June 19, 1956 E. L. BAXTER 2,751,309

PAPER FOR ROLL PHOTOGRAPHIC FILM

Filed April 10, 1953

Fig. 1

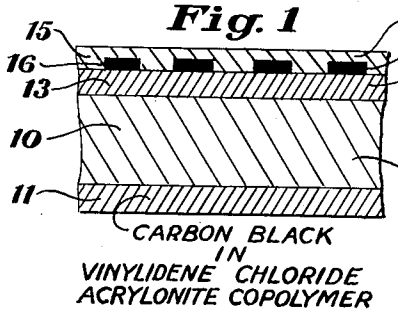


Fig. 2

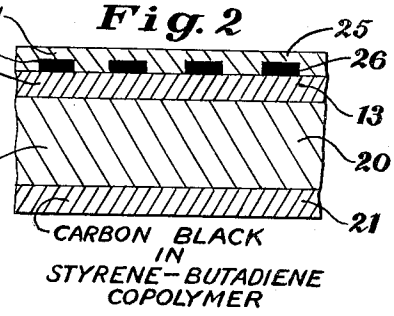


Fig. 3

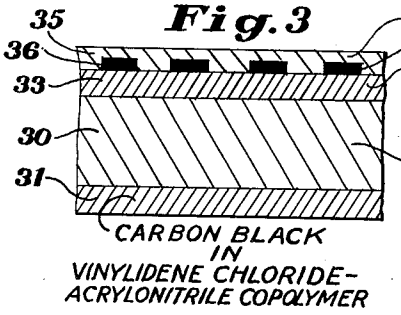


Fig. 4

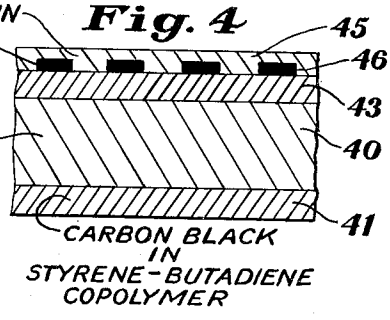


Fig. 5

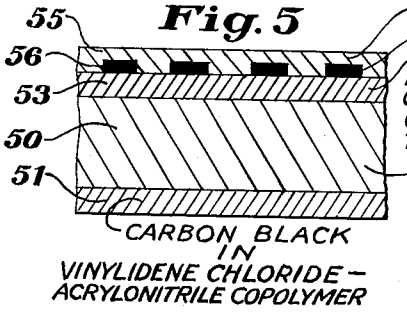


Fig. 6

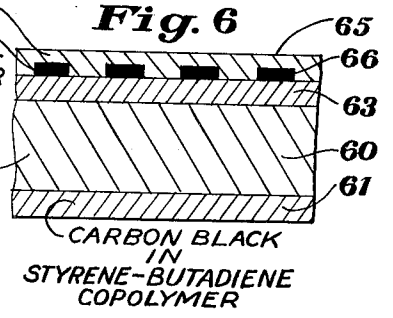
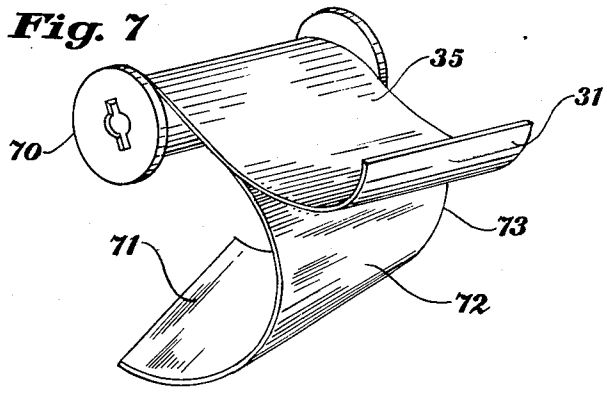


Fig. 7



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PAPER FOR ROLL PHOTOGRAPHIC FILM

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Application April 10, 1953, Serial No. 347,983

7 Claims. (Cl. 117—14)

This invention relates to improvements in backing paper for roll photographic film, and more particularly relates to a backing paper with protective light-colored and opaquing coatings thereon, which has appreciably less overall thickness than conventional backing papers, and which is superior in opaqueness and equal in other respects to presently employed duplex backing paper.

The backing paper of this invention is an improvement over that described and claimed in my copending patent application Ser. No. 187,124, filed September 27, 1950, now Patent 2,646,365 and is a continuation-in-part of my copending application Ser. No. 260,714, filed December 8, 1951, now Patent 2,646,366 of July 21, 1953.

As is well understood, a photographic roll film cartridge generally comprises a flanged spool upon which is wound a long strip of backing paper to which before winding has been attached a strip of light sensitive photographic film. The ends of the backing paper are positioned to extend beyond the ends of the film and constitute light protective leader and trailer strips for the film which is interwound with the backing paper and, therefore, separates adjacent convolutions of the film.

In a commonly available roll film cartridge, the film is attached to the black side of a duplex backing paper, the side of the backing paper opposite that contacting the film is differently colored and carries various printed symbols such as the number of the exposed areas, warning marks, and advertising matters, over which is coated a protective layer intended to protect the sensitive emulsion from the paper and ink imployed in printing when the film and paper are interwound in close contact. It has been the practice to depend somewhat on the paper itself to prevent the transmission of light. To assure opaqueness, backing paper presently employed for roll films consists of a duplex paper with one side being black and the other side colored with a characteristic identifying color. The paper may be made by means of a Fourdrinier paper machine and a cylinder paper machine. The two sheets are brought together wet under the first press and thus form a composite sheet of duplex backing paper.

Duplex backing paper which is thus processed has certain definite specifications that must be met. The black side must be opaque and free from pinholes. The lighter colored side should be uniform in color and appearance and should not permit any of the black on the opposite side to be visible through the paper. The diameter of the finished spool of roll film, and, therefore, the number of exposures, is dependent on the overall thickness of the coated backing paper and the film, so thickness of the paper itself must be limited. The required strength of the paper which is important both in the camera and in processing, also limits the thinness of the paper. Either black numerals on a white paper or white numerals on a black paper gives the greatest contrast, but neither paper is very pleasing to the eye. Lighter colored backgrounds such as shades of red, green, yellow and blue are most desirable from an appearance standpoint.

It does not appear possible for a paper mill to make a thinner duplex backing paper than those in current use, which will fulfill the necessary requirements of such a paper. In order that the sheet may be photographically opaque, a certain minimum weight and thickness of black is required. The lighter the shade and color of the other side, the greater is the weight and thickness of paper required to hide the black side and to give the light colored side a uniform appearance. The present invention, however, provides a thinner backing paper which does not have a duplex structure but which has superior characteristics in several important respects.

An object, therefore, of the present invention is to provide a backing paper comprising a single sheet of paper, as contrasted to a duplex paper, which has a strength at least equal to the thinnest duplex papers now produced.

Another object of the invention is to provide a single sheet coated backing paper which is not only thinner than present duplex paper, but has an opaqueness superior to such duplex backing papers.

Another object of the invention is to provide a thin single sheet backing paper, the opacity of which is dependent primarily on the chemical coatings on the paper rather than the paper structure itself.

Still another object is to provide a backing paper having an improvement in overall thinness so that extra film exposures are permitted without increasing the diameter of the roll beyond that of the same type of presently employed roll film.

Yet another object is to provide a backing paper comprising a single sheet of paper with black opaquing coatings thereon which are more flexible than those black coatings on the backing papers described in my copending applications Ser. No. 187,124, filed September 27, 1950, now Patent 2,646,365 and Ser. No. 260,714, filed December 8, 1951, now Patent 2,646,366 of July 21, 1953.

In accordance with the present invention these and other objects are attained by employing as the paper strip in the backing paper a single sheet, as contrasted to a duplex paper, which has been supercalendered to a thickness appreciably less than commonly employed duplex papers. By itself this paper is so thin that it transmits sufficient actinic light to cause film exposure. This single paper is then coated on one side with a black opaque coating and on the other side by a composite coating of lighter colored composition. The paper may then be printed on the lighter colored side and, if so printed, the printed side is given a transparent protective overcoating to protect the film emulsion from the printing inks. The various coatings may be applied in proper sequence by a rotogravure process or by other suitable coating processes such as described hereinafter. The coatings may be suitably dried between applications.

The paper preferably employed as the base of the backing paper structure is a 15-pound per 1000 sq. ft. paper made of a purified fiber or of unpurified fiber such as unbleached natural color kraft paper which is conditioned to 4–12% moisture content and supercalendered to a thickness of 0.0025 to 0.0030 inch. This thin single sheet paper is then coated on one side with a black coating. The opposite side of this thin paper is coated with a yellow coating. The compositions of the black and yellow coatings are described hereinafter. The thus coated paper is printed on the yellow side with suitable legends and overcoated with a transparent protective coating to protect the film emulsion from the printing inks when the film and backing paper is rolled onto the film spool.

One of the following three black coating compositions may be advantageously employed for preparing a backing paper in accordance with my present invention:

BLACK COATINGS

The following three examples describe the composition of suitable black opaquing coatings.

Example I

	Percent
Vinylidene chloride-acrylonitrile copolymer (51.5 to 53% of solids)	28.0
Paris black (carbon)	13.4
Water	57.8
Sodium salt of partially desulfonated lignin sulfonic acid	0.7
Triton X–100 (an alkylated aryl polyether alcohol containing 20% butyl phthalate)	0.5

Example II

	Percent
Styrene-butadiene copolymer (50–70% styrene) (48% solids in aqueous colloidal dispersion)	21.6
Carbon black	14.8
Sodium salt of partially desulfonated lignin sulfonic acid	0.75
NaOH	0.014
Water	62.8

Example III

	Percent
Styrene-butadiene copolymer (50-70% styrene) (48% solids in aqueous colloidal dispersion)	19.8
Carbon black	16.0
Water	63.3
Sodium salt of partially desulfonated lignin sulfonic acid	0.80
NaOH	0.08

In preparing the black colored dispersions the selected resin copolymers is added with stirring to a 30–40% aqueous carbon dispersion. The carbon dispersion is made by adding the carbon to water containing as a dispersing agent the sodium salt of the partially desulfonated lignin sulfonic acid and caustic soda is added to control the pH within the range of 10 ± 1.

The black coating of Example III is preferred.

YELLOW COATINGS

The following three compositions may be employed for coating the light colored side of the backing paper.

Example IV

	Pounds
Zein	20
Medium chrome yellow	10
Light orange (chrome)	5
Titanium dioxide	15
Isopropyl alcohol	64
Water	16

Example V

	Percent
Styrene-butadiene copolymer (50 to 70% styrene) (48% solids in aqueous dispersion)	9.4
Medium chrome yellow	37.5
Titanium dioxide	9.3
Lecithin	.94
Triton X–100 (alkylated aryl polyether alcohol)	.47
Carboxy methyl cellulose	.37
NaOH	.05
Water	42.00

Example VI

	Percent
Vinylidene chloride-acrylonitrile copolymer latex (51.5–53% solids)	19.2
Medium chrome yellow	12.6
Titanium dioxide	12.6
Tamol (sodium salt of condensed sulfonic acid)	1.3
Sodium hydroxide	0.4
Water	53.9

The yellow coating of Example V gives a very uniform flexible light colored side which is superior to the coating of Example IV which is somewhat more brittle and eventually has a poorer color because of the darkening of the yellow pigment by the zein.

In these formulas the titanium dioxide pigment is finely divided; medium chrome yellow is a finely divided metal chromate pigment; light orange is a finely divided metal chromate pigment. Zein is employed as the binder in the yellow coating of Example IV and the protective overcoating since it will not fog or desensitize the photographic emulsion of the film.

A suitable rotogravure process for applying these coatings to the paper base of the backing paper is described in U. S. Patent 2,218,249 of October 15, 1940. The various applications are made continuously and each coating is dried before the next is applied. The coating is applied to the paper by the intaglio roll which is rotatably mounted in a pan containing the coating solution. The surface of the intaglio roll is embossed providing a plurality of very minute cups which carry the solution, the excess solution being removed from the intaglio roll by a doctor blade. The solution in these various cups is then transferred or applied uniformly to the strip by pressing the strip firmly against the cups by means of a rubber pressure roll over which the strip is fed. Each of these deposits after being placed on the paper is merged into a continuous layer by means of a smoothing bar to provide a uniform coating over the entire paper surface. Each coating is preferably dried in heated air having a relative humidity of 6% at 170° F. before applying a second coating.

The various coatings described herein may also be applied to my backing paper base by the roll and air knife method generally described in Patent 1,980,923 of November 13, 1934. The selected black coating is applied first to one side of the single sheet backing paper and spread by the air knife. This black coating is dried at 180°–200° F. by being passed through a heated drying chamber. In some instances a plurality of black coatings may be spread onto the black side of the backing paper by alternate coating and drying steps. If desired a final wash of 20% zein is applied to prevent blocking before the paper is rolled up.

Suitable ink compositions for printing indicia by rotogravure processes on the backing paper are disclosed in my Patent Re. 21,268 of November 21, 1939. These inks comprise suitable coloring materials in a prolamine binder such as zein. Other suitable printing inks for such backing papers are disclosed in my Patent 2,262,986 of November 18, 1941.

The invention will be further understood by reference to the drawings in which Figs. 1 to 6 represent a greatly enlarged cross-section of backing paper made in accordance with various forms of my present invention, and Fig. 7 shows the novel backing paper of Fig. 3 and photographic film wound on the roll with the film and backing paper separated at one end for purpose of illustrating their relative positions in the roll.

Referring to Fig. 1, a cross-section of a strip of unbleached kraft paper is shown at **10** having thereon a coating **11** of a layer of carbon black in a vinylidene chloride-acrylonitrile copolymer coated from the composition of Example I. On the opposite side of the paper **10**, there is the yellow coating **13** comprising chrome orange and yellow pigments as well as titanium dioxide pigments in a zein binder. This was coated from the composition found in Example IV, supra. The printed indicia is shown at **16** overcoated with a transparent protective zein coating **15**. Such a transparent zein protective coating is described in my Patent 2,262,987 of November 18, 1941.

Referring to Fig. 2 a cross-section of a strip of unbleached kraft paper is shown at **20** having thereon a coating **21** of a layer of carbon black in a styrene-butadiene copolymer coated from the composition of

Example III. On the opposite side of the paper **20** there is a yellow coating **23** comprising chrome yellow and titanium dioxide in a zein binder which is coated from the composition of Example IV. This was coated onto the backing paper base from the composition of Example IV. The printed indicia is shown at **26** overcoated with a transparent protective zein coating **25**. This coating is similar to the coating **15** of Fig. 1.

Referring to Fig. 3 a cross-section of a strip of unbleached kraft paper is shown at **30** having thereon a coating **31** of a layer of carbon black in a vinylidene chloride-acrylonitrile copolymer coated from the composition of Example I. On the opposite side of the paper **30** there is a yellow coating **33** comprising chrome yellow and titanium dioxide in a styrene-butadiene copolymer. This was coated onto the backing paper base from the composition of Example V. The printed indicia is shown at **36** overcoated with a transparent protective zein coating **35**. This zein coating is similar to the coating **15** of Fig. 1.

Referring to Fig. 4 a cross-section of a strip of unbleached kraft paper is shown at **40** having thereon a coating **41** of a layer of carbon black in a styrene-butadiene copolymer coated from the composition of Example II. On the opposite side of paper **40** there is a yellow coating **43** comprising chrome yellow and titanium dioxide in a styrene butadiene copolymer. This was coated onto the backing paper from the composition of Example V. The printed indicia is shown at **46** overcoated with a transparent zein coating **45** which is of a composition similar to that coating **15** of Fig. 1.

Referring to Fig. 5 a cross-section of a strip of unbleached kraft paper is shown at **50** having thereon a coating **51** of a layer of carbon black in vinylidene chloride-acrylonitrile copolymer from the composition of Example I. On the opposite side of paper **50** there is a yellow coating **53** comprising chrome yellow and titanium dioxide in a vinylidene chloride-acrylonitrile copolymer coated from the composition of Example VI. This was coated onto the paper from the composition of Example VI. The printing is shown at **56** overcoated with a transparent zein coating **55** which is a composition similar to that coating **15** of Fig. 1.

Referring to Fig. 6 a cross-section of a strip of unbleached kraft paper is shown at **60** having thereon a coating **61** of a layer of carbon black in a styrene-butadiene copolymer coated from the composition of Example II. On the opposite side of paper **60** there is a yellow coating **63** comprising chrome yellow and titanium dioxide in a vinylidene chloride-acrylonitrile copolymer coated from the composition of Example VI. The printing is shown at **66** overcoated with a transparent zein coating **65** which is a composition similar to that coating **15** of Fig. 1.

The backing paper structure described in connection with Fig. 3 is the preferred form of the present invention. However the backing paper structures shown in Figs. 1 to 6 give a product that fulfills all the advantages described in my copending applications, supra, at a great reduction in cost and at the same time results in a more flexible product which does not produce harmful dust when wound through a camera.

Referring to Fig. 7, a film cartridge **70** is shown partly open in which the backing paper of the present invention is employed. This figure shows the relation of the backing paper surfaces **31** and **35** of Fig. 3 in respect to the film **73** when assembled on the spool. The emulsion side of the film is shown at **71** and the base side at **72**.

Although I prefer for the yellow coating a butadiene-styrene copolymer having approximately 60% styrene, other similar proportions may be used. However as the styrene content of the resin falls below 50% the composition becomes somewhat tacky. As the styrene content rises above 70% the composition becomes somewhat brittle. The vinylidene chloride-acrylonitrile copolymer

may advantageously contain 15% acrylonitrile and 85% vinylidene chloride.

I have found that by employing an initial coating of carbon black in the above resinous matrices on the black side of the paper, the resulting backing paper structure has considerable improvement in respect to flexibility of the black side without loss of resistance to scratching and abrasion. In this respect the backing paper of the present invention is superior to that described and claimed in my copending applications Ser. Nos. 187,124 and 260,714 supra. These resinous binder coatings are less brittle than a zein-black or vinylacetate-black coating of a corresponding thickness.

While the preferred coating compositions are described above, satisfactory backing papers may be made by employing the various coating materials in the following ranges:

Compositions	Preferred Range
Vinylidene chloride-acrylonitrile copolymer or Styrene-butadiene copolymer.	5 to 25%.
Black pigment	1 to 20%.
White pigment	15 to 45%.
Yellow pigment	15 to 45%.
Water	50 to 70% of total composition.

Other useful pigments are, for example, Hansa Yellow, Fast Pigment Yellow and any carbon black of suitable dispersion.

Other pigments which are inert to photographic emulsions may be employed. In fact, any choice of pigments of suitable size for this invention is limited only by the requirement that they be without detrimental effect on the photographic film.

THICKNESS OF COATING

Black coating composition is applied in two coatings to give a total of 12 lbs. of solution per 1000 sq. foot for satisfactory opacity.

Light pigment composition is applied in the amount of 4¼ lbs. per 1000 sq. foot to give satisfactory uniformity of color.

Any other type of paper may be employed if it has good strength at least comparable to the present duplex paper. A rag paper, for example, is suitable but, of course, more expensive than kraft paper.

COMPARISON OF DUPLEX AND KRAFT TEAR STRENGTH

	Elmendorf Tear		Schopper Folds	
	Along, gms.	Across, gms.	Along	Across
Typical Duplex Paper	70	84	410	28
Tan Kraft Paper (as employed in the present invention)	113	113	442	616
	104	103	589	956
	121	114	395	906
	115	116	513	701

Preferably the average tear strength of a suitable paper should be at least 50 gms. as determined by the Elmendorf tear test. This tear test is described in Paper Trade Journal for June 18, 1942, as Tappi Standard T 414 M 40.

While, as indicated above, tan kraft paper is particularly suited for employment in my invention, certain other types of paper could be employed instead, such as unbleached sulfate paper colored with a suitable dye such as Stilbene yellow in which a small amount of filler such as TiO_2 is added to give body and density or opacity to the paper.

These papers comprising the base of the backing paper are of a weight that can be supercalendered to a thinness that the paper itself plus the coatings thereon does

not exceed a maximum thickness of 0.0040 inch. A 15-pound per M sq. ft. paper has been found satisfactory.

The opacity of roll film backing paper is tested in the following manner.

A sheet of the backing paper under test is placed over a sheet of highly sensitive film, such as Super XX Panchromatic film with the black side of the backing paper in contact with the back of the film, duplicating its position on roll film. An orange-red filter of the type employed in camera back windows is placed over the opposite side of the backing paper and the assembly is placed in a printing frame. The test material is exposed to a light intensity of 5000 foot candles for ten minutes. The film is then processed in the usual way and examined for the presence of specks of developed silver. A satisfactory backing paper should show no visible silver image.

The improvement in employing the resinous coatings of the present invention as respects flexibility is shown in the following table:

	Taber Stiffness [1]	Clark Stiffness,[2] dbl. sample
Butadiene-Styrene, black—Zein, yellow pigmented	1.95	55
Butadiene-Styrene, black—Butadiene-Styrene, yellow pigmented	1.85	38
Zein Yellow on Black Paper	4.30	89
Red and Black Duplex Paper	5.10	134
Green and Black Duplex Paper	4.85	133

(The higher the number the stiffer the paper.)
[1] Tappi Tentative Method T-451.
[2] Tappi Instrumentation Studies XIV.

I have found that my improved backing paper has many advantageous features not possessed by duplex papers which it may replace. The strength and other physical properties of the paper employed as the base of the backing paper is at least equal to the strength of the thinner duplex papers now available to the trade. The overall thickness can be made as low as 0.0032 up to 0.0040 inch thus permitting extra exposures to be added to present rolls of film without increasing the diameter beyond that of films now in use. The opaqueness, even though the overall thickness is less than backing papers now available in the trade, is better than such backing papers. The backing paper made in accordance with my invention requires the least amount of coating materials, both black and colored, of any of the methods described or known in the trade. The uniformly light colored side gives maximum contrast with the legends printed thereon. Also less clock springing of freshly rolled film is experienced with this paper than with the thicker duplex paper. These advantages plus the advantage of applying the coatings by rotogravure and air knife methods, which are fast, accurate and efficient, emphasize the importance of my present invention in this art.

I claim:

1. Photographic backing paper having an overall thickness less than 0.0040 inch comprising a single sheet of kraft paper, as contrasted to a sheet of duplex paper, of a thickness of approximately 0.0026 inch which will permit passage of substantial amounts of actinic light, having on one side an opaquing coating composition comprising carbon black in a binder selected from the class consisting of vinylidene chloride-acrylonitrile copolymer and styrene butadiene copolymer, a lighter colored pigmented coating on the opposite surface of the paper comprising a yellow pigment in a binder selected from the class consisting of vinylidene chloride-acrylonitrile copolymer, styrene-butadiene copolymer and zein, printing on said colored coating, and a clear zein protection coating thereover, the complete backing paper structure being sufficiently opaque to prevent actinic light from passing therethrough.

2. Photographic backing paper having an overall thickness less than 0.0040 inch comprising a single sheet of kraft paper, as contrasted to a sheet of duplex paper, of a thickness of approximately 0.0026 inch which will permit passage of substantial amounts of actinic light, having on one side an opaquing coating composition comprising carbon black in a vinylidene chloride-acrylonitrile copolymer binder, a lighter colored pigmented coating on the opposite surface of the paper comprising a yellow pigment in a zein binder, printing on said colored coating, and a clear zein protection coating thereover, the complete backing paper structure being sufficiently opaque to prevent actinic light from passing therethrough.

3. Photographic backing paper having an overall thickness less than 0.0040 inch comprising a single sheet of kraft paper, as contrasted to a sheet of duplex paper, of a thickness of approximately 0.0026 inch which will permit passage of substantial amounts of actinic light, having on one side an opaquing coating composition comprising carbon black in a styrene-butadiene copolymer binder, a lighter colored pigmented coating on the opposite surface of the paper comprising a yellow pigment in a zein binder, printing on said colored coating, and a clear zein protection coating thereover, the complete backing paper structure being sufficiently opaque to prevent actinic light from passing therethrough.

4. Photographic backing paper having an overall thickness less than 0.0040 inch comprising a single sheet of kraft paper, as contrasted to a sheet of duplex paper, of a thickness of approximately 0.0026 inch which will permit passage of substantial amounts of actinic light, having on one side an opaquing coating composition comprising carbon black in a vinylidene chloride-acrylonitrile copolymer binder, a lighter colored pigmented coating on the opposite surface of the paper comprising a yellow pigment in a styrene-butadiene binder, printing on said colored coating, and a clear zein protection coating thereover, the complete backing paper structure being sufficiently opaque to prevent actinic light from passing therethrough.

5. Photographic backing paper having an overall thickness less than 0.0040 inch comprising a single sheet of kraft paper, as contrasted to a sheet of duplex paper, of a thickness of approximately 0.0026 inch which will permit passage of substantial amounts of actinic light, having on one side an opaquing coating composition comprising carbon black in a styrene-butadiene copolymer binder, a lighter colored pigmented coating on the opposite surface of the paper comprising a yellow pigment in a styrene-butadiene binder, printing on said colored coating, and a clear zein protection coating thereover, the complete backing paper structure being sufficiently opaque to prevent actinic light from passing therethrough.

6. Photographic backing paper having an overall thickness less than 0.0040 inch comprising a single sheet of kraft paper, as contrasted to a sheet of duplex paper, of a thickness of approximately 0.0026 inch which will permit passage of substantial amounts of actinic light, having on one side an opaquing coating composition comprising carbon black in a vinylidene chloride-acrylonitrile copolymer binder, a lighter colored pigmented coating on the opposite surface of the paper comprising yellow pigment in a vinylidene chloride-acrylonitrile copolymer, printing on said colored coating, and a clear zein protection coating thereover, the complete backing paper structure being sufficiently opaque to prevent actinic light from passing therethrough.

7. Photographic backing paper having an overall thickness less than 0.0040 inch comprising a single sheet of kraft paper, as contrasted to a sheet of duplex paper, of a thickness of approximately 0.0026 inch which will permit passage of substantial amounts of actinic light, having on one side an opaquing coating composition comprising carbon black in a styrene-butadiene copolymer binder, a lighter colored pigmented coating on the oppo-

site surface of the paper comprising yellow pigment in a vinylidene chloride-acrylonitrile binder, printing on said colored coating, and a clear zein protection coating thereover, the complete backing paper structure being sufficiently opaque to prevent actinic light from passing therethrough.

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