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PHOSPHORESCENT COATED TEXTILE

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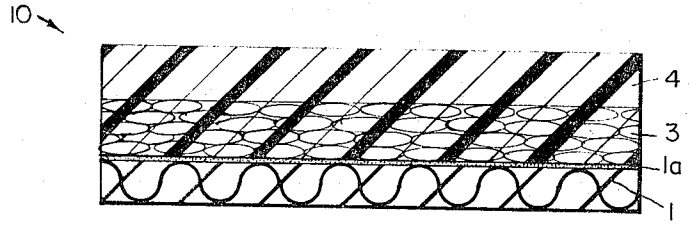


FIG. 1

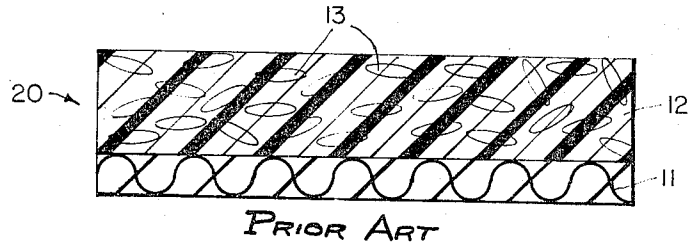


FIG. 2

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PHOSPHORESCENT COATED TEXTILE

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The present invention relates to phosphorescent coated textiles and fabrics and more particularly to a phosphorescent laminate which exhibits outstanding after-glow properties and pleasing appearance to the eye even after the laminate has been exposed to extreme conditions of use.

Phosphorescent coated textiles and fabrics are known, at least in part due to prior work by this inventor, as exemplified by U.S. Patent No. 2,473,877, No. 2,650,169, and No. 2,635,969. Such materials have met with outstanding commercial acceptance particularly in the foot covering art where phosphorescent coated textiles are used to clearly indicate and allow differentiation between left and right shoes of a pair in the dark. As described in the above noted patents, phosphorescent coated textile fabrics are commonly made by applying phosphorescent crystals or "phosphors" in a liquid vehicle such as a plasticized plastic, to a textile base by a liquid calendering coating method. These phosphorescent fabrics are often subjected to extreme conditions of use such as bending, scuffing and the like which often impairs the after-glow properties of the phosphors.

It is an important object of this invention to provide an improved phosphorescent coated textile material which has outstanding after-glow properties and retains such properties even after being exposed to scuffing, flexing and bending forces of large magnitude.

It is another object of this invention to provide an efficient and inexpensive method for producing a phosphorescent coated textile in accordance with the preceding object.

It is another object of this invention to provide a method in accordance with the preceding object which is free from complexity and relatively inexpensive in view of the substantially increased life span of the manufactured product.

It is another object of this invention to provide a method in accordance with the preceding objects which may be carried out in conventional equipment with a minimum of specialized processing.

In accordance with this invention, a laminate is provided having a textile or fabric base layer, an overlying layer of phosphorescent material and a clear, transparent heat and pressure bonded plastic outer layer. Surprisingly, the use of elevated temperatures and pressures in the bonding procedure increases the number of lattices formed by the phosphor crystals and appears to increase the intensity of after-glow. In the preferred embodiment of the invention, a uniform laminating pressure is applied simultaneously over the entire top and bottom of the laminate. It has been found that temperatures in the range of from 250° to 400° F. and pressures of from 300 to 500 lbs. per square inch are preferred for use in this invention.

Other objects, features and advantages of this invention will become readily apparent from the following detailed description and drawing which is not limiting, but only illustrative of the preferred embodiments of the invention.

FIG. 1 is a schematic end view of a phosphorescent laminate of this invention; and

FIG. 2 is a schematic end view of a prior art phosphorescent coated textile.

With reference now to FIG. 1 the laminate is designated generally at **10** having a base textile or fabric material layer **1**. Preferably the base layer is a woven, pliable, thin cotton fabric. Other textiles such as linens, wools, flannels and organdies and in some cases synthetic textile materials such as Orlon, Dacron and nylon may be used for the base layer. The fabric increases dimensional stability of the completed laminate **10** and acts as a yieldable base which can be sewn into shoes and the like to act as a phosphorescent marker.

Preferably a paint or lacquer **1***a* is sprayed or brushed over the base layer **1** to provide a pure white reflecting surface thereby making a uniform background and giving high light reflecting properties to the fabric base **1**. The paint or lacquer also seals or waterproofs pores of the fabric so that moisture is prevented from entering the base layer and passing through to the phosphorescent layer of the laminate. White pigments such as lithopone, titanium dioxide or other suitable pigments may be used in the paint composition. Preferably the vehicle of the paint composition is compatible with other plastics used in the laminate as will be further described. In some cases, when a white textile base is employed the coating **1***a* can be eliminated.

The coating **1***a* may be applied to the base layer **1** by conventional methods such as spraying, dipping, etc. A coating suitable for layer **1***a* may be made of vinyl chloride-acetate resin dissolved in a suitable liquid, such as methyl-ethyl ketone in a concentration between 20% and 30%. Suitable amounts of plasticizer, white reflecting pigments, such as titanium dioxide, filler, stabilizers with a small amount of stearic acid to deter settling and serve as a lubricant are incorporated in the resin. A specific base coat formula on the basis of approximately 100 lbs. may comprise the following:

60–70 lbs. vinyl chloride-acetate resins of a concentration of 20 to 30% in methyl-ethyl ketone,
4–6 lbs. aryl alkyl-phosphate,
4–6 lbs. plasticizer, such as di-2-ethyl hexyl phthalate,
13–17 lbs. white pigment which may be a combination of titanium dioxide and natural water ground calcium carbonate or other inert highly reflecting material non-soluble in the vehicle,
5–8 lbs. other materials such as suspensoids, wet dispersion stabilizers, thinners, etc.

The base coating using 100 lbs. as set forth above, will cover approximately 100 linear yards of 38 or 39 inch wide cotton material. After application the coating may be left to air dry or dried in a conventional drying oven.

The phosphorescent layer 3 is preferably provided by a calendering method wherein phosphorescent crystal pigments are suspended in a liquid resin and coated on the base. In an alternate procedure, finely divided phosphorescent crystal pigments may be uniformly positioned on the layer **1***a* in a dry state. Preferably 2½ to 6 ounces of phosphorescent pigments per square yard of base is utilized.

The phosphorescent crystal pigments employed in this invention may be activated metal solids such as zinc sulphide or sulphides of calcium, strontium, cadmium, barium or the like, to which colored pigments may be added. Other known phosphorescent crystals such as magnesium sulphide aniline dyes and other coloring pigments are also

suitable for use in this invention. Preferably the crystals are of small size such that they will pass through a 100–200 mesh screen.

In a preferred form, approximately 75% by weight of (A) a mixture of 15% calcium sulphide, 85% strontium sulphide, and copper activator in combination with 25% by weight of (B) a mixture of 92% zinc sulphide and 8% cadmium sulphide with copper activator are evenly spread over the base coating in amounts of 2½ to 6 ounces per square yard. This particular combination of phosphorescent materials is particularly desirable in combination with the overlayer laminating procedure of this invention to increase after-glow properties of the laminate visible to the naked eye. The two phosphors have different emission bands, thus the short wave emission band cascade excites the long wave emission band at a rate which is largely determined by the long band and is augmented by the short wave band which first reaches an equilibrium.

The phosphorescent pigments utilized in this invention may be activated by exposure to "black" light, "white" light, daylight or artificial light. Any of these sources provide long after-glow properties to the specific combination of phosphors noted above as well as to other known combinations and individual phosphorescent crystals.

In the calendering method a particularly useful phosphorescent coating on the basis of approximately 100 pounds may comprise: 65–75 pounds of 22 to 30% vinyl chloride-acetate resin solutions.

	Pounds
Plasticizer	6–7
Titanium dioxide	2–2.5
Aluminum stearate	3.5–2.5
Phosphorescent pigment	18.8–19.3

The above formula may be varied over at least a 10% range, but for best results the phosphorescent pigment used should be sufficient to provide a uniformly covered surface without voids of crystals. The aluminum stearate serves to prevent the settling of heavier phosphorescent pigments in the coating, so that the phosphorescent pigment will remain uniformly dispersed throughout the coating as the coating dries. If the phosphorescent pigment settles to the bottom of the coating, it would have to shine through the entire thickness of the coating.

The particular resin employed for carrying the phosphorescent pigment may comprise any of the resins above noted for use in the coating **1***a*, or as will be noted, for use in the clear overlayer **4**.

The third main component of the laminate **10** comprises a clear transparent plastic film **4** firmly bonded by heat and pressure to an upper surface of the phosphorescent material used. Preferably the film overlayer **4** is compatible with other plastic materials which may be used in the laminate. Polyvinyl chloride film and sheeting materials having approximately 20–30% plasticizer content are preferred for usage in this invention. However, other clear transparent plastic sheets and films may also be used, such as vinyl acetate resin, cellulose, nitrate, cellulose acetates, vinyl chloride acetate, ethyl-methacrylate, melamine resins, urea-formaldehyde, styrene and styrene copolymers, nylon polymers or any of the other numerous thermoplastic or thermosetting resins to which such phosphorescent materials may be added without chemical change.

Preferably the overlayer has a thickness of 0.02 to 0.0002 inch while the completed laminate has a thickness of less than 0.04 inch. These values are particularly desirable for a laminate used in the shoe manufacturing art as previously described.

It is a critical feature of this invention that the clear transparent overlayer **4** be bonded in the laminate by the use of elevated temperature in the range of from 250–400° F., and uniformly applied pressure in the range of 300 to 500 lbs. per sq. inch. The particular time of lamination may vary considerably, but a laminating time of from 8 to 25 minutes is preferred.

Preferably the laminating procedure is carried out in conventional laminating presses such as a Watson-Stillman laminating press. In a preferred form of the invention the completed laminate is quenched after application of heat and pressure for a period of at least 8 and preferably 15 minutes. The quenching step may be carried out in conventional water tanks whereby the laminate is quickly cooled to room temperature.

In a specific example of this invention, a fine print cotton bleached cloth was coated with a base coating comprising 15 pounds of titanium dioxide suspended in a base coat formula as above described. A phosphorescent coating of the combination of (A) and (B) in amount of 19 pounds to 70 pounds of a 30% solution of vinyl chloride-acetate in methyl-ethyl ketone was calendered on to the base coating. In a subsequent step a polyvinyl chloride film having a thickness of 0.0016 inch was laminated to the phosphorescent coated textile in a Watson-Stillman press employing a temperature of 350° F. at a pressure of 400 p.s.i. for 15 minutes.

The completed laminate had an overall thickness of approximately 0.003 inch and had long after-glow properties. The after-glow properties of the laminate as well as its general aesthetic appearance remained unchanged after repeated bending and mild scuffing.

In the preferred form of the invention as illustrated in FIG. 1, it is believed that the phosphorescent crystals are affected by the laminating procedure causing the crystals to line up in such a manner that the crystals are protectively imbedded and become an integral part of the overlayer **4**. Therefore a larger surface area of each crystal is provided for than would be the case in prior art calendering methods as exemplified in FIG. 2. It is believed that in phosphorescent textiles such as **20**, having a base **11** with the phosphorescent crystals **13** imbedded in a resin **12**, crystal lattices are formed having smaller areas of traps and random dispersion of the crystals. Thus the laminate **20** in the prior art is believed to be structurally different than the laminate **10** of this invention. This difference is believed to account for the difference in after-glow properties and flexing properties of the present invention. Thus, it is believed that the present laminating procedure releases additional traps and adds to the great density of the traps accounting in part for increased intensity and length of after-glow.

It is evident that those skilled in the art may now make further modifications of and departures from the specific embodiments described herein without departing from the inventive concepts. Consequently, the breadth of this invention is to be construed as limited only by the spirit and scope of the appended claims.

What is claimed is:

1. A method of preparing a phosphorescent laminate having good afterglow properties and high resistance to bending stress for use as a visible night marker in footwear and having a thermoplastic overlayer with a thickness in the range of 0.02 to 0.0002 inch and wherein said laminate has an overall thickness of less than about 0.04 inch, said method comprising,

applying a coating of phosphorescent crystals in a transparent thermoplastic resin carrier over a textile base,

applying a thin, clear, transparent thermoplastic sheet over said coating of phosphorescent crystals,

laminating said sheet to said coating and base by heating to a temperature in the range of 250 to 400° F. and applying a pressure between 300–500 p.s.i. for a period of at least 8 minutes to align said crystals so as to obtain increased afterglow effects.

2. A method in accordance with claim **1** wherein said crystals are of a size which will pass through a screen of 100 to 200 mesh and are distributed on said base in amounts of 2½ to 6 ounces per sq. yard.

3. A method of claim 1 and further comprising first coating said textile base with a white pigmented paint.

4. The method of claim 1 wherein said phosphorescent crystals comprise approximately 75% by weight of (A) 15% calcium sulphide, 85% strontium sulphide and 25% by weight of (B) 92% zinc sulphide and 8% cadmium sulphide.

5. A phosphorescent laminate prepared by the method of claim 1.

References Cited by the Examiner

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