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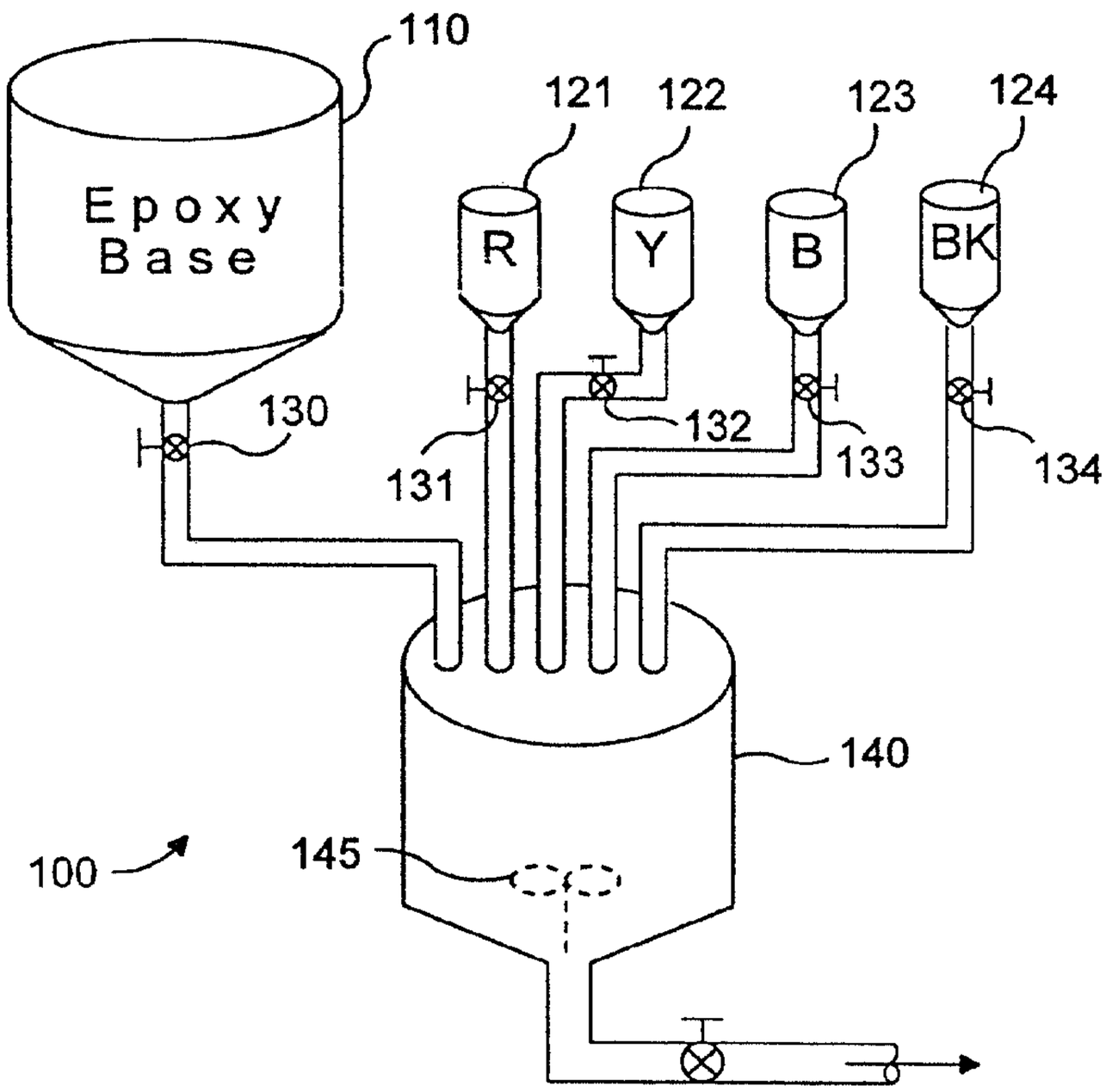
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(71) Demandeur/Applicant:
ILLINOIS TOOL WORKS INC., US

(72) Inventeurs/Inventors:
TURANSKY, ALBERT, US;
RICE, BRIAN, US

(74) Agent: FINLAYSON & SINGLEHURST

(54) Titre : SYSTEME DE REVETEMENT EPOXYDE MULTICOLORE
(54) Title: MULTI-COLORED EPOXY COATING SYSTEM



(57) Abrégé/Abstract:
An epoxy coating base composition and a color system of tinting the composition are provided in which a single base formulation of epoxy coating material can be combined with selected amounts of tinting compositions from one or more tinting sources to provide a selectively colored high solids epoxy coating composition. The base compositions include an uncured epoxy resin. White, light colored or neutral pigments are advantageously added to the resin. Wetting agents and other additives are also advantageously added. To this, colored pigments can be added as desired to provide a colored composition in a rainbow of colors, based on red, yellow and blue and also black and varied gray tones.

MULTI-COLORED EPOXY COATING SYSTEM

ABSTRACT

An epoxy coating base composition and a color system of tinting the composition are provided in which a single base formulation of epoxy coating material can be combined with selected amounts of tinting compositions from one or more tinting sources to provide a selectively colored high solids epoxy coating composition. The base compositions include an uncured epoxy resin. White, light colored or neutral pigments are advantageously added to the resin. Wetting agents and other additives are also advantageously added. To this, colored pigments can be added as desired to provide a colored composition in a rainbow of colors, based on red, yellow and blue and also black and varied gray tones.

MULTI-COLORED EPOXY COATING SYSTEM

BACKGROUND OF THE INVENTION

The invention relates generally to multi-colored epoxy coating compositions and more particularly to a system including one or more base compositions and a set of tinting compositions for coloring the base compositions to yield epoxy coating compositions in a variety of colors.

Multi-colored paint systems are known in which a variety of tinting compositions can be used to custom tint a one component solvent based or water based paint compositions. For example, one can go to a paint store, select a flat, gloss or semi-gloss white base paint and a color from a color chart and by adding specified amounts of tinting compositions from a pre-assembled set, the base paint can be colored to match the color selected from the color chart. However, the same procedure has not existed with respect to two-component epoxy type high solids coatings. As used herein, epoxy materials will be given the ordinary meaning of epoxy in the field, including materials which are applied in a relatively soft or liquid state as a mixed two or more component system, one of the components including ingredients having reactive epoxide groups. Another component is generally referred to as the hardener or activator. Known epoxy resins are made from epichlorohydrin, bisphenol A, bisphenol F or other aliphatic polyols such as glycerol. Such materials can be characterized by a glycidyl ether structure and are commonly cured with a variety of amines and/or amides. The result of the combination of the components is a resin based on the reactivity of such epoxide groups.

In contrast to the virtually unlimited colors which can be achieved from one-component solvent based and water based paint systems, high solids colored epoxy coating compositions tend to be formulated individually, for a specific desired color and not with a

versatile base composition which can be tinted as desired. For example, Lee and Neville's "Handbook of Epoxy Resins", copyrighted in 1967, Chapter 24, p. 33, describes two formulas for epoxy-coating compositions:

Red Lead Primer Dispersion

Material	Percent by Weight
Red Lead	69%
Diatomaceous Earth	6.5%
Magnesium Silicate	5.4%
Aluminum Stearate	0.3%
Resin Vehicle	18.8%
DGEBA, 55%	
Toluene, 22.5%	
Methyl isobutyl ketone, 20.3%	
Butyl Cellosolve, 2.2%	
Used at 79.5% in letdown base	

Dark-Green Enamel Dispersion

Material	Percent by Weight
Phthalocyanine Green	25%
Resin Vehicle	75%
DGEBA 331/3 %	
Butanol, 33 1/3 %	
Toluene, 33 1/3 %	
Used at 44% in letdown base	

As can be seen, the formulations for these compositions are significantly different. While it is true that the red formulation is characterized as a primer and the green formulation is characterized as an enamel, it is believed that families of colored epoxy coating compositions varying only in pigment selection are heretofore unknown. Moreover, the approach of formulating colored epoxy coating compositions for each specific color has not changed significantly over the past 30-plus years.

For example, referring to a 1992 list of colored coating compositions available from Shell, significant differences can be seen in the black enamel, white enamel and gray enamel formulations. Also, the black formulation instructions call for steel ball mill processing for 48 hours and the white and gray enamel instructions call for high speed dispersing equipment or a sand mill.

Black Enamel No. 401

Material	Pounds
Curing Agent Component	
Mill Grind	
Carbon black: Monarch 880 (Cabot-Corporation, Special Blacks Division)	13.6
EPON CURING AGENT V-15-X-70	98.7
Ethyl 3-Ethoxy Propionate	41.0
Let down	
EPON CURING AGENT V-15-X-70	29.6
n-Butanol	17.9
Ethyl 3-Ethoxy Propionate	193.4
Paint Additive #11 (Dow Corning Corporation)	0.8
Total Curing Agent Component	395.0
Base Component	
EPON® Resin 1001-CX-75	217.5
Beetle 216-8 (American Cyanamid Company)	13.6
Xylene	175.5
Total Base Component	406.6
TOTAL FORMULATION	801.6

White Enamel No. 416

Material	Pounds
Base Component	
Pigments	
Ti-Pure R-902 (E.I. duPont de Nemours & Company, Inc.)	240.2
Phthalocyanine Blue	(trace)
Mistron CF5A (Cyprus Industrial Minerals Company)	32.5
Vehicle	
EPRON® Resin 1001-CX-75	264.4
Beetle 216-8 (American Cyanamid Company)	12.1
MIBK	29.8
Propylene glycol methyl ether	55.4
Cyclohexanol	7.5
Xylene	35.8
Tolulene	133.3
Total Base Component	**811.0**
Curing Agent Component	
EPRON CURING AGENT® C-112H	98.4
Methyl Isobutyl Ketone	86.3
Total Curing Agent Component	184.7
TOTAL FORMULATION	**995.7**

Gray Enamel No. 434

Material	Pounds
Base Component	
Pigments	
Ti-Pure R-902 (E.I. duPont de Nemours & Company, Inc.)	175
PFICARB 200 (Harcros Pigments, Inc.)	65
Sparmite (Harcros Pigments, Inc.)	20
Carbon Black LB-1011 (Harcros Pigments, Inc.)	4
Slurry: Bentone 34 (Rheox, Inc.) 95% ethanol in water 65/35 by weight	8
Vehicle	
EPRON® Resin 1001-CX-75	301
Beetle 216-8 (American Cyanamid Company)	12
MIBK	64
Propylene glycol methyl ether	76
Xylene	79
Total Base Component	804
Curing Agent Component	
EPRON CURING AGENT V-15-70	174
Methyl isobutyl ketone	18
Total Curing Agent Component	192
TOTAL FORMULATION	**996**

One factor which interferes with the ability to provide a standard base and various pigments which can be mixed into the base to change color tones at will, is related to the nature of colored pigments. For example, various data sheets for formulating colored epoxy compositions describe steel ball milling and grinding the ingredients for 48 hours. This is not compatible with a tint-to-order system.

Accordingly, it is desirable to provide a base composition and a set of tinting compositions which can be combined with the base composition to provide epoxy coatings in a

rainbow of colors and which overcome other drawbacks or unsatisfactory characteristics of the prior art.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, an epoxy coating base composition and a color system of tinting the composition are provided in which a single base formulation of epoxy coating material can be combined with selected amounts of tinting compositions from one or more tinting sources to provide a selectively colored epoxy coating composition, such as a high solids epoxy coating composition. The base compositions include an uncured epoxy resin. White or white base producing pigments are advantageously added to the resin and ground to a Hegman 6 or smaller. Wetting agents and other additives are also advantageously added. Neutral pigments can be added after the grind. White or light colored pigments are advantageously added to the resin. These can be ground to Hegman 6 or smaller. Wetting agents and other additives are also advantageously added. Neutral pigments are added after the grind. To this, colored pigments can be added as desired to provide a colored composition in a rainbow of colors, based on red, yellow and blue and also black and varied gray tones.

The invention accordingly comprises compositions possessing the characteristics, properties and the relations of components and a system and method involving these compositions, which will be exemplified in the compositions, methods and systems hereinafter described.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a schematic diagram of a system in accordance with a preferred embodiment of the invention for providing a multitude of differently colored epoxy coating compositions, all formulated from the same base composition; and

FIG. 2 is a schematic diagram of a system in accordance with different preferred embodiments of the invention for providing a multitude of differently colored epoxy coating compositions, all formulated from the same base composition.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention is directed to a base epoxy coating composition and a set of tinting compositions which are compatible with the base compositions to provide the ability to custom tint the base composition to a selected color. The resulting colored epoxy coating composition can include red, yellow and blue tones. Thus, the composition can be tinted red, yellow or blue and also orange, which includes red and yellow tones, green, which includes blue and yellow tones, or purple, which includes red and blue tones, and various shades and variations thereof. In a preferred embodiment of the invention, the base composition can also be tinted black or to various levels of gray.

Color materials and pigments could not be added to existing epoxy coating compositions because the chemistries of the existing coating compositions could and generally would perform differently with different pigment materials. This would yield color inconsistencies such as flooding and floating. It has been determined that pigments are inorganic and organic materials in the form of particles, with charges and densities that must be balanced with the coating binder/resin composition and any solvents, fillers, flow agents and other additives which may be present in the composition. Thus, while prior compositions have been

formulated to balance the characteristics of one particular pigment, the formulations which are known for one color pigment will generally not be applicable to other differently colored pigments.

In a one-component system, after the coating material, such as latex paint, is applied to the substrate, the solvents evaporate. This tends to increase the viscosity and thus the immobility of pigment particles within the coating film. Thus, movement and color imbalances and inconsistencies have not been a problem in one component solvent based systems, because pigment movement is generally inhibited by the application process.

On the other hand, the phenomenon of an evaporating solvent leading to pigment mobility inhibition does not occur with most two (or more) component epoxy type coating compositions. This is especially true with 100% solids or high solids thermosetting coatings, where the applied coating stays "liquid" and the particles stay mobile for relatively long periods of time.

The term "high solids" compositions refers to compositions without significant amounts of volatile components. For example, many known two component systems which would not be classified as high solids compositions contain 50 to 60% volatiles, which evaporate within about 48 hours after the coating composition is applied. In preferred embodiments of the invention, the coating composition can be formulated substantially without volatile organic compounds. Thus, compositions in which the solids component (as opposed to the volatiles component) is greater than 70%, and even 90%, 95% (said volatiles component being incidental to some of the commercially available additives which are added in small quantities) and higher can be achieved. Thus, the advantages of the invention can even be achieved with substantially 100% solids formulations.

The pigment in an epoxy coating composition is generally stabilized in one of the components of the coating system. It has been determined that when the components are combined to initiate hardening, a different set of charges and polarities must be dealt with, as well as various changes in viscosity and particle mobility. Thus, pigment instability can occur before the composition hardens. Furthermore, various components in the two-component system are reacting and cross-linking is occurring and the system characteristics which keep the colored particles evenly dispersed can change radically during the hardening process. Thus, it has been determined that as the two components react, changes occur in the density, charge balance, wetting properties, and so forth of the coating composition. These changes can destabilize pigments in the coating and lead to flooding, floating and a number of other color defects.

Previously, these difficulties have been addressed by formulating a specific two-component system to a specific set of pigments, additives and processing techniques. However, by carefully matching a set of pigments to a suitable base composition, the problem of pigment compatibility in multi-component epoxy coating systems has been solved. By matching the compatibility of the binder/resin to pigments, by the choice of materials, additives, amounts of additives and processing of those additives in the binder/resin pigment mixture, suitable compositions have been developed. Accordingly, a high solids or 100% solids coating can be formulated to provide one coat film thicknesses of about 8 to 20 mils and higher.

Base compositions in accordance with preferred embodiments of the invention can include the following ingredients:

About 30% - 90% epoxy resin, preferably about 40% to 60% epoxy resin. Such resins can include bisphenol and novalac types of resins.

About 0.1% to 10% additives, including wetting agents, slip agents, anti foam agents and flow agents. Preferred are polymeric acrylic wetting agents.

About 10% to 60%, white, light or neutral particles or pigments. Preferred are TiO_2 particles.

About 30% to 60% fillers, such as silica, magnesium silicate, talc and synthetic or glass beads can also be employed.

About 2 - 15% epoxy diluents are also advantageous.

To the base composition can be added various combinations of about 0.1% to 10%, preferably about 0.5% to about 5% standard colored pigments, including oxides, such as iron oxide, phthalo-type and quinacridone pigments as well as lamp black. The colored base composition is then combined with standard hardeners suitable for the epoxy resin selected.

Various hardener compositions, such as those based on amines and amides, including polyamides can be used. The choice of hardener depends on the various applications of the coating composition, such as temperature and humidity. Preferred hardeners include any or all of cycloaliphatic amines based on isophorone diamine, aliphatic polyamines and aliphatic polyoxypropyleneamine. The weight ratio of hardener to resin component can be about 1:3 and varies with the exact hardener selected and application conditions and surfaces.

Aspects and embodiments of the invention will be exemplified with reference to the following examples. These examples are presented for purposes of illustration only and are not intended to be construed in a limiting sense. The compositions presented were mixed with appropriate hardeners, applied to substrates and acceptable uniformly colored epoxy coated substrates were obtained.

The following abbreviations will be used for chemical components that are advantageously included in coating compositions in accordance with the invention and in the examples:

Table 1

Abbreviation	Chemical Name or Identification	Company
BYK 161, 162 & 163	Block copolymer with pigment affined groups	BYK CHEMIE 525 S. Cherry St., Wallingford, CT 06492
Perenol F40	Acrylated Copolymer	COGNIS 300 Brookside Ave. Ambler, PA 19002
Surfynol 440	Ethoxylated Non-ionic Acetylenicdiol	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Blvd. Allentown, PA 18195-1501
BYK 080	Non-aqueous emulsion of a polysiloxane copolymer	BYK CHEMIE 525 S. Cherry St., Wallingford, CT 06492
BYK 555	Foam destroying polymers, non-silicone	BYK CHEMIE 525 S. Cherry St., Wallingford, CT 06492
Bis A Epoxy Resin, EPON 828	Bisphenol A, diglycidyl ether of	SHELL CHEMICAL COMPANY Houston, TX 77252
DER 331		DOW CHEMICAL CO. .P.O. Box 1026 Midland, MI 48674
Araldite 6010		CIBA SPECIALITY CHEMICALS 540 White Plains Road Tarrytown, NY 10591

Abbreviation	Chemical Name or Identification	Company
Bis F Epoxy Resin	Bisphenol F, diglycidyl ether of DPL 862	SHELL CHEMICAL COMPANY Houston, TX 77252
	GY 282	CIBA Specialty Chemicals Additive Div. 540 White Plains Rd. Tarrytown, NY 10591
	Epalloy 8230, 8250	CVC 2980 Rt. 73 North Maple Shade, NJ 08052
Novolac Epoxy Resin	Phenol-Formaldehyde Polymer of glycidyl ether (EPN1138, 1139)	CIBA Specialty Chemicals Additive Div. 540 White Plains Rd. Tarrytown, NY 10591
	DEN 439	DOW CHEMICAL COMPANY PO Box 1206 Midland, MI 48674
BYK 410, 411	Modified polymeric urea	BYK CHEMIE 525 S. Cherry St., Wallingford, CT 06492
BYK 500	Foam destroying polymer, silicone free	BYK CHEMIE 525 S. Cherry St., Wallingford, CT 06492
Disparlon KS-873N	Surfactant amine salt in Xylene	KING INDUSTRIES Norwalk, CT
L-1983	Polyacrylate	KING INDUSTRIES Norwalk, CT
Nuosperse 657	Oligomeric Wetting Agent	CONDEA SERVO LLC 2 Turner Pl. Piscataway, NJ 08855
Serad FX 9085	Polymeric acrylate base wetting agent	CONDEA SERVO LLC 2 Turner Pl. Piscataway, NJ 08855
CT-136 & CT-141 & CT-151	Anionic dispersants	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Blvd. Allentown, PA 18195-1501
CAFA 250	Non-functional polyacrylate solution	PCI GROUP Tempe, AZ

Abbreviation	Chemical Name or Identification	Company
CAFA 350	Epoxy functional polyacrylate solution	PCI GROUP Tempe, AZ
CAFA 450	Acid functional polyacrylate solution	PCI GROUP Tempe, AZ
GE10	Cresyl Glycidyl Ether	CVC 2980 Rt. 73 North Maple Shade, NJ 08052
GE20	Neopentyl Glycol Diglycidyl Ether	CVC 2980 Rt. 73 North Maple Shade, NJ 08052
GE22	Cyclohexanedimethanol Diglycidyl Ether	CVC 2980 Rt. 73 North Maple Shade, NJ 08052
Heloxy 107	Cyclohexanedimethanol Diglycidyl Ether	SHELL CHEMICAL COMPANY Houston, TX 77252
Epodil 757	Cyclohexanedimethanol Diglycidyl Ether	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Blvd. Allentown, PA 18195-1501
GE30	Trimethylol propane Triglycidyl Ether	CVC 2980 Rt. 73 North Maple Shade, NJ 08052
Cyclic Ester	Butyrolactone	BASF CORPORATION 3000 Continental Dr. North Mount Olive, NJ 07828 ARCO CHEMICAL CO. 2502 Sheldon Rd. Channelview, TX
Heloxy 7	Alkyl Glycidyl Ether (C8-C10)	SHELL CHEMICAL COMPANY Houston, TX 77252
Epodil 747	Alkyl Glycidyl Ether (C8-C10)	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Blvd. Allentown, PA 18195-1501
Heloxy 8	Alkyl Glycidyl Ether (C12-C14)	SHELL CHEMICAL COMPANY Houston, TX 77252

Abbreviation	Chemical Name or Identification	Company
Epodil 748	Alkyl Glycidyl Ether (C12-C14)	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Blvd. Allentown, PA 18195-1501
Heloxy 9	Alkyl Glycidyl Ether	SHELL CHEMICAL COMPANY Houston, TX 77252
Epodil 746	2-Ethylhexyl Glycidyl Ether	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Blvd. Allentown, PA 18195-1501
Carbonic Ester	Propylene Carbonate, Ethylene Carbonate or blends thereof	HUNTSMAN CORPORATION Conroe, TX 77305 LYONDELL 3801 Westchester Pike Newtown Square, PA 19073
Heloxy 67	Butanediol diglycidyl Ether	SHELL CHEMICAL COMPANY Houston, TX 77252
Epodil 750	Butanediol diglycidyl Ether	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Blvd. Allentown, PA 18195-1501

Example 1 – White Dispersion Base Composition

The following white dispersion (WD) base composition was prepared by blending the ingredients with high shear until the ingredients were well ground. Disperser, sandmill, pebble mill, 3-roll mill and/or other grinding types of mixers are acceptable.

Material	Percent By Weight
EPOXY RESIN: Bis A, Bis F or Novalac types. Examples DER 331, Epotuf 37-140, Epon 828, DER 330, Eppaloy 8230, 8250, GY 282, DPL 862, EPN 1138, 1139, DPL 862, DEN 439 or DER 361	40%-90%

ADDITIVES: BYK 161, 162, 163, 410, 411, 500, Disparlon KS-873N, L-1983, Perenol F-40, Nuosperse 657, SER AD FX 9085, Surfynol 440, CT-136, Ct-141, CT151, TG, CAFA 250, CAFA 350, and CAFA 450	0.1%-10%
TITANIUM DIOXIDE: Kronos 2102, 2310, TR93, R900, R902, R960, RCL9 and RCL535	10%-60%

If excess epoxy resin is included, the coating can have insufficiently low hiding power. This could result in the color appearing diaphanous or appear to be washed out. Thus, attaining selected color could be difficult or impossible. Reactivity would also increase and this could affect the coating application. If epoxy resin levels are too low, the final composition could have inadequate coating qualities. It could be too thick to apply easily, smoothly or with standard techniques and technologies. Surface leveling, gloss and texture could also be adversely affected.

If the additive quantity is insufficiently low, its ability to render the color materials compatible with the system can become inadequate to yield a uniform color throughout the cured colored coating composition. Also, although using below the specified amount of additive may be sufficient to render the pigments compatible in certain colors, problems can arise when other "more difficult" colors are selected. The use of excess additive can destabilize the pigment to binder compatibility, by the way the additive builds up on an already "saturated" pigment particle surface. This excess "build-up" layer can actually lead to some of the color problems which the additives are intended to solve. Serad FX 9085 (polymeric acrylate base wetting agent), BYK 161 and BYK 163, (block copolymers with pigment affined groups) and CAFA (nonfunctional polyacrylate solution) are preferred wetting agents. Perenol F40

(acrylated copolymer surfynol 440 (ethoxylated non-ionic acetylenicdiol) BYK 080 (non-aqueous emulsion of a polysiloxane copolymer) and BYK 555 (foam destroying non-silicone polymer are preferred surface modifying additives.

Including excess TiO_2 can lead to improper color attainment and high and potentially unmanageable viscosity, which leads to undesirable application properties. Including too little TiO_2 can cause improper color attainment and low hiding power of the coating.

Example 2 - Let Down Composition

The following let down (LD) composition was prepared by combining the following ingredients and mixing until consistent.

Material	Percent By Weight
EPOXY RESIN: Bis A, Bis F or Novalac types. Examples DER 331, 37-140, Epon 828, DER 330, Eppaloy 8230, 8250, GY 282, DPL 862, EPN 1138, 1139, DPL 862, DEN 439 or DER 361	30%-65%
FILLERS: Examples: Magnesium Silicate, Aluminum Trihydrate, Ground Silicas, Calcium Carbonate, Barium Sulfate, Synthetic Beads, Mica, Aluminum Silicate glass and or blends of any of these	30%-60%
DILUENTS: Reactive type epoxy diluents: Examples GE10, GE20, GE22, GE30, Cyclic Ester, Heloxy 7, Heloxy 8, Heloxy 9, Heloxy 67, Heloxy 107, Carbonic Ester, Epodil 746, Epodil 747, Epodil 748, Epodil 757	2%-15%
ADDITIVES: Leveling And Air Release BYK 161, 162, 163, 410, 411, 500, Disparlon KS-873N, L-1983, Perenol F-40, Nuosperse 657, SER AD FX 9085, Surfynol 440, CT-136, Ct-141,	0.5%-8%

CT151, TG, CAFA 250, CAFA 350, CAFA 450, BYK A 500, BYK 104, BYK 080, BYK 361, BYK 066, BYK 555, DOW DB-100, BYK A 525 and BYK 530	
TITANIUM DIOXIDE: Kronos 2102, 2310, TR93, R900, R902, R960, RCL9 and RCL535	10%-60%

Including excess epoxy resin can adversely affect the polymerization (curing) of the final coating. Proper color attainment can also be adversely affected as well as curing rate and application properties and characteristics.

Including insufficient resin can lead to coating materials which are difficult to apply using standard techniques.

Including excess filler can adversely affect the application properties and the appearance of the finished coating. Excess filler can also adversely affect adhesion, various rates of reaction, and mechanical properties such as hardness and/or abrasion resistance. Including insufficient filler can also adversely affect the application properties of the coating material as well as the final appearance of the product. The amount of filler must be balanced by proper amounts of reactants that are employed to produce a finished polymer of selected properties.

When insufficient diluent is included, certain application properties, such as leveling of the coating can be adversely affected. Adverse coating effects could occur if excess diluent is included. Furthermore, inclusion of too much or too little diluent can affect the packaging scheme, which simplifies and satisfies the stoichiometric requirements of a complex thermosetting polymeric system.

Including too little additive can adversely affect the surface and color consistency. Excess additive can create build up problems which can lead to floating, floating, color rub-up and other color problems.

Example 3 - Pastel Tint Base

A pastel tint base was prepared by mixing about 40% - 70% of the Let Down composition of Example 2 with about 30% to 60% of the white Color Dispersion Example 1.

Example 4 - Midtone Tint Base

A midtone tint base was prepared by mixing, about 50% to 80% of the Let Down composition of Example 2 with about 20% to 50% of the WD composition of Example 1.

Example 5 – Deeptone Tint Base

A deeptone tint base was prepared by mixing about 60% - 90% of the Let Down composition of Example 2 with 10% to 40% of the White Color Dispersion composition of Example 1.

Example 6 – Ultradeeptone Tint Base

An ultradeeptone tint base was prepared by mixing 90 – 100% let down of Example 2 with 0 – 10% of other additives.

Example 7- Light Grey Pastel Coating Composition

To form a light gray coating composition having a pastel appearance, a one gallon can (3402 grams) of a pastel tint base in accordance with Example 3 was provided. To this one gallon can, the following tints were added and mixed by shaking for three-twelve minutes in a conventional paint shaker until the color is consistent. The tints were from the 844 series of Creanova, Inc. of Piscataway, NJ:

Pigment	Identification Number	Amount
Lamp Black	844-9955	7 grams
Yellow Iron Oxide	844-1863	11 grams
Phthalo Green	844-5558	0.48 grams

After application and hardening, an acceptable light gray epoxy coating composition was obtained.

Example 8 - Medium Blue

The Following Pigments from the 844 Series of Creanova, Inc. of Piscataway, New Jersey were added to one gallon (3402 grams) of a mid tone tint base coating composition in accordance with Example 4.

Pigment	Identification Number	Amount
Lamp Black	844-9955	16.5 grams
Phthalo Blue	844-7262	69.1 grams
Quinacridone Red	844-0451	17.2 grams

After hardening, an acceptable medium blue epoxy coating was obtained.

Example 9 - Deep Tone Tan

The following tints from the 844 Series of Creanova, Inc. of Piscataway, New Jersey were added to one gallon (3402 grams) of a Deep Tone tint base of Example 5.

Pigment	Identification Number	Amount
Lamp Black	844-9955	8.9 grams
Yellow Iron Oxide	844-1863	107.9 grams
Red Iron Oxide	844-1063	16.4 grams

After hardening, an acceptable tan epoxy coating was obtained.

Example 10- Dark Green

The following 844 Series Tints from Creanova, Inc. of Piscataway, New Jersey were added to one gallon (3402 grams) of an Ultra-Deep Tone Tint base of Example 6.

Color	Identification Number	Amount
Lamp Black	844-9955	2.8 grams
Yellow Iron Oxide	844-1863	54.9 grams
Phthalo Green	844-5558	68.9 grams
White	844-0061	29.2 grams

After hardening, an acceptable dark green epoxy coating composition was obtained.

Example 11- TB White Dispersion

34 pounds of bisphenol A diglycidyl ether resin (EPON 828 or CIBA 6010) was mixed at slow speed for 5 minutes in a 55 gallon drum. A 30 or 60 horse disperser with a 12 inch F-type blade can be used. 1.08 pounds of SER-AD FX 9085 polymeric acrylate base wetting agent and 45.0 pounds of TiPure R902 TiO_2 particles were added slowly and mixed for 30 minutes on medium speed. The pigment grind target was greater than Hegman 6. 20.1 pounds of additional EPON 828 or CIBA 6010 resin was added and mixed for 10 minutes at slow speed. The resulting white dispersion was compatible with a variety of colored pigments and when mixed with a hardening agent, provided a wide variety of colored epoxy coating compositions based on red, yellow and blue tones, (i.e., green compositions are based on blue and yellow tones).

Example 12- White Dispersion

Material	Percent by Weight
EPON 828	43.67%
SERAD FX 9085	1.32%

TiPure R900	55.01%

The resin and wetting agent were added in order and mixed for 5 minutes, or until consistent. The TiO_2 pigment was then added slowly with a disperser and a shear type blade for 30 minutes at medium to high speed to yield a Hegman grind of 6 or greater.

This base was compatible with a wide variety of colored pigments and when combined with a hardener, provides a durable epoxy coating in a rainbow of colors.

Example 13- White Dispersion

Material	Percent by Weight
GY 282 resin (Bisphenol F diglycidyl ether)	33.831%
SER-AD FX 9085	0.240%
Ti Pure R902	10.006%
GY282 resin	55.923%

The resin and wetting agent were added in order and mixed for about 5 minutes, until consistent. The TiO_2 powder was then added slowly and mixed with a disperser and a shear type blade until consistent, for about 30 minutes. A grind of Hegman 6+ was achieved before adding the remaining resin.

This dispersion was compatible with a variety of differently colored pigments and provided a rainbow of differently colored epoxy coatings.

Example 14 - Let Down

Step 1. The following liquid ingredients were placed into a mixing pot and mixed at slow speed for about 5 minutes.

49 lbs	EPON 828 or CIBA 6010
134.4 g	anti-settle resin concentrate, (glycerin) available from Ashland Chemical Co. of Columbus, OH.
7.7 lbs	propylene carbonate, sold under the name HIPURE, from Huntsman Corp. of Conroe, TX
2.5 lbs	butyrolactone, sold under the name BLO, from BASF Corp.

of North Mount Olive, NJ.

Step 2. The following ingredients were added slowly to the resin mixture and mixed for 10 minutes on medium speed.

493.2 g	HDK WACKER N20 or AEROSIL 200 fumed silica particles
266 lbs	talc powder (MP 45/26 Montana Talc)
897 g	MISTRON MONOMIX talc
3.6 lbs	325 Mesh silica
13.4 lbs	PR3/PF11R Glass beads
3.6 lbs	OMYA or Snow White 12 calcium carbonate powder

Step 3. The remaining ingredients were added in order, slowly and mixed on slow speed for about 10 minutes.

274.9g	anti foam agent (BYK-555)
420.4g	MODA Flow, a flow agent available from Solutia, St. Louis, MO.

The resulting composition was compatible with a variety of pigment materials and lends to epoxy coating compositions in a rainbow of colors.

Example 15- Let Down

Step 1. The following ingredients were combined and mixed for about 15 minutes, until consistent. All percentages are by weight.

Material	Percent by Weight
Bisphenol A polymer of glycidyl ether (DER 330)	30%
ground silica	10%
synthetic glass beads	20%
magnesium silicate	18%
calcium carbonate	6%

Step 2. The following ingredients were then added and mixed for about 10 minutes, until consistent.

Material	Percent by Weight
alkyl glycidyl ether (Epodil 747)	15%
BYK 555	0.5%
Modaflow	0.5%

The composition was compatible with a variety of pigments to provide epoxy coatings in a rainbow of colors.

Example 16- Let Down

Step 1. The following ingredients were combined and mixed for about 15 minutes until consistent.

Material	Percent by Weight
Novolac epoxy resin (Epalloy 8230)	83.8%
ground silica	5.0%
Synthetic glass beads	5.0%
magnesium silicate	5.0%
calcium carbonate	2.7%

Step 2. add the following ingredients and mix about 10 minutes, until consistent.

Material	Percent by Weight
GE 22	3.0%
BYK 066	0.5%
CAFA	5.0%

The resulting composition was compatible with a variety of differently colored pigments to provide epoxy coating compositions in a rainbow of colors.

Example 17- Pastel Tint Base

72.6 lbs	Let Down
27.4 lbs	White Dispersion

These ingredients were mixed for about 15 minutes consistent to provide a pastel base compatible with a variety of differently colored pigments to provide epoxy coatings in a rainbow of colors.

Example 18- Midtone Tint Base

72.6 lbs	Let Down
20.6 lbs	White Dispersion

These ingredients were mixed for about 15 minutes until consistent to provide a pastel base compatible with a variety of differently colored pigments to provide epoxy coatings in a rainbow of colors.

Example 19- Deeptone Tint Base

83.1 lbs	Let Down
16.9 lbs	White Dispersion

These ingredients were mixed for about 15 minutes until consistent to provide a pastel base compatible with a variety of differently colored pigments to provide epoxy coatings in a rainbow of colors.

Example 20- Ultradeeptone Tint Base

Step 1. The following liquid ingredients were added to a 55 gal drum mixing pot and mixed at medium speed for about 10 minutes with a 12" F type blade until consistent.

48 lbs	EPON 828 or CIBA 6010

134.7 g	anti-settle resin concentrate
889.4 g	Ser-Ad FX 9085

Step 2. The next two ingredients were added and mixed for 5 minutes until consistent.

2.5 lbs	Butyrolactone (BLO)
7.5 lbs	Propylene carbonate (HiPure)

Step 3. The next set of ingredients were added slowly and mixed for about 10 minutes on medium speed.

483.5 g	HDK WACKER N20/200AEROSIL
15.2 lbs	MP 45/26 Montana Talc
879.8 g	Mistron Monomix
3.6 lbs	325 mesh silica
13.1 lbs	PR3/PF11R glass beads
3.5 lbs	OMYA 14 or Snow White 12

Step 4. Add remaining ingredients, in order, slowly and mix on slow speed for about 10 minutes.

269.5 g	BYK-555
412.2 g	MODA FLOW

The resulting composition provided a Let Down composition that was compatible with a variety of differently colored pigments to provide epoxy coatings in a rainbow of colors.

Example 21- Deep Red

The following 844 series pigments available from Creanova Inc. of New Jersey were added to 1 gallon (3402g) of an Ultradeeptone Base, such as that of Example 20, shaken for 3 - 12 minutes until consistent and provided acceptable deep red epoxy coatings.

Pigment	Identification Number	Amount
Lamp Black	844-9955	8.4 grams
Titanium White	844-0061	39.6 grams
Red Iron Oxide	844-1063	102.8 grams
Quinacridone Red	844-0451	15.9 grams

Example 22 Yellow

The following 844 series pigments were added to 3402 g of a pastel base, such as that of Example 17, shaken for 3 - 12 minutes until consistent and provided acceptable yellow epoxy coatings.

Pigment	Identification Number	Amount
Organic Yellow	844-2852	3.1 grams
Yellow Iron Oxide	844-1863	8.5 grams

Example 23- Medium Green

The following pigments were added to 3402 g of pastel bases, such as that of Example 17, shaken for 3 - 12 minutes until consistent and provided an acceptable medium green epoxy coatings.

Pigment	Identification Number	Amount
Lamp Black	844-9955	3.5 grams
Yellow Iron Oxide	844-1863	32.3 grams
Phthalo Green	844-5558	16.1 grams

Example 24- Teal

The following pigments were added to 3402 g of deeptone bases, such as that of Example 19, shaken for 3 - 12 minutes until consistent and provided acceptable teal epoxy coatings.

Pigment	Identification Number	Amount
Lamp Black	844-9955	0.7 grams
Phthalo Blue	844-7262	28.1 grams
Phthalo Green	844-5558	122 grams

Example 25 **Plum**

The following pigments were added to 3402 g of ultradeeptone bases, such as that of Example 20, shaken for 3-12 minutes until consistent and provided acceptable plum (purple) epoxy coatings.

Pigment	Identification Number	Amount
Lamp Black	844-9955	24 grams
Quinacridone Violet	844-9451	13.8 grams
Red Iron Oxide	844-1063	35.7 grams

Example 26 **Orange**

The following pigments were added to ultradeeptone bases, such as that of Example 20, shaken for 3-12 minutes until consistent and provided acceptable orange epoxy coatings.

Pigment	Identification Number	Amount
Unleaded Medium Yellow	844-2555	132.0 grams
Quinacridone Red	844-0451	4.0 grams
Unleaded Orange	844-0982	5.0 grams
Yellow Iron Oxide	844-1863	29.6 grams

Systems for providing multi-colored epoxy coatings are shown in FIGS. 1 and 2. In FIG. 1, an industrial system 100 includes one or more tanks 110 of an epoxy base composition

and a series of hoppers 121-124 containing pigments, such as, but not limited to red, yellow, blue and black pigments. The amount of base and pigment added to a mixing drum 140 which, includes a mixing blade 145 can be controlled by a series of controls 130-134. A consumer oriented system 200 is shown in FIG. 2. Pigments from a set of hoppers 221-224 are selectively added to a can 210 of epoxy base composition and mixed with a shaker 245.

Example 27 Hardener

The following hardener was used in connection with the above Examples. The ingredients were mixed at a slow speed for about 15 minutes until consistent.

57 lbs	Modified IPDA cycloaliphatic amine sold under the name Pacific Anchor 1618, from Air Products of Allentown, PA.
14 lbs	aliphatic polyamine sold under the name Pacific Anchor 1768 or Versamine 642 CE, from Air Products or Cognis of Allentown, PA or Ambler, PA.
30 lbs	modified aliphatic polyoxypropylene amine sold under the name Pacific Anchor 1784 or Versamine 643 CE.

Acceptable proportions of the above hardener to 1 gallon of pastel, midtone, deeptone or ultradeeptone base, which weighs about 7.5 to 7.6 lbs was about 2.4 to 2.5 lbs.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently obtained and, since certain changes may be made in the above-compositions of matter without departing from the spirit and scope of the invention, it is intended that all matter contained in the above-description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Particularly, it is to be understood that in said claims, ingredients or compounds recited in a singular are intended to include compatible mixtures of such ingredients wherever the sense permits.

CLAIMS

What is claimed is:

1. A system for providing multi-colored epoxy coatings, comprising:

a plurality of containers containing differently colored pigments;

a hardener formulated to cure an uncured epoxy resin; and

a base coating composition comprising at least one uncured epoxy resin, light colored or white particles, and at least one wetting agent which interacts with the light colored or white particles; and the colored pigments, hardener, and base coating composition are sufficiently compatible so that a plurality of different amounts and combinations of the differently colored pigments can be added to the base composition and the base composition together with the differently colored pigments can be cured by the hardener, to provide a plurality of differently colored epoxy coatings with a substantially uniform color.

2. The system of claim 1, wherein the colored pigments, hardener and base composition can provide epoxy coatings having at least colors based on the colors red, yellow and blue and combinations thereof.

3. The system of claim 2, wherein the system can provide gray epoxy coatings.

4. The system of claim 1, wherein the resin is selected from the group consisting of bisphenol A, bisphenol F and novalac epoxy resins and derivatives thereof.

5. The system of claim 1, wherein the uncured epoxy resin component comprises a diglycidyl ether of Bisphenol A.

6. The system of claim 1, wherein the base coating composition comprises about 30% to 90% epoxy resin.

7. The system of claim 4, wherein the epoxy coatings can have colors based on at least red, yellow and blue and the base coating composition comprises about 30% to 90% epoxy resin.

8. The system of claim 1, wherein the light colored or white particles are size 6 on a Hegman scale or smaller.

9. The system of claim 1, wherein the light colored or white particle component comprises TiO_2 pigment particles.

10. The system of claim 7, wherein the light colored or white particle component comprises TiO_2 pigment particles.

11. The system of claim 1, comprising 10-60% TiO_2 particles.

12. The system of claim 1, wherein the base coating composition comprises an additive selected from the group consisting of acrylated copolymer wetting agents, ethoxylated non-ionic acetylenicdiol and modified polymeric urea.

13. The system of claim 1, wherein the base coating composition comprises a polymeric acrylate based wetting agent.

14. The system of claim 8, wherein the base coating composition comprises a polymeric acrylate based wetting agent.

15. The system of claim 1, wherein the base coating composition comprises foam destroying polymers.

16. The system of claim 2, wherein the base coating composition comprises at least one polyacrylate solution.

17. The system of claim 1, wherein the base coating composition comprises reactive-type epoxy diluents.

18. The system of claim 9, wherein the base coating composition comprises filler particles.

19. The system of claim 18, wherein the filler particles are selected from the group consisting of silica, magnesium silicate, talc and glass beads.

20. The system of claim 18, wherein the filler particle component is selected from the group consisting of aluminum trihydrate, calcium carbonate, mica and aluminum silicate.

21. The system of claim 1, wherein the epoxy coating is a substantially 100% solids coating.

22. The system of claim 1, wherein one coat of the coating composition can be applied to form a coat at least 8 mils thick.

23. The system of claim 1, wherein the base coating composition comprises propylene carbonate.

24. The system of claim 1, wherein the base coating composition comprises butyrolcatone

25. An epoxy coating composition, comprising an uncured epoxy resin and a wetting agent, the composition formulated to be compatible with at least two different colored pigments in varied proportions so as to be capable of providing substantially uniform, homogeneous multi-colored epoxy coatings from a single base composition substantially without flooding or floating of the colored pigments by mixing in different amounts of the at least two colored pigments and curing the differently colored epoxy compositions.

26. The composition of claim 25, comprising light, white or neutral colored particles.

27. The composition of claim 25, wherein the epoxy is present as 30-90 percent of the composition.

28. The composition of claim 27, comprising about 10-60% light, white or neutral colored particles.

29. The composition of claim 25, comprising an additive selected from the group consisting of acrylated copolymer wetting agents, ethoxylated non-ionic acetylenicdiol and modified polymeric urea.

30 The composition of claim 25, comprising a polymeric acrylate based wetting agent.

31. The composition of claim 25, formulated as a high solids coating.

32. The composition of claim 25, wherein one coat of the composition can be applied to provide a coat at least 8 mils thick.

33. The composition of claim 25, comprising less than about 30% volatile components which evaporate within 48 hours of application.

34. The composition of claim 33, comprising less than about 10% volatile components.

35. A method of providing differently colored epoxy coating compositions, comprising:

providing a container of base composition comprising an uncured epoxy resin and a plurality of bins of pigment that are compatible with the coating composition; and

selectively mixing in pigments from the bins to at least three different containers of coating composition to provide at least three differently colored coating compositions.

36. The method of claim 34, wherein the at least three colors of the at least three differently colored coating compositions are based on red, yellow and blue.

37. A method of forming an epoxy coating composition, comprising mixing a wetting agent into an uncured epoxy resin and mixing light, white or neutral colored particles into the resin/wetting agent mix to provide an epoxy coating composition that is compatible with a plurality of different pigments to provide a plurality of differently colored epoxy coating compositions having substantially uniform color properties.

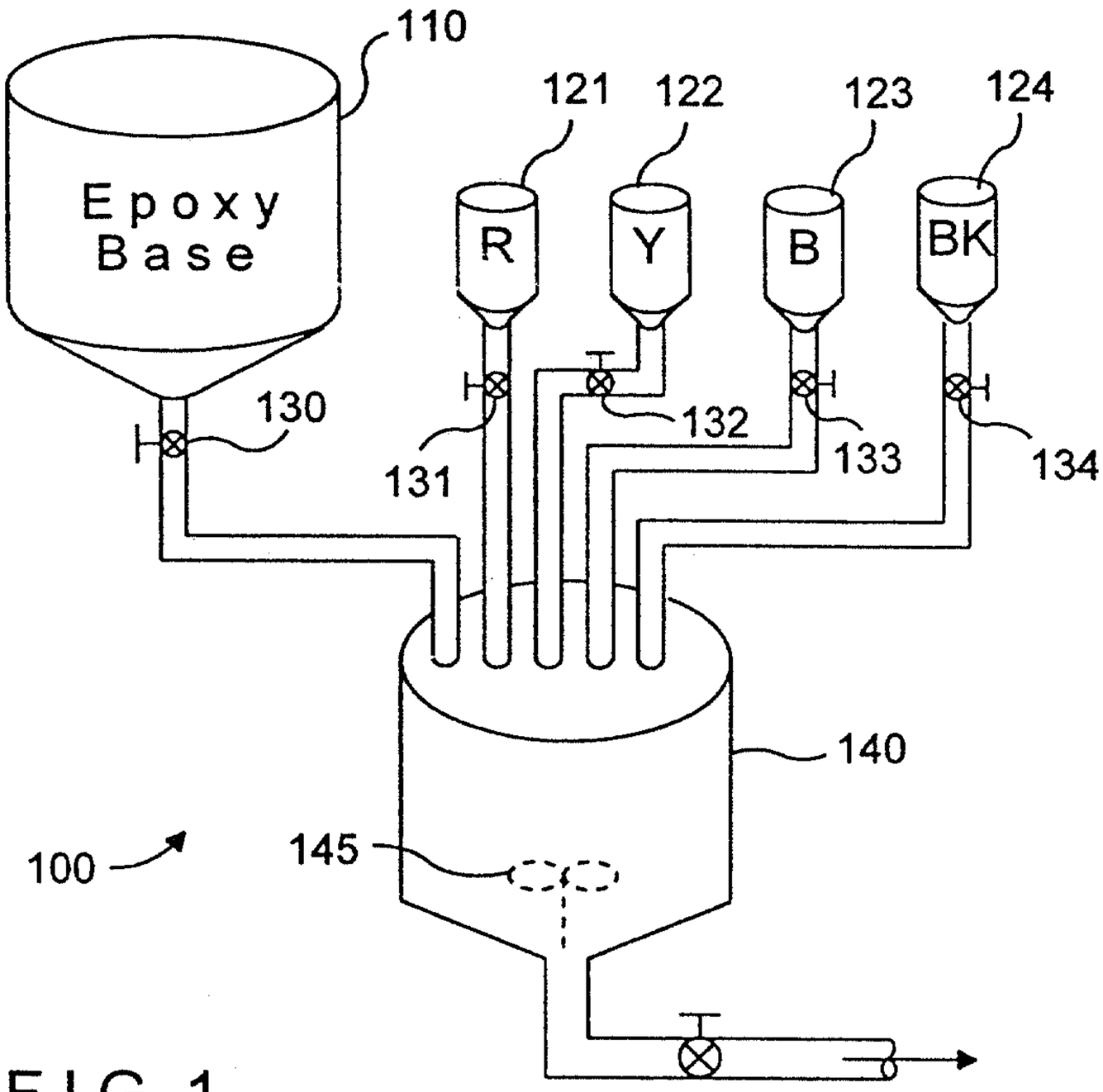


FIG. 1

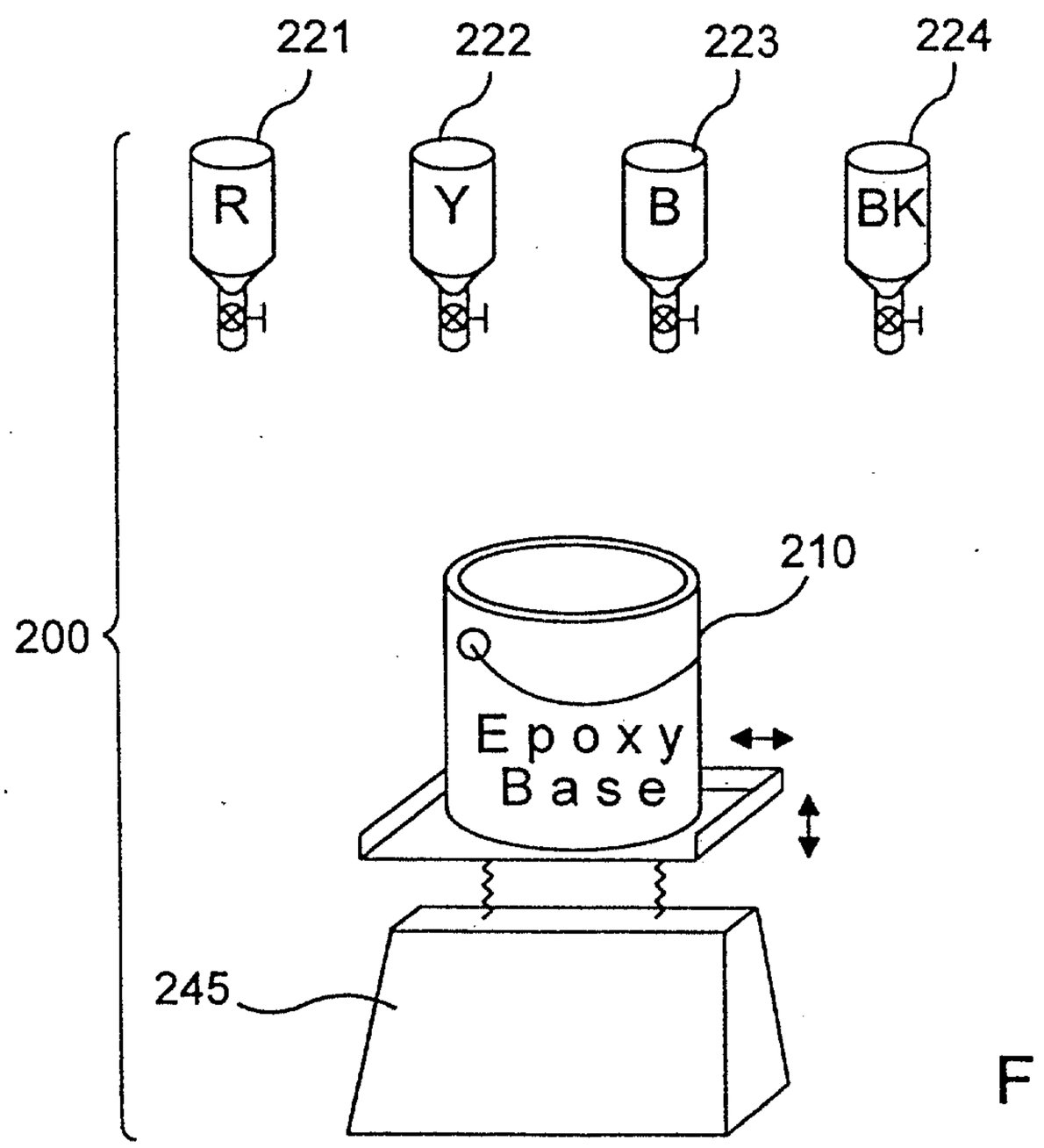
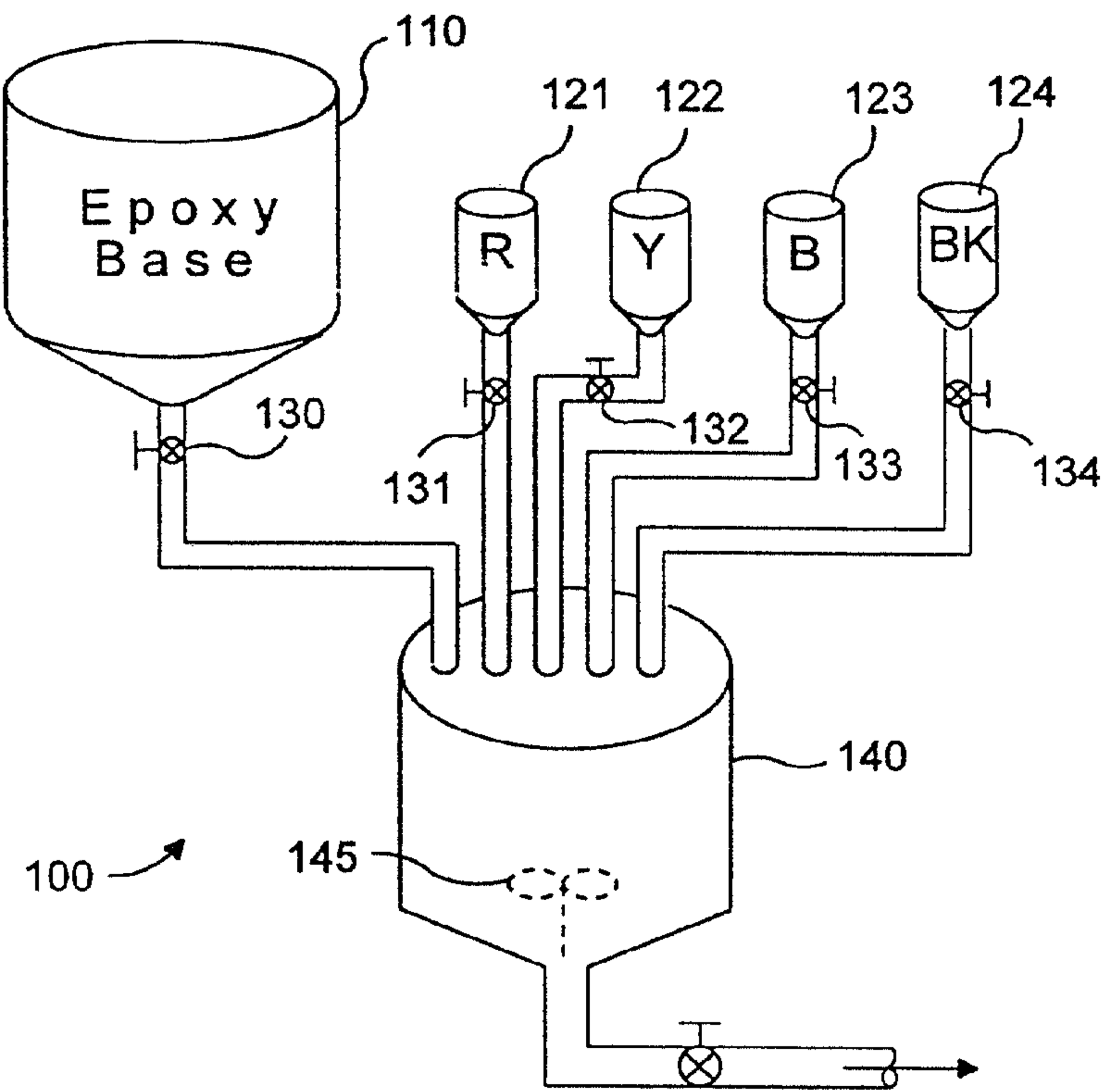


FIG. 2

Fetherstonhaugh & Englehurst

PATENT AGENTS


110
Epoxy
Base
121
122
123
124
R
Y
B
BK
130
131
132
133
134
140
145
100