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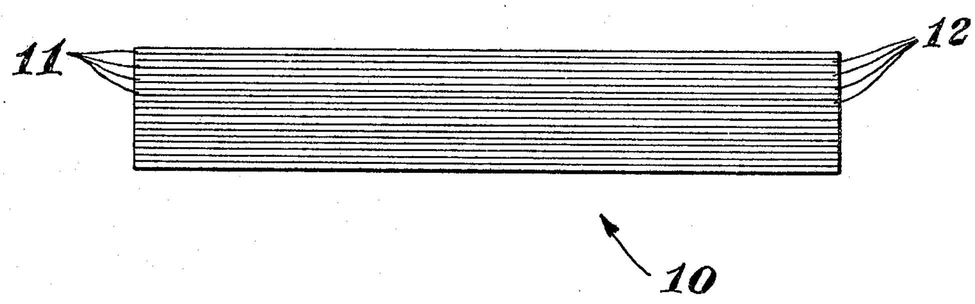

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METHOD OF MAKING CHRISTMAS TINSEL

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ABSTRACT OF THE DISCLOSURE

Christmas tinsel is prepared by slitting an iridescent pigment free plastic film having very thin layers.

The present invention relates to non-tarnishing iridescent decorative materials and particularly to multilayer iridescent films in ribbon form suitable for use as tinsel in decorating Christmas trees and in similar applications.

The Christmas tinsel of the "icicle" type heretofore in use comprises the familiar strips of lead alloy foil which have been sold for this purpose for many years. The high volume of the market for this material long invited the development of a competitive alternative possessing its advantages and eliminating its disadvantages. Another type of Christmas tinsel enjoying a relatively high market volume was the so-called "garland" type; that is, relatively short and stiff staples of a copper alloy foil locked into a twisted central strand of flexible twisted cordage to provide a deep pile surrounding the central cord.

A particular incentive has been the obviously desirable goal of providing a substitute for lead foil so that the present dangerous possibility of lead poisoning is avoided. Another objective has been to provide a tinsel which has a better resistance to the darkening and dulling characteristics of lead foil which has heretofore made such foil unattractive for re-use after its first season of use. The particular advantage of the copper foil tinsels was that they possess a stiffness which makes them satisfactory for "garland" type tinsels although almost wholly unsatisfactory for the "icicle" type for which lead foils were adapted. Also, copper foil tinsels possess a silvery brightness greatly in excess of lead foil tinsels, but this advantage is relatively short-lived, for the copper foils quickly tarnish upon exposure to atmosphere.

Supported foils and films of aluminum and other bright and relatively specular metals having a melting point higher than the ignition temperature in air of powders of such metals have been considered for use as Christmas tinsel and have been tried, at least on an experimental basis but have been found wanting, particularly from the standpoint of fire safety. Even combinations of aluminum foil with films of materials such as cellulose acetate, which are considered to be relatively non-inflammable, may ignite from low-temperature ignition sources such as a match flame or even radiant heat from a fire place. If ignited, the aluminum foils of which the tinsel comprises or consists do not merely sustain combustion, a serious fire hazzard when the tinsel is put on Christmas trees, but often the tinsel metals other than lead will advance combustion at a rate approaching explosive violence.

In view of these considerations, various metal-pigmented and fire-proof organic films, coatings on paper, and the like have been tried in an attempt to provide a safe dead-hanging, i.e., soft-draping, strip of specular, metallic appearance at a cost which is low enough to permit marketing in competition with lead foil strips. But, such films and coatings heretofore proposed have been found lacking in the drape and/or non-tarnishing characteristics desirable in Christmas tinsel, and thus do

not have a wholly satisfactory appearance. Nonmetallic inorganic filaments, e.g., spun glass fibers, have also enjoyed some commercial success, but, to have any drape at all, they must be extremely fine and cannot cause annoying skin irritation when handled.

The improved tinsels of the present invention not only have desirable iridescence and drape but also they overcome the difficulties set forth above; that is, no health or fire hazards will be encountered in connection with their use.

Other objects and advantages of this invention will be apparent from the following specification and claims.

In accordance with the present invention, the new and improved tinsel is a narrow iridescent ribbon prepared from thermoplastic film preferably of the so-called "self-extinguishing" variety with respect to combustion or its ability to burn; i.e., a film which will not burn with self sustaining combustion, such film being characterized by having a plurality of resinous materials therein, wherein contiguous adjacent layers are of diverse resinous material and at least 20% of the layers have a thickness of from about .05 to 1.0 micron for maximum iridescent effects, and wherein the said 20% of the layers are disposed entirely within the body of the ribbon.

In the figure and is shown a fractional end view of a film **10** suitable for the practice of the present invention. The film **10** is an iridescent film and comprises a plurality of layers **11** of a transparent synthetic resin thermoplastic material which lies between the end and adhered to a plurality of layers **12** of a transparent synthetic resin material. The refractive index of the thermoplastic material of layers **11** and **12** differ by at least about 0.03.

Films of the type employed are prepared by the methods and apparatus described in the copending application of Walter J. Schrenk et al., Ser. No. 445,851, filed Mar. 29, 1965, now abandoned, which is a continuation in part of the copending application Ser. No. 431,336, filed Feb. 5, 1965 and now abandoned.

To further clarify the requirements for a tinsel showing required iridescence, it must be prepared from a film having at least two pairs of adjacent discontinuities in refractive index, each member of the pair being separated by a distance of from about 0.05 to about 5 microns, and preferably 0.05 to 1 micron for maximum iridescent effect. That is, the iridescent film shall have within the body of the film two layers having a thickness of about 0.05 micron to about 5 microns, and preferably 0.05 to 1 micron for maximum iridescent effect, and differing from the adjacent portions of the body in refractive index by at least 0.03. Thus, the layers within the film which are responsible for the iridescence are restricted in thickness between the foregoing limits and may be bonded to each other by other layers in the body which are transparent and may be thicker, thinner, or equal to the thickness of the layers, giving rise to iridescence. Maximum iridescence is achieved generally when two or more materials are interlayered which have a maximum difference in refractive index and all of the layers lie within the range of 0.05 micron to 5 microns, and preferably 0.05 to 1 micron. Multilayer film having all layers less than about 0.05 micron or having no layers within the range of about 0.05 micron to about 5 microns and preferably 0.5 to 1 micron do not exhibit the desirable iridescent characteristics. Composite film structures having a thickness of from about 0.25 mil to 10 mils, and generally above 1 mil, are preferred.

The visual intensity of such iridescence for a film of a given thickness, for example, a 1 mil film, is increased as the number of thin layers are increased. That is, the greater the number of interfaces between the diverse polymers, the greater the effect of the iridescence. A difference in refractive index between the diverse resins is highly desirable; however, an iridescent effect is obtained when differences of refractive index as low as 0.03 are utilized. Preferably, the refractive indices should differ by at least about 0.03. The greater the difference in value between the refractive indices of adjacent layers, the greater the iridescent character becomes. Depending upon the particular apparatus employed and the geometry of the resultant multilayer film, the iridescence may be substantially uniform over the entire width of the film, or it may be varied from zone to zone in the product. If the geometry of the film is such that the layers are substantially parallel, equal in number and in thickness in all areas of the film, the iridescent effect will be substantially constant and vary primarily with the minor mechanical deviations from perfect geometry of the equipment employed and the uniformity of temperature of the extruded resinous material. Many attractive and interesting optical effects are achieved by employing non-uniform geometry in the film. This may be introduced in a number of ways, for example, by varying the relative feed rates of the extruders so that the thickness of the layers changes as one extruder feeds a greater or lesser amount, transverse bonds are generated wherein the iridescent character of the film is substantially constant in the transverse direction of the extruded ribbon, but varies in the machine or longitudinal direction.

Employing the modifications of the apparatus shown and described in the referred to copending application Ser. No. 445,851, one can readily extrude an iridescent film on an opaque or dissimilar substrate. For example, if desired, an iridescent film may be laminated to a colored polymeric substrate. Thus, black, white, or colored substrates are often desirable. Further, it may be desired to coat one side of the iridescent film with a pressure sensitive adhesive which permits ready application to a wide variety of surfaces. Any pressure sensitive adhesive which does not chemically attack and destroy the structure is satisfactory. The choice of such adhesives is primarily dependent upon the chemical properties of the iridescent film being used. Due to the laminar configuration of the film, pressure sensitive adhesives which do not attack one component of the iridescent film are found satisfactory. If one layer of the film is attacked by the adhesive and the adjacent layer is not, excellent bonding is achieved and the insensitive layers serve to protect the adjacent layer of sensitive material from the pressure sensitive adhesive. Thus, under relatively unfavorable conditions, only one layer of the iridescent structure is destroyed or distorted. Generally, however, many pressure sensitive adhesives are available which may be applied from an aqueous dispersion and do not effect any of the layers of the iridescent material. Many adhesives or pressure sensitive compositions are known, some of which are described in the following United States patents: 2,358,-761; 2,395,419; 2,744,041; 2,750,316; 2,783,166; 2,156,-380; 2,177,627; 2,319,959 and 2,553,816.

The herein described film structures are then cut or slit into narrow strands of the desired width by conventional slitting methods. Advantageously, the film is slit into strands having widths between one-thirty-second and one-eighth of an inch. The narrow strands or monofilaments are then cut to tinsel lengths, laid parallel to each other before and/or after cutting. Such tinsel lengths (hereinafter referred to as "staples" to denote their relatively minor width and still lesser thickness with respect to the much greater though substantially equal lengths in any given package) may vary from as much as approximately one to four feet in length for tinsel of the icicle type to approximately one-half inch for staples used in a garland type of tinsel.

For the icicle type of tinsel, the relatively longer staples are packaged in bundles in which individual staples, having a ratio of length to width not exceeding approximately 1500 to 1, are packaged in substantially co-extensive parallelism with staples of substantially equal length.

Beneficially, attractive iridescent ribbons or tinsel prepared from a wide variety of synthetic resinous thermoplastic materials include the materials hereinafter tabulated with their refractive index in Table 1.

TABLE 1

Polymer name	Refractive index
Polytetrafluoroethylene	1.35
FEP (fluorinated ethylene propylene copolymer)	1.34
Polyvinylidenefluoride	1.42
Polychlorotrifluoroethylene	1.42
Polybutyl acrylate	1.46
Polyvinyl acetate	1.47
Ethyl cellulose	1.47
Polyformaldehyde	1.48
Polyisobutyl methacrylate	1.48
Polybutyl methacrylate	1.48
Polymethyl acrylate	1.48
Polypropyl methacrylate	1.48
Polyethyl methacrylate	1.48
Polymethyl methacrylate	1.49
Cellulose acetate	1.49
Cellulose propionate	1.49
Cellulose acetate-butyrate	1.49
Cellulose nitrate	1.49
Polyvinyl butyral	1.49
Polypropylene	1.49
Low density polyethylene (branched)	1.51
Polyisobutylene	1.51
Natural rubber	1.52
Perbunan	1.52
Polybutadiene	152
Nylon (condensation copolymer of hexamethylenediamine and adipic acid)	1.53
Polyvinyl chloroacetate	1.54
Polyvinylchloride	1.54
Polyethylene (high density linear)	1.54
A copolymer of 67 parts by weight methyl methacrylate and 33 parts by weight styrene	1.54
A copolymer of 85 parts by weight vinyl chloride and 15 parts by weight vinylidene chloride	1.55
Poly-a-methylstyrene	1.56
A copolymer of 60 parts by weight styrene and 40 parts by weight butadiene	1.56
Neoprene	1.56
A copolymer of 70 parts by weight styrene and 30 parts of weight acrylonitrile	1.57
Polycarbonate resin	1.59
Polystyrene	1.60
A copolymer of 85 parts by weight vinylidene chloride and 15 parts by weight vinyl chloride	1.61
Polydichlorostyrene	1.62

By selecting combinations which have a difference in refractive index of at least 0.03, an iridescent film results. However, for maxium iridescence, beneficially, the difference is about 0.1 or greater. When multilayer films are prepared using 3 or more components, iridescence is obtained when at least some of the adjacent layers exhibit the desired difference in refractive index. Further, it is generally desirable to select combinations of thermoplastic resins which have desirable flame-resistant or self-extinguishing properties. Such combinations may be easily prepared for example by utilization of halogen containing materials and/or other resins which are resistant to burning. A particularly desirable composite structure is composed of a plurality of alternating layers of a normally crystalline copolymer of vinylidene chloride, such as the copolymer of vinylidene chloride and vinyl chloride described above, and a polymeric material such as polymethyl methacrylate, which structure is further illustrated in the following Example I.

It is to be understood that various additives, including flame-retarding agents, may also be beneficially utilized. In addition, pigments, stabilizers, dyes, lubricants, and other additives may be present in the polymeric materials comprising the tinsel of this invention. However, if maximum iridescence is desired, such additives should be maintained at a level which does not interfere significantly with the transparency of the product.

EXAMPLE I

Employing an apparatus generally as illustrated in FIGURES 2–5 of the heretofore referred to pending application Ser. No. 445,851, filed Mar. 29, 1965, a two-component oriented film is prepared having about 250 layers and a final thickness of about .7 mil. The transparent thermoplastic resinous polymers are 57 parts of a normally crystalline copolymer of **85** weight percent vinylidene chloride and 15 weight percent vinyl chloride and 43 parts of polymethyl methacrylate. The thickness of the polymethyl methacrylate film is about .075 micron. The resultant film, when slit into strands having a width of about $\frac{1}{32}$ of an inch shown highly desirable iridescence and drape, and in addition will not burn with self-sustaining combustion.

Tinsels made according to this invention possess the soft-draping of lead foil tinsels while eliminating the ever-present danger of possible lead poisoning due to ingestion of lead by infants or young children. At the same time, they resist tarnishing and are relatively non-matting even when badly snarled and when made with films, such as polyvinylidene polymers and copolymers, known to have self-cohering surface characteristics. To aid in the draping characteristics, the films may be plasticized with suitable combustion-resistant, non-volatile plasticizers which film manufacturers frequently incorporate to soften the films for various uses, provided such materials are used only in an amount which does not interfere with the transparency or iridescence of the product.

What is claimed is:

1. The method of making iridescent Christmas tinsel comprising the steps of

(a) providing a thermoplastic resinous film having a thickness of from about .25 mil to 10 mils and having at least about 10 layers of transparent resinous material therein, wherein contiguous adjacent layers are of transparent resinous material having a refractive index difference of at least about 0.03 and at least 20 percent of the layers have a thickness of from about 0.05 micron to about 5 microns and the resinous materials are transparent to visible light,

(b) slitting said film to narrow strands, and

(c) successively cutting said strands into substantially equal staple lengths.

2. The method of claim **1** wherein said strands range in width between about one-thirty-second and one-eighth inch.

3. The method of claim **2** wherein said strands are cut to staple lengths ranging between about one-half to four feet in length.

4. The method of claim **3** wherein alternate layers are of (a) a normally crystalline copolymer of vinylidene chloride and (b) polymethyl methacrylate.

5. The method of claim **4** wherein said normally crystalline copolymer is a copolymer of about 85 weight percent vinylidene chloride and about 15 weight percent vinyl chloride.

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