquid carrier and organic liquid compound is an emulsion.

5. In the formation of a paperboard carton by setting up with automatic machinery a paperboard carton blank having a water insoluble substantially solid protective coating composed primarily of wax, the method of reducing frictional resistance between the paperboard carton blank and adjacent blanks in removing said blank from a stack of blanks and of reducing chattering and frictional resistance between said coated carton blank and the carton setting up machinery, which consists essentially in forming on such coating of said carton blank a film of a lubricating agent by applying to said coating a composition comprising 79.5% to almost 99% by weight of water, up to 0.5% by weight surface active agent, and 1% to 20% by weight based on the total weight of the composition of a substantially non-volatile organic liquid compound which is essentially insoluble in and softer than said coating, and retaining said organic liquid compound as a discrete lubricating film on such coating upon evaporation of said water.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 17,605	Schecker	Feb. 25, 1938
1,688,478	Weiss	Oct. 23, 1928
1,769,633	Fischer	July 1, 1930
1,839,868	Damarin	Jan. 5, 1932
2,017,449	Thompson	Oct. 15, 1935
2,167,711	Dalton	Aug. 1, 1939
2,642,366	Rumberger	June 16, 1953

OTHER REFERENCES

Synthetic Organic Chemicals, 12th ed., 1947, Carbide and Carbon Chemicals Corp., New York, N. Y., page 21. (Copy in Div. 25.)