

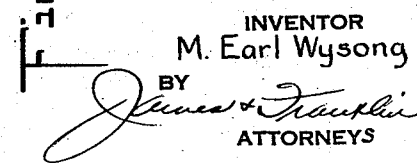
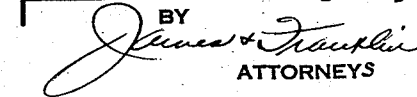
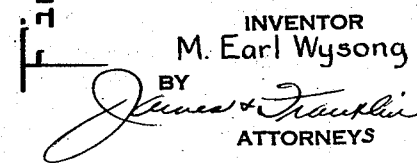
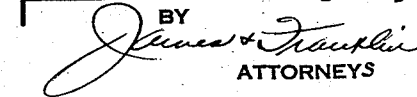
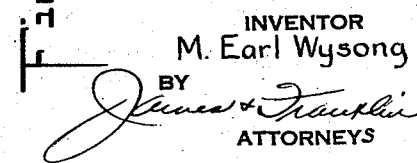
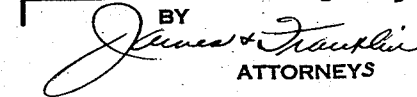
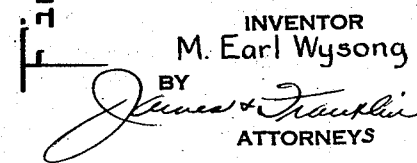
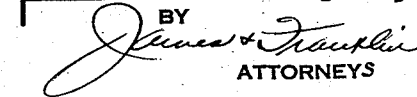
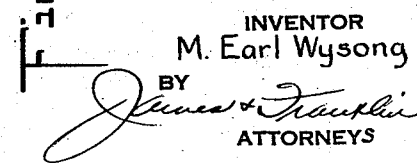
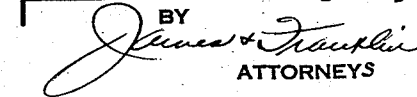
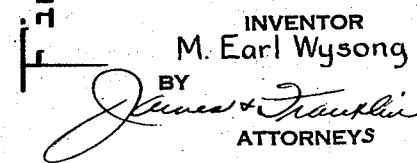
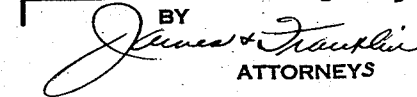
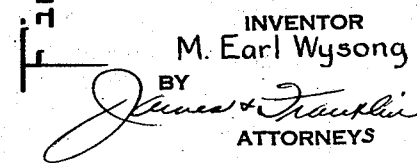
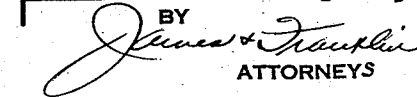
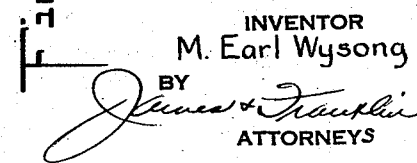
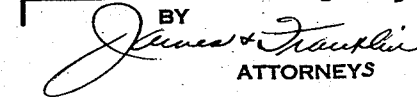
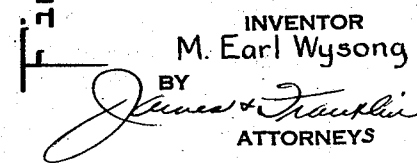
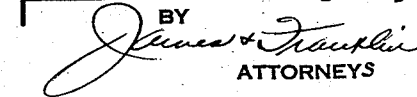
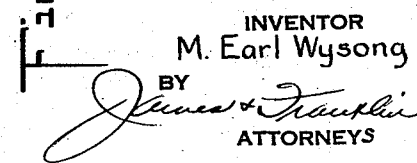
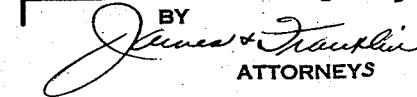
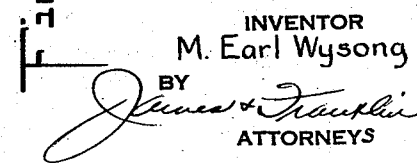
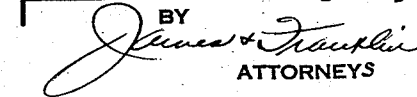
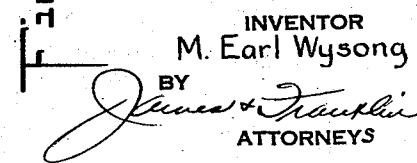
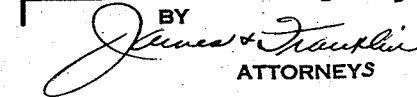
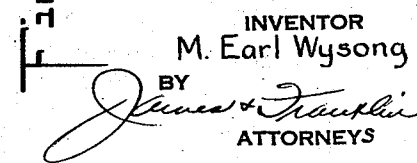
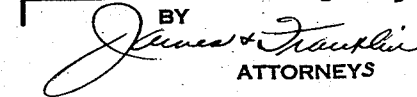
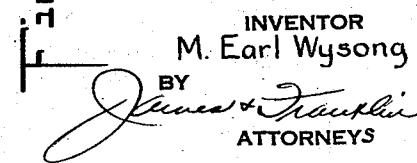
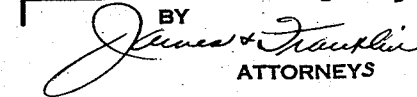
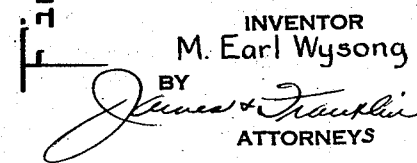
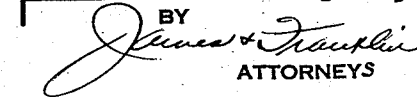
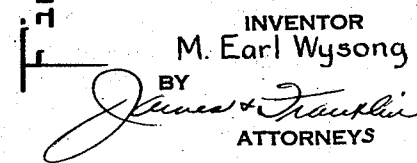
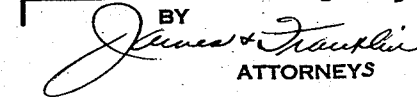
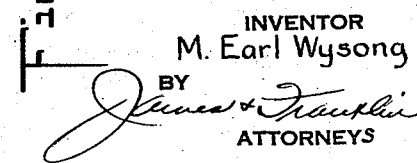
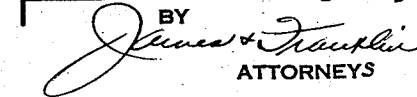
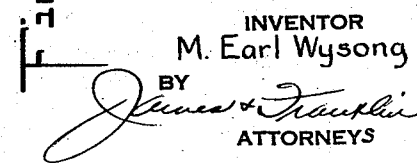
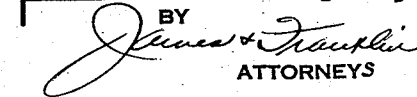
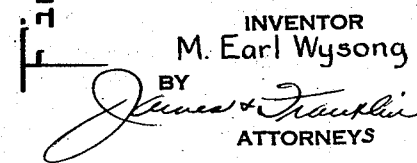
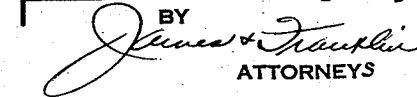
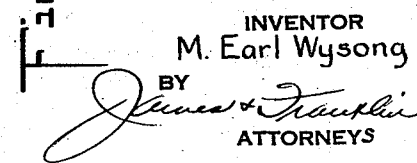
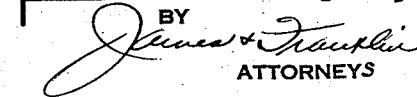
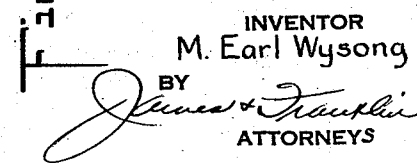
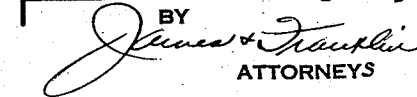
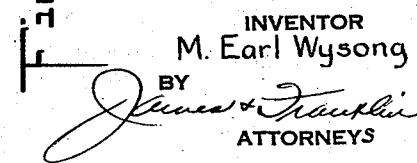
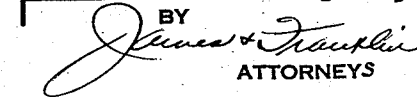
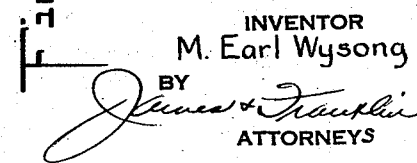
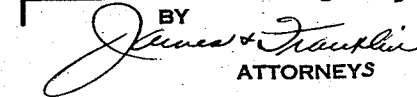
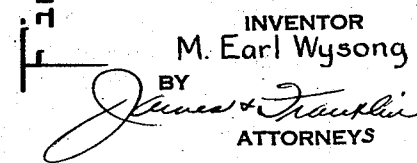
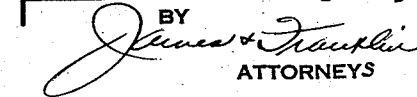
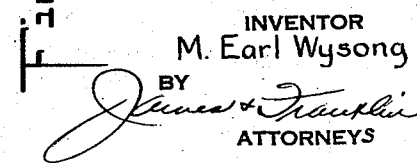
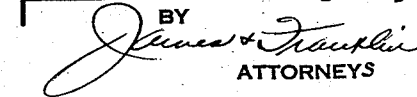
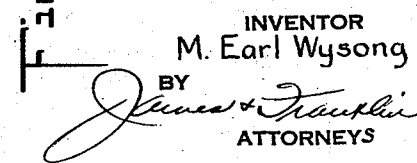
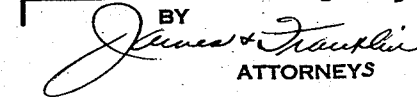
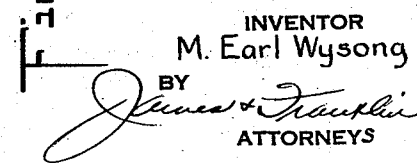
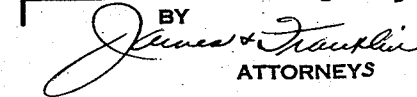
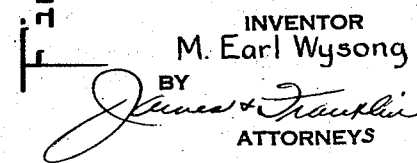
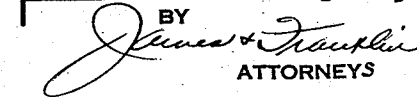
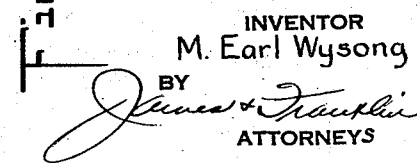
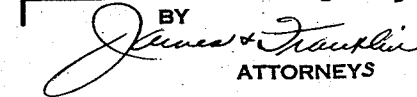
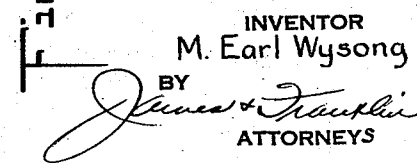
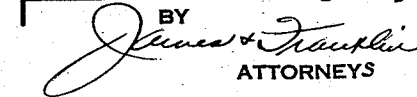
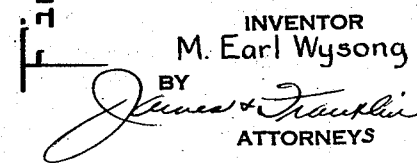
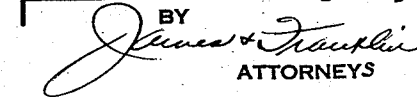
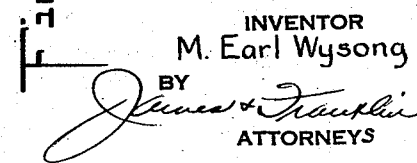
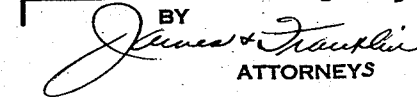
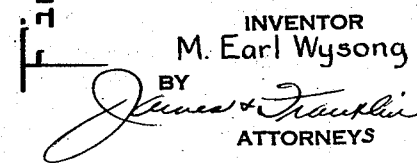
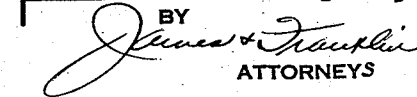
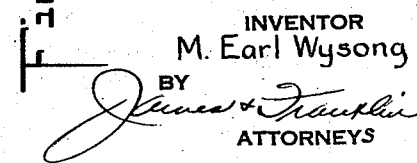
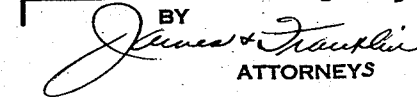
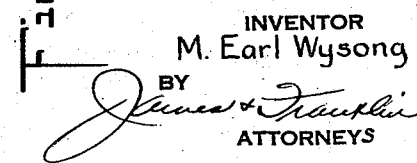
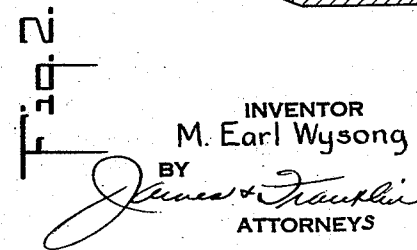
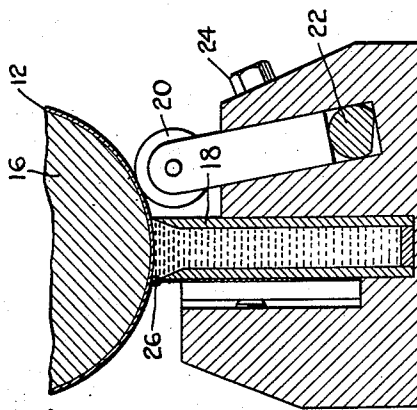
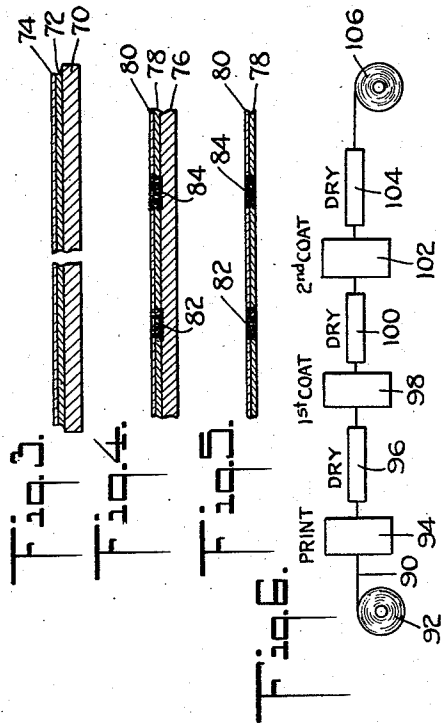
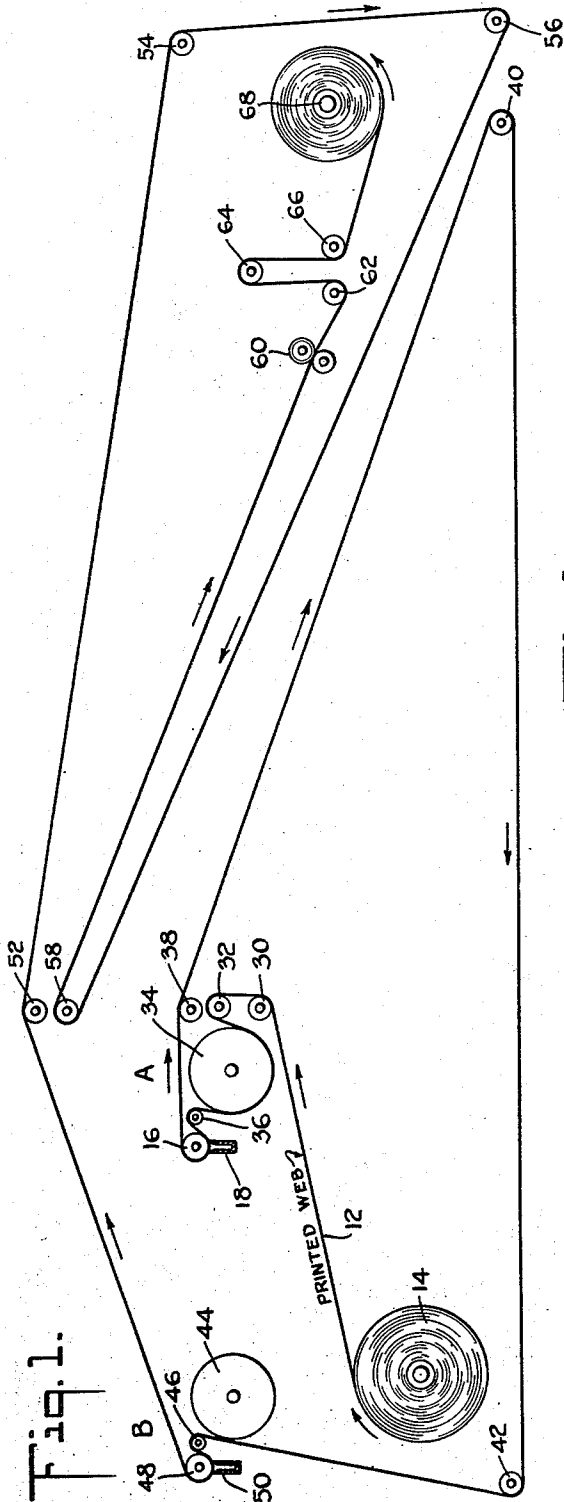
Feb. 4, 1941.

M. E. WYSONG

2,230,876

COATING PROCESS AND PRODUCT

Filed July 14, 1937



UNITED STATES PATENT OFFICE

2,230,876

COATING PROCESS AND PRODUCT

M. Earl Wysong, New York, N. Y., assignor to The
Fred Goat Co. Inc., Brooklyn, N. Y., a corpora-
tion of New York

Application July 14, 1937, Serial No. 153,493

6 Claims. (Cl. 91—67.9)

This invention relates to methods of protecting and improving the appearance and strength of materials such as paper, paper products, foil, and sheet or web materials in general, and to the product resulting therefrom.

The use of transparent materials such as cellulose esters and ethers and regenerated cellulose, as a protective coating of this kind, is already known but has largely been limited to a separate outer wrapping of the cellulose material. This substantially increases the packaging cost, for it not only involves the expense of the cellulose sheet or film, but also the expense of the second or separate wrapping operation.

To a limited extent, such cellulose materials have been applied in the form of a lamination to the web or sheet material to be protected, but this is an expensive and difficult operation to control. Furthermore, where the web or sheet carries printing, it is very difficult to prevent bleeding of the printing ink or color, due to the solvent action of the adhesive or laminating agent on the vehicle of the printing ink, together with the exclusion of air between the laminations, which causes relatively slow drying of the solvent.

Some attempt is also being made at coating with cellulose lacquer applied by roller coating devices or by a spray. These lacquers do not afford as good protection as a film of transparent cellulose material applied either as a separate wrap or as a laminated sheet. The lacquers ordinarily have a nitrocellulose base, and this does not possess the required durability; and in general such coatings may be cracked by sharply creasing the paper, which, of course, destroys any attempt at water-proof protection. Moreover, because of the fluidity of the lacquer and the method of applying the same, it is difficult to provide a lacquer coating of adequate thickness for the present purpose.

The primary object of my invention is to overcome the foregoing difficulties and to provide an improved method of protectively coating sheets or webs, and to improve their strength, wear, resistance to soiling, and resistance to moisture, grease, and deteriorating agents. A further object is to provide a protective coating which is tasteless and odorless and thus suitable for the packaging of foods. Still another object of my invention is to protect and enhance the quality

of printing on such webs or sheets, particularly with reference to the brilliance, warmth, and vividness of the colors and the permanence of the same, all without blurring of the printed matter.

In accordance with a feature and object of my invention, the web to be protected is coated with the protective material in liquid form, the material preferably being a transparent cellulose material, more specifically a cellulose ester or cellulose ether or regenerated cellulose, and most preferably cellulose acetate. The application of this material in the form of a solution or liquid is to be contrasted with the prior practice of laminating an already made sheet of cellulose material by adhesively securing the same to the sheet to be protected.

A protective film of cellulose material is desirable because it quickly dries to a hard glossy finish, and also because of its beneficial protective properties, but it raises some important difficulties. In the first place, the cellulose film shrinks on drying and therefore causes a serious curl of the paper or other web on which it is coated. Moreover, it can be readily broken away from the paper. In accordance with my invention, this difficulty is overcome by coating the paper twice. The first coat contains material which penetrates the paper and seals the pores thereof, and which remains pliable or flexible and plastic so that it does not crack on creasing of the paper. It forms a good adhesive seal or bond with the paper. The surface remains tacky and is so chemically related to the outer coat, preferably by the use of a common solvent, that the first and second coats interpenetrate or blend and form an excellent bond with one another. The shrinkage of the top coat is taken up by the first coat, because of the permanently yieldable or plastic nature of the same. Both coats are water-proof.

Considered in another aspect, the invention comprises a second coat which is applied as a finishing coat to a protective first coat, for I prefer to use as the first coat a solution of a resin, particularly a vinyl acetate resin (polymer of vinyl acetate), and this material affords excellent protection, it being resistant to water, oils, and many chemicals. When used with a volatile solvent, this coating dries quickly after application to the paper, but remains tacky or gummy and is not satisfactory for reeling. Moreover, it does not

possess the high luster or gloss that characterizes materials such as cellulose acetate and regenerated cellulose. Considered in this aspect, it may be said that the protective first coating is subsequently treated by the transparent cellulose coating in order to eliminate the tacky surface of the first coating and to instead provide a hard, non-tacky surface, with a high luster or gloss.

I have already mentioned that the preferred material for the first coat is a solution of vinyl acetate resin, and that the second coat is preferably a solution of cellulose acetate. These materials are non-compatible, and it might be assumed to be impossible to combine them. In accordance with my invention, the second coating may be successfully applied to the first coating, despite the incompatibility of the materials, by permitting the first coating to dry, and thereafter limiting the application of the second coating to a very brief instant insufficient to permit appreciable solution of the first coating in the body of liquid being applied as the second coating.

Further objects of my invention center about the protection of printed matter. The coatings of my invention greatly improve the appearance of printed matter, and in accordance with a further feature and object of the invention, these coatings draw the ink or color from the printed web into themselves, the ink then penetrating through the full thickness of the protective film, so that if the paper base is wetted and rubbed away, the transparent coat or film is left with the printing intact therein. This absorption of the color helps enrich and enliven the printed matter, and, more importantly, definitely protects the same. Ordinarily any solvent action on the ink is undesirable because it causes blurring or bleeding of the printed matter. In accordance with the present invention, the ink or color is fully absorbed, yet there is no blurring discernible to the naked eye. This desirable result is obtained because of the high viscosity of the coatings, the rapid drying of the same, the brief instant of application of the same, and the complete absence of pressure or squeezing of the surface such as might take place with roller coating or other coating processes.

I find that I can apply the coating to printed matter in films having a thickness of only one or several 10,000ths of an inch in thickness, without bleeding, by proper control of the amount of solvent in the coating, the time of contact of the sheet with the body of liquid being applied, and the smoothing out or doctoring of the coating. I find that I can secure similar results with either coating. The ink is therefore drawn up into both coatings, and is improved in brilliancy and color. This improved intensity of tone is particularly noticeable when dealing with printing from half-tones or plates which have been made by photographing through a screen. A very slight bleeding can be controlled so that it is not at all noticeable to the eye, yet fills in partially or completely the spaces between the printed dots, and this ability to bleed the inks to so small an extent as not to be discernible to the naked eye, helps improve the blending and intensity of the color tone. The improvement is very great indeed where coarse screens have been employed in making the plates, or where the printing is on a paper of poor finish.

I prefer to apply the coatings in a far more viscous condition than is usually practical with ordinary roller coating machines, the liquids being of a comparatively syrupy consistency. For

this and other reasons, my coating process is preferably carried out by using the coating apparatus described in a co-pending application of Jay G. Swab, Serial No. 139,698, filed April 29, 1937, which issued as Patent Number 2,195,101 on March 26, 1940. Inasmuch as the said apparatus is capable of handling a very wide range of viscosities, it is apparent that I can adjust the viscosity of my coating materials to the particular class of product being coated. For example, with relatively porous papers, I prefer to use a relatively high viscosity in order to prevent undue penetration of the coating into the paper and unnecessary waste of coating material. As an example of the wide range of viscosity which may be used in practicing the invention, I may point out that the quantity of solvent used in the first coating may vary anywhere from as little as 20% to as much as 80% by weight, although the preferred formula subsequently given calls for 50%.

To the accomplishment of the foregoing objects and such other objects as will hereinafter appear, my invention consists in the process steps and product elements, and their relation one to the other as hereinafter are more particularly described in the specification and sought to be defined in the claims. The specification is accompanied by a drawing in which:

Fig. 1 is a schematic diagram explanatory of the coating process and preferred apparatus for practicing the same;

Fig. 2 is an enlarged fragmentary section through one of the coating units;

Fig. 3 is a section through a coated web, showing the manner in which the first coat accommodates the shrinkage of the second coat;

Fig. 4 is a similar section showing the manner in which printed matter is absorbed from the web or sheet, and is drawn upwardly through both the first and second coats;

Fig. 5 is a similar section through the double coating alone, the base or paper web having been rubbed away; and

Fig. 6 is a schematic diagram explanatory of a modification of the process.

Referring to the drawing and more particularly to Fig. 1, a web 12, in this case paper, is drawn from a paper supply roll 14. The web may be plain or printed. The first coat is applied by a coating unit A, and the second coat is applied by a coating unit B. The coating unit A comprises essentially a floating roll 16 and a trough or fountain 18. These parts are better shown to an enlarged scale in Fig. 2, in which it will be seen that the web 12 passes around roll 16 and rests upon feeler wheels 20. The elevation of the feeler wheels is fixedly adjustable by means of the eccentric or flattened rod 22, and the feeler wheels are locked in adjustment by bolts 24. The coating solution is pumped into the trough or fountain 18, there preferably being a continuous circulation of the liquid. The web is brought close to the open top edge or mouth of the trough, and is spaced therefrom by a slight amount determined by the elevation of the feeler wheels 20. The film thickness is determined by a doctor 26.

It will be evident that with this arrangement the thickness of the coating applied to the paper is independent of variations in thickness of the paper itself, for any such variations are accommodated by a rising or falling of the floating cylinder 16 relative to the stationary feeler wheels 20. In other words, the coating is applied solely

with reference to the bottom face or surface being coated, and therefore remains constant in thickness. This I consider important for the sake of economy, for the coat ordinarily is to be maintained at a predetermined small thickness, say $\frac{1}{10000}$ of an inch, which may be less than the variations in thickness of the paper web. An increase in paper thickness might otherwise expose the bare paper, and a decrease in paper thickness would greatly increase the amount of coating applied, both of these variations being, of course, objectionable. The coating materials are relatively expensive, and it would not be feasible to simply increase the coating thickness enough to cover variations in paper thickness, even if there were no difficulty with curling.

Reverting now to Fig. 1, the web 12 is led over suitable guide rolls 30 and 32 and thence around a cylinder 34 adapted to be heated. This heating cylinder 34 is not essential, for the preferred coats here recommended to be used are rapid-drying even without the application of heat. The apparatus in Swab application Serial No. 139,698 previously referred to, employs heating cylinders merely to increase the flexibility and widen the range of use of the apparatus. From cylinder 34, the web passes around a guide roll 36 and thence around the floating roll 16 previously referred to, at which point it is coated with the first liquid. The web then passes over guide roll 38 to remote guide roll 40, thence back to guide roll 42, and up to the coating unit B. The feed of the web is such that the coating is on the outside, thus preventing contact with the guide rolls. As here shown, the heating cylinder 44 of the second unit is not in use, the web being passed directly to guide roller 46 and around the floating roll 48 of the second coating unit. At this point the first coating is exposed to a body of the second liquid, in trough or fountain 50, but the mouth of the trough is made very narrow so that the exposure of the first coating to the liquid of the second coating is for only a brief instant. The web with two coatings then passes around a guide roller 52, thence to remote guide roller 54, around guide roller 56, back to guide roller 58, thence through optionally usable slitting mechanism 60, and around rollers 62, 64, and 66, the roller 64 being counterbalanced or resiliently urged upwardly in order to apply a desired tension to the web before it is reeled on take-up roll 68. The second coating dries almost instantly to a hard finishing surface, and is in excellent condition to be reeled into a roll by the time it reaches the take-up roll 68.

The manner in which the intermediate coat functions to prevent curling of the sheet, may be described with reference to Fig. 3 in which I show a base sheet 70 coated with a first coat 72 of flexible or plastic material, and a second coat 74 of a transparent cellulose material. It will be noted that the coat 74 has shrunk relative to the sheet 70, but this shrinkage has been taken up by a contraction of the top surface of the intermediate web 72 relative to the bottom surface thereof. In this manner, curling of the foundation sheet 70 is prevented, as well as peeling of the coat 74 from the foundation sheet.

It will be noted that in Fig. 3 the second coat is shown thinner than the first coat. I prefer this relation of coat thickness, and recommend that the second coat be of the order of one-half the thickness of the first coat. If the second coat is made too thick relative to the first coat, the

sheet will curl. This indicates the desirability of limiting the thickness of the second coat. However, the second coat cannot be made too thin, for the finished product must compete with a laminated sheet, and therefore the coating used when practicing the present invention should be kept thick enough to have good sales appeal. In other respects, of course, the present product is far superior to a laminated sheet, as for example, the permanence and indestructibility of the bond between the protective coating and the paper.

The manner in which the ink or color of printed matter penetrates the coatings and is drawn thereinto, is illustrated in Fig. 4 in which a printed sheet 76 has been coated in accordance with my invention, with first and second coatings 78 and 80. It will be noted that the printed areas 82 and 84 have been drawn upwardly and extend throughout the thickness of the layers 78 and 80. In fact, the attraction of my coatings for the dried ink is so strong that the paper foundation 76 may be removed completely, as by soaking the same in warm water and rubbing the paper away, yet the printed matter remains an integral part of the transparent film, as is indicated in Fig. 5.

In Fig. 1, I have described my process as applied to a previously printed web. It will be understood, however, that it is not necessary to reel the paper after printing and to then unroll the same for coating. Thus, referring to Fig. 6, a web of paper 90 is drawn from a supply reel 92 of plain or unprinted paper. This web is passed through suitable printing machinery, schematically indicated at 94. The web is then dried, either by air-drying or by passing the same through a drying tunnel, and either arrangement is schematically indicated at 96. The printed web is then coated with the first liquid, as indicated at 98, following which the web is permitted to at least partially dry, as indicated at 100, whereupon the second coat is applied, as indicated at 102, this being permitted to dry, as shown at 104, after which the finished web is fed to the take-up reel 106.

As has already been mentioned, a transparent cellulose coating, for example cellulose acetate, does not adhere strongly to all papers and particularly to hard-surface stock or highly calendered stock such as glassine paper. Also, the cellulose acetate coating shrinks on drying, and curls the sheet. The preferred method of coating is therefore to first apply a sealing coat which has good adhering qualities and can be adjusted to prevent excessive penetration of the paper. This coat should have sufficient plasticity to prevent the second coat from conveying its contraction to the paper itself. Since in most commercial applications it is preferable to have the coating transparent and preferably colorless, and because it provides a tough elastic sealing coat, I have found the poly-vinyl resins particularly suitable for the dry substance of the first coat.

However, these resins are known to be non-compatible with cellulose acetate. For example, if solutions of the first and second coats are mixed together, it is found that the resulting mixture is quite different in physical properties from either of the separate coats. The mixture as it dries becomes lumpy, turns opaque or milky, and does not possess the elasticity of the first coat. Nevertheless, when practicing my process as herein described, it is entirely possible to use

these two ordinarily incompatible coatings, and with highly beneficial results.

The first coat may be made in accordance with a number of formulae. The preferred formula, by weight, is as follows:

	Per cent
"Vinylite" A—Viscosity #15.....	40
Dibutyl phthalate.....	10
Acetone.....	50

The drying time and viscosity can be adjusted by varying the percentage of solvent and plasticizer used.

"Vinylite" A referred to in the above formula is a vinyl acetate resin or polymerized vinyl acetate made by Union Carbide and Carbon Corporation. The said company makes a series of "A" resins, it being supplied in three different grades varying only in viscosity. I have used all of these "A" resins successfully, and prefer the viscosity #15 resin only because it is a convenient viscosity for the present purpose. The aforesaid corporation also makes "Vinylite" resins in a series "V" which are co-polymerized vinyl chlorid and vinyl acetate, and these resins may also be used in my process. Similar remark applies to a series "H" which are better adapted for heat sealing work. I prefer the series "A" resins because these produce the best physical properties and permanence of transparency. All of these "Vinylite" resins are transparent, that is, water-white or colorless, but some may be affected on long exposure to light, then turning to a light straw color. They are all excellent preservatives for surface coating, being unaffected by water, and the "A" resins being unaffected by mineral oils, fatty acids, petroleum fractions, glycols, glycerine, and neutral salt solutions. The "V" resins are similarly resistant, and possess better resistance to acids, alcohols, and alkalis, in addition.

"Synthetic Organic Chemicals," 1937, issued by the Carbide and Carbon Chemicals Corporation, lists the following characteristics of these resins:

SURFACE COATING RESINS

Surface coating resins are available in two series, i. e.: Series A and Series V.

SERIES "A"

(Polymerized vinyl acetate)

GENERAL PHYSICAL CHARACTERISTICS

Form.....	Granular
Color.....	White or colorless
Specific gravity.....	1.19
Heat stability.....	200° C.—1 hour
Light stability.....	Excellent
Melting point.....	106°–151° C.
Aging.....	Unaffected
Water immersion....	Unaffected after drying
Water absorption....	2%—A. S. T. M. (24 hours)

Series "A" resins are manufactured in three different grades, varying only in the viscosity of their solutions: Grade AYAA, viscosity 7; AYAF, viscosity 15; AYAT, viscosity 25. These resins are soluble in the lower alcohols, esters, ketones, aromatic hydrocarbons, chlorinated solvents and "Cellosolve" * derivatives, while water, mineral oils, fatty acids, petroleum fractions, glycols and glycerine are non-solvents. They are unaffected

*Trade-mark.

by neutral salt solutions. Weak acids and alkalies decompose them slowly.

SERIES "V"

(Copolymerized vinyl chloride and vinyl acetate)

GENERAL PHYSICAL CHARACTERISTICS

Form.....	Granular, powder
Color.....	White or colorless
Size.....	99% through 10-mesh screen
Total solids.....	96%–98% by weight
Viscosity (18% methyl isobutyl ketone)....	90–120 Centipoises (Hoeppler No. C.)
Insoluble matter.....	Not more than 0.10% in acetone
Softening point.....	115° C.—136° C. (Ring and Ball)
Humidity resistance...	No appreciable effect after 7 days at 100% humidity at 47–50° C.
Specific gravity.....	1.35
Heat stability.....	125° C.—1 hour
Light stability.....	Good
Chemical resistance...	Unaffected by acids, alcohols, alkalies, oils, fats, corrosive chemicals and moisture.

The surface coating resins of the V series are manufactured in two very similar grades, VYHH and VYHF. Grade VYHH is recommended where extremely high humidity resistance is important. These resins are soluble in ketones such as acetone, methyl isobutyl ketone, methyl ethyl ketone and methyl n-amyl ketone. Although the ester solvents have solvent action they produce solutions of high viscosity and are not recommended. Series V resins are not soluble in alcohol, water, mineral oils, fatty acids, petroleum fractions, glycols or glycerine. Aromatic hydrocarbons such as benzol, toluol and xylol may be used as diluents in the presence of ketones. Both grades of resin are finding wide usage in lacquer applications where chemical inertness is an important factor, and are also extensively used as impregnating agents for felt, paper, cloth and other porous products.

Vinyl coating resins made by other manufacturers may also be used, and I may refer specifically to "Mowilith" made by I. G. Farbenindustrie Gesellschaft, of Germany. Other solids of a resinous nature may also be used, such as dammar, Zanzibar copal, Congocopal, Kauri copal, Manila copal, and elemi gum; but without giving specific formulae with these substances, I may add the following typical formulae using still another resin, shellac, etc.

EXAMPLE 2

	Per cent
Bleached shellac.....	10
W. W. rosin.....	10
Castor oil.....	4
S. P. #1 alcohol.....	8.4
Butanol.....	3.6
Butyl acetate.....	18
Toluol.....	46

EXAMPLE 3

	Per cent
Bleached shellac-----	25
W. W. rosin-----	3
5 Castor oil-----	14
Dibutyl phthalate-----	22
S. P. #1 alcohol-----	7
Butanol-----	12
Butyl acetate-----	4
10 Toluol-----	13

The foregoing solutions can be thinned with a thinner comprising 30% toluol and 70% alcohol. The above formulae are unsuitable for contact with food products, because of odor.

The second or final coat is preferably made in accordance with the following formula:

	Per cent
20 Cellulose acetate-----	25
Dibutyl phthalate-----	5
Acetone-----	70

For this solution, straight acetone may be used as a solvent or thinner. This second coating may be used with any of the above-mentioned first coats.

In respect to the above formulae using acetone, it will be understood that I may use other solvents than acetone, as, for example, ketones. I prefer acetone for general use, as it is water-free and relatively inexpensive, and leaves the coated stock without odor or taste, which is important if the coated material is to be used for carrying or wrapping foodstuffs. It is, of course, important to use a solvent which is free from moisture, for otherwise there is danger of causing a blush in the cellulose acetate coat.

Inasmuch as it is important to securely bond together the first and second coats, I prefer to use a solvent which is effective with the dry or solid materials in both the first and second coats. Acetone is satisfactory for this purpose, and I find that the two coats blend and bond together at the contacting faces, so that they cannot be separated. Moreover, this blending action appears to reduce the otherwise rather brittle nature of the cellulose acetate film.

The formulae are, of course, only approximate, and the proportions used are not critical. The per cent solvent may be varied widely, as previously indicated, particularly when using the apparatus of Swab application Serial No. 139,698 above referred to. Ordinarily, for more porous stock, I use less solvent, to avoid undue penetration of the stock and waste of material, but in some cases I may use a high ratio of solvent, even on porous paper, as where the primary object is to waterproof and strengthen the paper.

It will also be understood that the dibutyl phthalate acts simply as a plasticizer to maintain a desired degree of flexibility or plasticity of the coats, and that other known suitable plasticizers may be employed, as for example, dimethyl phthalate and triethylene glycol.

Furthermore, as above-mentioned, the relation between the thickness of the two coats is significant, and I find it desirable to make the first coat at least equal to the thickness of the second coat, and preferably of greater thickness, say twice the thickness of the second coat, the first coat then being two-thirds the total and the second coat one-third the total.

In practicing my method with the apparatus described in the aforesaid Swab application Se-

rial No. 139,698, I have used coatings ranging in total thickness from $\frac{1}{10000}$ of an inch upward. I have operated at web speeds ranging from 16 feet a minute to 110 feet a minute, and with a throat or top opening for the trough or fountain ranging from $\frac{1}{8}$ inch in width to $\frac{1}{2}$ inch in width. In general, I find that it is preferable to use a smaller width of fountain opening for the second coat than for the first, and when operating the web at high speed it is, of course, helpful to have some circulation of air across the web in order to accelerate the evaporation of the solvent, particularly from the first coat. It is important that the first coat be nearly dried, say, as a rough test, to a point where it will not adhere to a polished roller, before the second coat is applied. Failure to provide sufficient drying of the first coat will involve danger of contaminating the body of liquid coating in the second fountain with material dissolved out from the first coat, thus producing a coating which lacks proper transparency and uniformity of sheen, for it will be understood that the materials of the first and second coats are incompatible, and the first coat if dissolved into the body of liquid in the second fountain forms a curdy coagulation of soft or gelatinous particles.

With respect to the transfer of printing inks from the base web to the coating, it will readily be understood that the bleeding or spreading of the ink depends upon the amount of solvent material in contact with the printing, and this in turn is influenced by the proportion of solvent in the coating material, and also the movement of the sheet with respect to the coating material. The latter factor is affected by the viscosity of the coating and the amount of clearance between the doctor and the surface being coated.

I have satisfactorily coated printed sheets with coatings ranging from a minimum of $\frac{1}{10000}$ inch in thickness to $\frac{10}{10000}$ inch in thickness. I find that it is not desirable to bring the coating down to a thickness of less than $\frac{1}{10000}$ of an inch, because the scraping action apparently causes too much movement of that portion of the wet film disposed immediately adjacent the printed surface, and causes a bleeding or running of colors. Similarly, when applying the second coat to a first coat which has itself been applied against a printed surface, I find it necessary to have at least $\frac{1}{10000}$ of an inch clearance between any part of the fountain and the surface of the first coat, for otherwise a little of the first coat may be rubbed off, and this rubbed-off material contains the printing inks and is quickly dissolved in the second solution, thus causing a general color contamination and a formation of particles as aforesaid due to the interaction of the two coating materials.

The tendency of the ink to bleed may be controlled, first, by changing the speed of travel of the web across the fountain, and second, by changing the width of the fountain opening without changing the speed of travel, for either of these factors determines the exposure of the web to the liquid.

The treatment of paper in accordance with my process greatly increases its strength. For example, using low-grade box cover stock which has been striped with rubber rollers using marking ink, the tensile strength of a strip about $\frac{1}{8}$ of an inch wide was 9 $\frac{1}{2}$ lbs. at the breaking point, there being a stretch of 2.8%. After coating this

paper with a total coating thickness of scant $\frac{1}{1000}$ of an inch, the breaking strength was practically doubled, it being increased to $18\frac{1}{4}$ lbs., the stretch being the same, 2.8%.

- 5 A Mullins pop test of the uncoated paper gave a bursting strength value of 12, while for the coated paper the figure was increased to 21.

It will be understood from the foregoing description that the main application of the invention is to the coating of paper or other webs, thereby producing an improved web having the advantages of a web laminated with regenerated cellulose, cellulose acetate, or the like, but without the disadvantages thereof, the layers of the compound web being inseparable. It will also be understood that the invention is applicable with additional advantages to printed webs. I may point out that there are numerous other practical uses for these coatings when taking advantage of their property of lifting the printing ink into the coating material. For example, a transparent material such as regenerated cellulose or cellulose acetate sheeting may be printed in reverse so that the reading will appear in the proper direction when the sheet is looked at from the unprinted side. By applying one of my coatings, preferably one with heat sealing properties, to the printed side of the sheet, the printing inks will be drawn into the coating. If such a sheet is then heat sealed or cemented against a surface such as glass, metal, or the like, the printing is protected from contact with the air, and is protected by the original sheet against abrasion and deterioration.

- 35 Another application of these coatings is in connection with the preparation of improved transfers of the decalcomania type. Here the desired printing is applied to prepared duplex paper. The printed surface of this paper is then coated in accordance with my invention, and the printing is drawn up into the coating. The coating may then be slid from the paper in the usual manner employed with decalcomania. The resulting transfer is much more durable and transparent than the conventional decalcomania, because of the fact that the ink is distributed throughout the depth of the coating, and the resulting product is much better than where the printing is merely on the surface of the transfer sheet.

50 It is believed that the method of my invention and the improved product resulting therefrom as well as the many advantages thereof, will be apparent from the foregoing detailed description. The coated sheet may be creased repeatedly without fracturing the coating. The protective film on the sheet is water-proof. The coating is odorless and tasteless as well as transparent and colorless (although it may be tinted, dyed, or pigmented). It protects printing on the surface of the sheet, and improves the tone and color effects.

The absorption of the ink into the coating prevents possible penetration of the ink in the other direction into the packaged product. The bursting strength, tearing strength, and wear resistance of the paper, are all increased enormously.

It will be apparent that while I have shown and described my invention in preferred forms, many changes and modifications may be made without departing from the spirit of the invention, defined in the following claims.

I claim:

1. The method of protectively coating a web having a printed or inked surface, which includes applying a first coating or solution of vinyl acetate resin which closes the surface pores of the web and which remains plastic and tacky but which draws the ink or color from the web into itself, and thereafter applying a second coating or solution of cellulose acetate which quickly dries to a hard and glossy finish and which also draws the ink or color into itself.

2. A transparent printed film comprising a film of vinyl acetate resin, and bonded thereto a film of a material selected from the group consisting of cellulose ester, cellulose ether, and regenerated cellulose, said composite film having the ink or color penetrated throughout the film.

3. A protectively coated printed web comprising a printed base sheet coated with a transparent protective coating, said coating comprising a film of vinyl acetate resin, and a film of a material selected from the group consisting of cellulose ester, cellulose ether, and regenerated cellulose, said composite coating having the ink or color drawn upwardly from the base sheet.

4. A protectively coated printed web comprising a printed base sheet coated with a two-layer transparent protective coating, the first layer being a polymerized vinyl acetate resin, and the second layer being cellulose acetate, said two-layer coating having the ink or color drawn upwardly from the base sheet, whereby the base sheet may be abraded or rubbed away without destroying or removing the printing.

5. A protectively coated printed web comprising a printed base sheet coated with a two-layer transparent protective coating, the first layer being a vinyl acetate resin and a plasticizer, and the second layer being a transparent cellulose derivative and a plasticizer.

6. A protectively coated printed web comprising a printed base sheet coated with a two-layer transparent protective coating, the first layer being a polymerized vinyl acetate and dibutyl phthalate, and the second layer being cellulose acetate and dibutyl phthalate, said coating serving not only to protect but also to brighten and give vividness and life to the printing, without blurring the same.

M. EARL WYSONG.