April 20, 1948. E. H. LAND 2,440,102

PROCESS OF MANUFACTURE OF LIGHT POLARIZING TWO TONE IMAGE ON A SHEET

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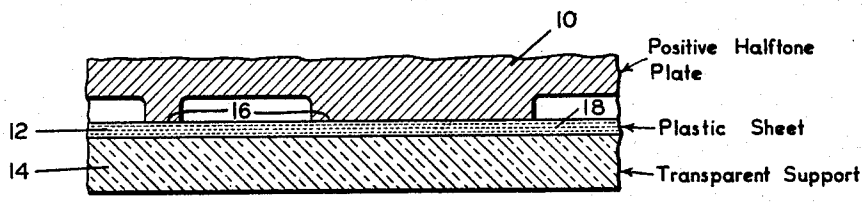

FIG. 1

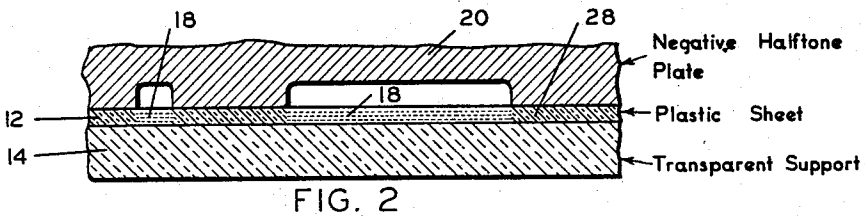

FIG. 2

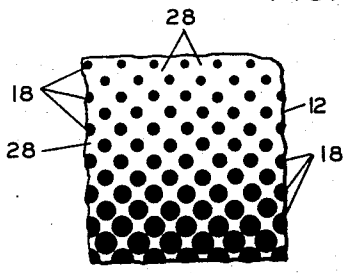

FIG. 3

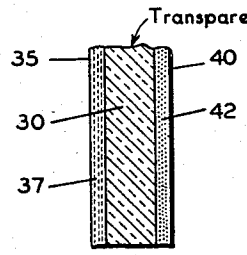

FIG. 4

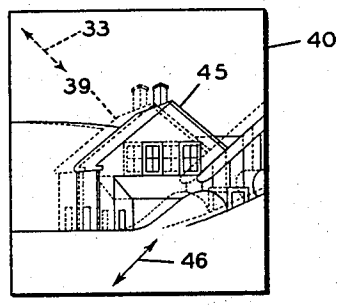

FIG. 5

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PROCESS OF MANUFACTURE OF LIGHT POLARIZING TWO TONE IMAGE ON A SHEET

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Application May 31, 1944, Serial No. 538,177

4 Claims. (Cl. 88—65)

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This invention relates to a process for forming, in material from the class consisting of the light-transmitting plastics having oriented, chain like molecules, a design most clearly visible in polarized light, and to the product of said process.

This application is a continuation-in-part of my copending application Serial No. 276,233 filed May 27, 1939, now Patent 2,373,035, April 3, 1945, for Light-polarizing image and process of manufacture.

A two tone image, parts of which are light-polarizing, may be formed in plastic material having oriented chain molecules. Also, an image having dot shaped light-polarizing areas which are joined by non-polarizing areas may be provided in a sheet of similar material, the polarizing and non-polarizing areas in the sheet forming in combination a halftone image.

As used herein, the term "two tone" image or design is intended to have the meaning commonly understood by the art, namely, an image, the various portions of which have only two tones as distinguished from a continuous tone image, as for example, an image having an uninterrupted tone range from white to black. Likewise, the term, "halftone" is intended to have the meaning commonly understood by the art, namely, a special type of two tone image consisting of regularly spaced dot shaped areas which appear in one tone and which are joined by other areas appearing in a second tone, the combined areas giving a visual sensation of a continuous tone range by reason of variation in the size of the dot shaped areas.

Hence, a primary object of the invention is to provide processes for the formation in a sheet or film of a light-transmitting plastic material having long chain, substantially oriented molecules of an image rendered in two tones and having parts which polarize light incident thereon, the optional density of the imagine being a function of the vibration direction of the incident light.

An equally important object is the provision of processes for forming halftone images in a transparent plastic sheet having substantially oriented, long chain molecules and wherein predetermined portions of the halftone image are light polarizing, while other portions are substantially non-polarizing.

A further object of the invention is to provide processes of the character described wherein the plastic material employed is from the class consisting of polyvinyl alcohol, regenerated cellulose

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or polyvinyl acetal, and wherein the sheet is prepared for the formation of the image therein by substantially orienting the molecules of the sheet.

Other objects of the invention are to provide processes wherein an oriented plastic sheet, such as heretofore described, is dyed wth a dichroic material, and parts of the sheet adapted to form non-polarizing image portions have their dichroism chemically destroyed while parts of the sheet adapted to form polarizing image portions are retained dichroic, a two tone or a halftone printing plate being used in carrying out these processes; wherein a two tone or a half tone printing plate is utilized to apply a dichroic material to paid plastic sheet to form the light-polarizing image portions of the sheet, or wherein the non-polarizing image portions of the sheet are blocked out with a resist provided on the sheet by printing with a two tone or a halftone plate, after which the image forming portions are rendered light-polarizing by the application of dichroic material thereto; as well as processes utilizing the foregoing practices to provde each of a stereoscopic pair of two tone or halftone images on separate sheets of a plastic of the character described which are positioned to have their molecules oriented at 90° to each other, and the superposition of the sheets on each other to provide a stereoscopic image.

Still further objects of the invention relate to the manufacture of an image carrying sheet or film comprising a transparent plastic sheet having long, substantially oriented chain molecules, to provide such a sheet or film with portions which have been stained or dyed with dichroic material to show a predetermined image, the optical density of which is a function of the direction of vibration of light incident thereon; to provide an image in such a sheet as a two tone or a halftone image; to provide stereoscopic images in two tones or in halftone; to provide a sheet of the character described which is formed of polyvinyl alcohol; and to provide such a sheet dyed with iodine or an iodine compound.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and relation of one or more of such steps with respect to each of the others and the article possessing the features, properties, and the relation of elements which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For the fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawing, in which:

Figure 1 represents diagrammatically and in section a positive halftone plate in printing position on a sheet of plastic material mounted upon a transparent support, the section being greatly enlarged and having parts thereof broken away;

Fig. 2 is a diagrammatic view similar to Fig. 1, showing a negative halftone plate in printing position upon a supported plastic sheet;

Fig. 3 shows a partial plan view, greatly enlarged, of the image reproduced in the plastic sheet of Figs. 1 and 2;

Fig. 4 is a diagrammatic section taken diagonally through a transparent support to which plastic sheets have been laminated; and,

Fig. 5 is a view showing a stereoscopic line drawing print prepared in accordance with the invention.

In carrying out the present invention, a desired image or design is reproduced in non-polarizing plastic material which is transparent by employing a dichroic stain or dye to render predetermined parts of the material of a light-polarizing character. These parts are of such nature that, in combination with adjoining non-polarizing parts of the material, they will form the desired image in two tones or as a halftone image, the dyed portions of which polarize unpolarized light incident thereon. This image, when viewed in polarized light, will display differing optical densities or differing degrees of contrast between the two tones given to it by its undyed areas and its dark or dyed areas in accordance with the vibration direction of the incident polarized light, that is to say, the differing optical densities of the design are a function of the vibration direction of polarized light traversing the image.

In the practice of the present invention, a sheet or a film of a light-transmitting, preferably transparent plastic, having chain molecules which have been substantially oriented, is preferably employed. Such a film may comprise any of a variety of plastic materials, such for example as regenerated cellulose, or vinyl compounds, such for example as incomplete polymerized polyvinyl acetal, or preferably polyvinyl alcohol. Orientation of the long molecules of the sheet or film may have been effected by subjecting the sheet to an extension or stretch while heated or otherwise softened. Polyvinyl alcohol, for example, may be suitably stretched or extended after it has been heated, while regenerated cellulose may be similarly suitably extended or stretched after it has been subjected to a swelling agent.

A preferred material for use in connection with the present invention as a sheet or film to be treated is accordingly a transparent plastic having long chain molecules which are oriented to substantial parallelism, and more specifically a sheet of polyvinyl alcohol so prepared.

It is to be understood that the degree of orientation of the molecules of the plastic sheet or film is subject to variation in the practice of the present invention. Where the product of the present invention is to be employed as one of a pair of stereoscopic images it is desirable that the orientation of the molecules within the plastic sheet be substantially complete. Where

the product of the present invention is to be otherwise employed, for example in advertising displays, as an image to be viewed in polarized light, such high degree of orientation is not essential. As the orientation of the molecules departs from substantial parallelism, the image formed in the sheet becomes more and more visible in polarized light vibrating substantially at right angles to the direction of vibration of light in which the image shows the most contrast.

In my copending application Serial No. 237,783, filed October 29, 1938, for Light-polarizer and process of manufacture, there are described methods of forming polarizing sheets or films of materials such as those described, as by dyeing or staining the said sheets or films. In the practice of the present invention, images, designs, indicia and the like which are visible in polarized light may be formed in the sheets or films by applying to them, over predetermined areas, suitable dyes or stains, so that predetermined areas of the sheets or films are rendered predeterminedly polarizing, the sizes and positions of the areas and the quantities of dye or stain applied thereto being predeterminedly controlled so that the areas form in polarized light a design which is an exact reproduction in two tones of the image, design, or indicium which it is intended to reproduce. This may be accomplished in various ways.

Preferred practices make use of destructive methods wherein an oriented plastic sheet is treated with a dichroic material to stain or dye the sheet by casting the dichroic material in the sheet or by imbibing it therein, and wherein the dichroic property imparted to the sheet by the dye or stain is chemically destroyed in predetermined portions of the sheet as, for example, by bleaching the dye in such portions, while retaining other predetermined portions of the sheet in their dyed condition, these portions together reproducing a desired image, parts of which are polarizing and parts of which are non-polarizing. Following this treatment, any excess of the material used for destroying dichroism in portions of the sheet is removed or rendered inactive by conventional practices. Image formation by destructive methods may be effected with the aid of photomechanical printing plates, for example, halftone, line drawing or lithograph plates, which may be employed to apply a resist over the portions of the sheet adapted to form the polarizing portions of the image in preparation for the application of a destructive agent or which may be employed to apply the agent itself.

The printing plate, on which a desired image or design is formed in a manner well known to the art, may be a positive plate or a negative plate, and after being inked with a suitable material is employed to print the image onto the plastic sheet. The printing may be carried out directly by applying the plate with pressure to the plastic sheet, or indirectly by first applying the plate to a printing blanket and transferring the ink on the blanket to the plastic sheet.

In the case of a positive plate, the print formed on the plastic sheet may cover those portions of the sheet which it is desired to retain as light-polarizing portions. For this purpose the positive plate is inked with a suitable resist material and is then applied to the plastic sheet. The result of such application is to reproduce on the plastic

sheet a positive image which is formed of the resist material in the form of a mask. A suitable agent capable of destroying the dichroic property of the dye, for example a bleaching agent, is then applied to the sheet, by any conventional practice, to render non-polarizing the portions of the plastic sheet adjacent those covered by the resist. When this has been completed, a two tone or halftone positive reproduction of the desired image is obtained.

Where the oriented plastic sheet is printed with a negative printing plate, the bleaching or other agent may be applied by means of the plate. In this case, the printing plate is inked with the agent which renders non-polarizing those portions of the sheet which it contacts.

A preferred dye or stain is one comprising iodine in combination with an iodide which forms with the iodine a polarizing polyiodide. Suitable iodides for use in the preparation of such a stain are, for example, sodium iodide and ammonium iodide. They are preferably employed with a relatively small amount of iodine. A suitable solution, for example, for staining polyvinyl alcohol, may be formed by preparing a solution of 20 grams of ammonium iodide in 100 c. c. of water, dissolving therein one gram of iodine, and adding thereto a solution of 50 grams of ammonium iodide in 500 c. c. of water. Other quantities of the iodide may be used. By altering the quantity of the iodide employed, predetermined changes in the extinction color of the image formed may be obtained. Stains produced from solutions of iodine and iodides are herein described as stains formed by polarizing polyiodides.

It is to be understood that many other dyes or stains may be used, for example, the dyes mentioned in my said copending application Serial No. 237,783. Speaking generally, most aniline dyes may be employed. Bromine also may be used in the process of the invention.

Suitable resist or masking materials include non-permeable "ink," such as printer's ink, preferably transparent. Also, wax, lacquer, or varnish may be employed, this being applied in a sufficiently thin layer so that it is substantially transparent. Removal of the resist is unnecessary unless an opaque or translucent material is utilized, in which event it may be dissolved in a solvent. For example, kerosene may be used to dissolve an opaque printer's ink which is employed as a resist.

Bleaching agents for the dyes heretofore disclosed include, to name a few, sodium hypochlorite, sodium hydroxide, ammonium hydroxide, or sodium thiosulphate.

As previously pointed out, a line drawing plate or a lithograph plate or a halftone plate may be used in carrying out the destructive methods. These plates have the image, which it is intended to reproduce, formed thereon by well known practices. In the destructive processes, all of these types of plates are used similarly. The principal difference in the plates lies in the character of the image produced. Thus, the halftone plate will provide a two tone printed image which gives the sensation of a continuous tone, for example, tones ranging from white to black. The line drawing and the lithographic plates will not produce the just noted sensation, but will give a two tone effect, for example, in black and white only.

The continuous tone sensation is made possible in halftone reproduction by forming the desired image in a series of dot shaped areas which are of varying sizes and are opaque or dark. These

dot shaped areas, which are predeterminedly and symmetrically arranged, are joined by clear or light areas, the dot shaped areas and the adjoining areas in combination reproducing the desired image. As it is well understood, the arrangement of the dot shaped areas on the halftone plate is effected by the use of a halftone screen when reproducing a transparency on the plate, these areas being transferred to a sheet by the printing operation.

A destructive process as carried out with a positive halftone plate is illustrated in Fig. 1 wherein a plate 10 is shown in printing position on an oriented plastic sheet 12 which has been dyed or stained and rendered polarizing substantially throughout its entirety as indicated by the horizontal dash lines 18. Sheet 10 is supported on a transparent base or support material such as the cellulose acetate sheet 14 to which it is secured by lamination. In Fig. 1, the printing surfaces of the plate 10 are shown as applying a resist material onto the sheet 12 over the areas of the sheet which are to form the polarizing portions of the image or design to be reproduced. This resist or mask is indicated by the dark lines 16 adjacent the printing surfaces of the plate.

For the sake of clarity in illustrating the invention, proportions in the drawings have been exaggerated and have not necessarily been made to scale. For example, polyvinyl alcohol sheet having a thickness of 0.0003 inch is frequently used as the sheet 12, while a halftone plate having the centers of its adjacent printing surfaces separated by 0.01 inch is often employed. Likewise, the thickness of the support 14 and plate 10 is not drawn to scale.

As already mentioned, after the printing of the resist, the dye in the portions not protected thereby may be bleached by treating the sheet 12 with one of the bleaching agents heretofore named.

Fig. 2 illustrates the destructive method when practiced with a halftone plate 20 which is the negative of the plate 10. A comparison of Figs. 1 and 2, which both illustrate a plate in printing position on an oriented and dyed plastic sheet 12, will show that the printing surfaces on plate 20 are the sunken or depressed surfaces on plate 10 and vice versa. Thus, the printing surfaces of the negative plate 20 will contact the surfaces of those portions of the sheet 12 which are to form the non-polarizing parts of the image. Obviously, this permits a bleaching or other destructive agent to be applied to the sheet 12 by inking or coating the printing surfaces of the negative plate 10 with the agent. In Fig. 2, portions 28 of the sheet, in contact with the printing surfaces of the plate 20 and the bleaching agent carried thereby, are shown as transparent to indicate that the dichroic property of the dye or stain has been substantially destroyed throughout those portions by bleaching, while the portions of the sheet which are unaffected and hence remain polarizing are indicated by the horizontal dashes 18.

The product of either of the destructive processes heretofore described is shown in Fig. 3 which is a greatly enlarged partial plan view of the plastic sheet 12 after the image has been formed thereon. As illustrated in Fig. 3, the dyed or polarizing areas 18 are represented by dots of varying size, the centers of which are symmetrically arranged, and the bleached and non-polarizing areas adjoining the dots are indicated by 28. In a positive halftone print, the shadow tones are formed by the large dots which, while

having their centers evenly spaced and symmetrically arranged, are so large that they form between them relatively small adjoining clear areas. On the other hand, the highlights of a positive halftone are provided by the symmetrically positioned small dots having large adjoining clear areas between them. Thus, the lower portion of Fig. 3 gives the effect of a shadow tone while the upper portions show a highlight.

While the methods heretofore described have been illustrated in connection with a positive print, it is to be understood that the invention comprehends the application of these methods as well as those to be hereinafter disclosed for the formation of both positive and negative halftone, line drawing or lithograph prints. Thus, for example, the use of a negative halftone plate to carry out the process described in regard to Fig. 1 and the use of a positive halftone plate to carry out the process described in regard to Fig. 2, will both produce a negative print which is the reverse of the print shown in Fig. 3 in that the dot shaped areas in such print will be the non-polarizing areas.

Instead of using the destructive methods for reproducing an image or a design in an oriented and dyed plastic sheet, the dichroic dye or stain may be introduced into the portions of the sheet which are to form the light polarizing parts of the image. Several methods may be employed for forming the polarizing portions by dyeing them directly, the halftone plates of Figs. 1 and 2 being admirably suited in carrying out these practices.

For example, if the positive halftone plate **10** of Fig. 1 is inked with one of the dyes or stains already mentioned, the desired image may be formed directly by printing on undyed but oriented plastic sheet which is supported on a suitable base, the image reproduced in the sheet having the appearance of the image shown in Fig. 3 which was formed by a destructive process.

As a further example, the negative halftone plate **20** of Fig. 2 may be used to form a desired image in undyed but oriented sheet. In this instance the plate **20** is inked or coated with one of the resist materials heretofore mentioned, since its printing surfaces will print over the portions of the plastic sheet which are to remain undyed so as to form the non-polarizing parts of the image or design being reproduced. The portions of the sheet adjacent those protected by the resist may then be dyed or stained by any conventional practice, for example by imbibition.

From the foregoing it will be apparent that the destructive methods and also the methods wherein a dye or stain is directly applied to an undyed plastic sheet may be practiced with line drawing plates and lithograph paltes as well as with halftone plates. In the use of lithograph plates, the bleaching agent in liquid form may be applied to the plastic sheet from the normally water wetted non-printing surfaces of the plate.

In explanation of the reproduction of a two tone image other than a halftone print, consideration may be given to a line drawing. A line drawing plate may be formed by practices well understood by the art. In the case of a positive line drawing plate, the printing surfaces thereof will be in the form of the lines of the drawing it is intended to reproduce and not in the dot pattern of the halftone. On the other hand, where the line drawing plate is a negative one, the printing surfaces will be the areas between the lines of the design or drawing to be formed.

Thus, it will be seen that a positive line drawing plate may, like a positive halftone plate, be employed to print a resist on an oriented and dyed plastic sheet to cover the portions thereof which are to remain polarizing and that the uncovered portions on the sheet may then have their dye bleached out or otherwise destroyed. Similarly, a positive line drawing plate may be employed to apply the dye or stain on the areas of an oriented but undyed plastic sheet so as to provide the polarizing parts of a desired image.

It will also be apparent that a negative line drawing plate may be used to apply the bleach in a destructive method of forming an image in an oriented and dyed plastic sheet, and likewise that such a plate may be used to print a resist material on an undyed but oriented plastic sheet so as to cover the portions thereof which are to remain non-polarizing in the image to be reproduced thereon.

Whether a positive or a negative line drawing plate is employed, positive images of a desired design will be alike when produced in the plastic sheet by the use of the foregoing methods and this will be true for negative images of a desired design. An illustration of plastic sheeting having a line drawing reproduced therein appears in Fig. 5 which together with Fig. 4 is intended to show a stereoscopic print and to illustrate practices by which the print is produced.

With special reference to Fig. 4, there is shown a transparent support **30**, to the respective faces of which oriented plastic sheets **35** and **40** are laminated. The plastic sheet **35** is intended to have one of a pair of stereoscopic images reproduced therein while the second of the pair of stereoscopic images is intended to be formed in sheet **40**. For this purpose it is necessary that the molecules in the sheets **35** and **40** be oriented at 90° to each other and for this reason the molecules **37** of sheet **35** have been shown as parallel dashes while the molecules **42** in the sheet **40** have been shown as dots.

Sheets **35** and **40** may be cut from a single piece of plastic, the molecules of which are oriented in the same direction. In such a case, the cut sheets are laminated on the support **30**, in such positions that their molecules are as indicated in Fig. 4. Instead of this practice, sheets **35** and **40** may be formed from two different pieces of plastic material, the molecules of each piece being oriented at 90° to each other.

In the making of a stereoscopic print, a left-eye and a right-eye image are respectively reproduced in the plastic sheets **35** and **40**. In the event that the sheets **35** and **40** have been dyed or stained, a destructive reproduction method is employed. On the other hand if the sheets **35** and **40** are undyed, one of the practices previously set forth for introducing a dye into the desired portions of the sheet may be used.

In reproducing an image in the structure shown in Fig. 4, first one of the sheets **35** and **40** has its image forming parts converted to light-polarizing portions and to non-polarizing portions by one of the previously described methods, after which this procedure is repeated for the second sheet. The result, as applied to a line drawing appears in Fig. 5 wherein the sheet **40** is shown as the uppermost sheet. When the stereoscopic print of Fig. 5 is viewed without the aid of a stereoscopic viewing device, two separate line images appear which are represented respectively by the full line image **45** on the sheet **40** superposed on the image **39** shown in dashes as being

in the lower sheet 35. The direction of the transmission axis or the direction of orientation of the molecules for the sheet 40 is shown by the arrow 46 while that for the sheet 35 is shown by the arrow 33. It may be noted that the images 39 and 45 are not congruent, being taken from different angles, and are positioned in a favorable relation for left-eye and right-eye images which can be fused into a stereoscopic image when viewed with a suitable viewer.

Although the formation of stereoscopic prints has been illustrated in connection with line drawings, it will be appreciated that such prints may be produced as halftones or lithographs by following the procedures just set forth as to stereoscopic prints of this character and using one of the methods for destroying the dichroism of the dye in predetermined portion of dyed plastic sheets or one of the processes described for staining predetermined portions of undyed plastic sherets.

From the standpoint of convenience in use, the sheets 35 and 40 have their axes of orientation running at 45° to the horizontal or vertical. However, other angles of orientation for the molecules of the sheets may be employed so long as the sheets are superposed in a relation wherein their orientation axes are crossed at 90°.

Other structures for a transparent stereoscopic print may be employed in place of that shown in Fig. 4. For example, it is possible to laminate the plastic sheets 35 and 40 to each other and mount them on a single support. Also it is possible to laminate the plastic sheets 35 and 40 to different supports and to laminate the supports together. These and similar modifications are included within the scope of the invention.

While the various modifications of the invention illustrated have been shown in connection with transparent prints, the invention contemplates the production of prints in which the support is an opaque reflecting surface, such as metallized paper or the like. In the case of stereoscopic prints, the plastic sheets containing the two images may be superposed one on the other and the prints mounted on such an opaque backing member. Similarly, a single print can be superposed on an opaque support instead of the transparent support shown in Figs. 1 and 2.

It is to be especially noted that the invention is not limited to the production of prints of the nature heretofore disclosed but may be employed to produce moving picture films of the character having stereoscopic images therein and also of the single image bearing type.

In all modifications of the invention it is generally desirable to cover a surface of the image formed in a plastic sheet with a protective coating such as a varnish or the like. This also has the advantage of filling in any uneven portions on the sheet caused by the resist material, and to present a substantially flat surface.

Under certain circumstances, and for example where polyvinyl alcohol is employed, the sheet or film in which the design is formed may be somewhat further polymerized after its molecules have been substantially oriented and before the image is formed therein. This may be accomplished by heating the sheet after it has been stretched and while maintaining it in stretched condition. A sheet so treated shows less water permeability and greater heat stability than an untreated sheet.

It is further to be understood that in the formation of the polarizing design the use of different stains or dyes, or different concentrations of the same stain or dye, may result in the production of polarizing images showing different extinction colors and varying degrees of contrast, even though the images be produced from the same plate relief. All such modifications of the process are to be deemed within the scope of the invention.

The terms "dye" and "stain" as used in the specification and claims are intended to include any material which when applied to or incorporated in an article causes a visible change in the color of the article or in the optical density of the article.

The term "image" in the specification and appended claims is intended to be generic and to include among other things a design, image, picture, indicium, mark, token, print, etc., whether as a positive or a negative.

Since certain changes in carrying out the above process may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. The method of forming a desired halftone image having predetermined polarizing portions and non-polarizing portions in a sheet of transparent plastic having substantially oriented, long chain molecules, comprising printing a surface of the sheet with a halftone plate on which the image has been reproduced and which is inked with a resist material to cover the portions of the sheet which are to provide the non-polarizing portions of the image, and then dyeing the image forming portions of the sheet adjacent those portions covered by the resist with a dichroic dye to provide image forming portions of similar tone.

2. The method of forming a desired halftone image having predetermined polarizing portions and non-polarizing portions in a sheet of polyvinyl alcohol having substantially oriented, long chain molecules, comprising printing a surface of the sheet with a halftone plate on which the image has been reproduced and which is inked with a resist material to cover the portions of the sheet which are to provide the non-polarizing portions of the image, and then dyeing the image forming portions of the sheet adjacent those portions covered by the resist with a dichroic dye to provide image forming portions of similar tone.

3. The method of forming a desired halftone image having predetermined polarizing portions and non-polarizing portions in a sheet of transparent plastic having substantially oriented, long chain molecules, comprising placing a resist on a surface of a sheet in the form of dot shaped areas of varying size which in combination with the areas left uncovered by the application of the resist reproduce the desired image on said surface of the sheet in halftone, and then dyeing the image forming portions of sheet adjacent those portions covered by the resist with a polyiodide to provide substantially dichroic image forming portions of similar tone.

4. The method of forming a desired halftone image having predetermined polarizing portions and non-polarizing portions in a sheet of polyvinyl alcohol having substantially oriented, long chain molecules, comprising placing a resist on a surface of a sheet in the form of dot shaped areas of varying size which in combination with the areas left uncovered by the application of the resist reproduce the desired image on said

surface of the sheet in halftone, and then dyeing the image forming portions of sheet adjacent those portions covered by the resist with a polyiodide to provide substantially dichroic image forming portions of similar tone.

EDWIN H. LAND.

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