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2,204,604

METHOD OF FORMING DESIGNS IN POLARIZING MATERIAL

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Fig 1

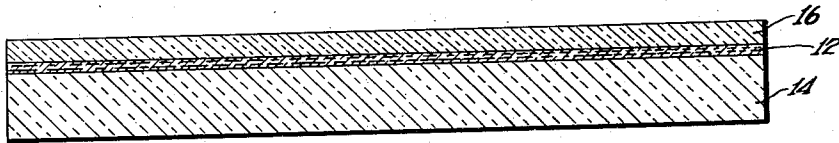


Fig 2

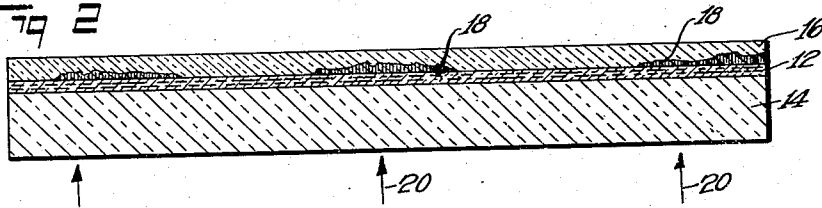


Fig 3

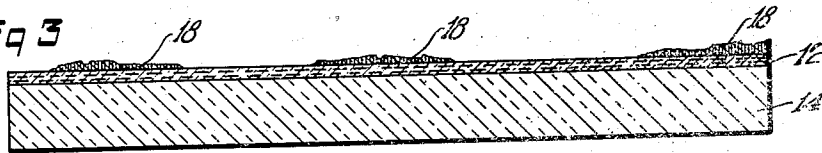


Fig 4

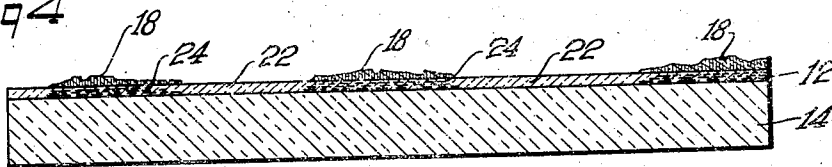
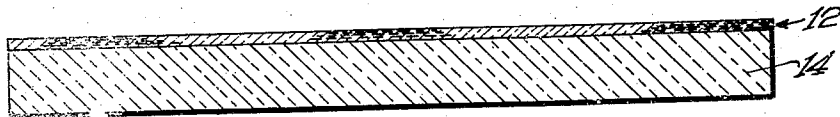


Fig 5



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UNITED STATES PATENT OFFICE

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METHOD OF FORMING DESIGNS IN POLARIZING MATERIAL

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16 Claims. (Cl. 95—5)

This invention relates to a new and improved process for making images in light-polarizing surfaces or films, the photographic contrast of the image being a function of the direction of vibration of polarized light traversing the surface or film.

An object of the invention is to provide a process for the production of an image or design in light-polarizing material which comprises treating a surface or film which shows substantially uniform light-polarizing properties so as to alter or destroy the polarizing properties of predetermined areas of said surface or film to produce therein an image or design of the type described.

Other objects of the invention are to provide such a process wherein the polarizing properties of the surface or film are altered or destroyed by subjecting the surface to a vapor; to provide means for protecting predetermined portions of the surface, in whole or in part, from the action of the destructive media; to provide light-polarizing surfaces or films which are quickly responsive to the destructive action of the vapor employed; and to provide a process of the character described admirably adapted for the reproduction of photographic images in light-polarizing media.

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

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others thereof which will be exemplified in the process hereinafter disclosed, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the invention, reference should be had to the accompanying drawing, in which:

Fig. 1 is a diagrammatic view in section of a product adapted to be employed in the process of the present invention;

Fig. 2 is a similar view of the product of Fig. 1 after the first step of the process of the present invention;

Fig. 3 is a similar view of the product of Fig. 2 after the next succeeding step of the process;

Fig. 4 is a similar view of the product after the next succeeding step; and

Fig. 5 is a similar view of the product of Fig. 1 after the completion of the process.

The present invention contemplates the provision of an improved process for the production of images, and more specifically photographic reproductions and the like, in light-polarizing

surfaces and films. The images so produced show photographic contrast which is a function of the direction of vibration of polarized light traversing the image. When the beam of light traversing the image is vibrating in a direction parallel to the polarizing axis of the surface in which the image is formed, the photographic contrast of the image is a minimum. When a beam of polarized light vibrating perpendicular to the polarizing axis of the surface in which the image is formed traverses the image, the photographic contrast of the image is a maximum.

In the practice of one form of the present invention, there is first prepared a light-polarizing film or surface 12 on a suitable support, for example on a transparent supporting sheet or film such as a glass plate or sheet of transparent plastic 14. On the exposed surface of the light-polarizing layer 12, there is provided a layer 16 of a photosensitive material, such for example as photosensitive gelatine emulsion of the type commonly employed in connection with wash-off relief film.

The polarizing layer 12 may comprise oriented light-polarizing crystals, such for example as crystals of herapathite, or it may comprise a suspension of minute, optically oriented light-polarizing particles in a transparent suspending medium, or it may comprise any other suitable means for providing a light-polarizing surface. Under certain conditions, as for example where the polarizing layer is of sufficient thickness to be self-supporting, the supporting plate or sheet 14 may be dispensed with.

The photosensitive layer is exposed, preferably through the light-polarizing layer 12, and the transparent support, if any, 14, as shown for example in Fig. 2, wherein the arrows 20 are indicative of the direction of propagation of light incident upon the photosensitive layer 16.

The composite sheet is then treated with the usual developer to develop the photosensitive gelatine emulsion, for example. If the sheet has been exposed with a photographic negative or positive positioned closely adjacent the uncoated surface of the support 14, the developed areas 18 of the photosensitive emulsion will comprise a reproduction of the design or image of the negative or positive.

The developer is then removed in the usual way, as by washing in cold water, and the developed gelatine emulsion is then "tanned" in the usual way and washed, for example in warm water, so that the untanned gelatine is removed. The resulting product shown in Fig. 3 comprises

the supporting layer 14, the light-polarizing layer 12, and the developed resist 18, the resist being in intimate contact with one surface of the polarizing layer and corresponding to the predetermined design or image which it is desired to reproduce.

The resist or relief is then washed to insure the removal of all material used in tanning the gelatine. It is not desirable, in connection with the practice of the present invention, that the tanned gelatine be subjected to an acid fixing bath.

The product shown diagrammatically in Fig. 3 may then be subjected to the action of vapors or other destructive media which alter or destroy the polarizing properties of so much of the layer 12 as is not protected by the relief or resist 18. It will be understood that the vapors or other destructive media attack the polarizing layer from the direction of the surface thereof, which is covered in part at least by the resist. In Fig. 4 the unshaded areas 22 are intended to indicate areas the polarizing properties of which have been altered or destroyed by the action of the destructive vapors, while the shaded areas 24 are intended to represent areas the polarizing properties of which have remained unaffected because of the protection offered by the resist 18.

A suitable light-polarizing material for use in the present invention, and one which is quickly responsive to the action of the destructive medium employed, may comprise a thin film of a highly concentrated suspension of minute, needle-shaped, herapathite-like polarizing particles in a suitable suspending medium, for example a film of incomplete polymerized polyvinyl acetal resin. It is to be understood, however, that the other suspending media may be employed with light-polarizing films or layers of the type described.

As an example of suitable "developing" vapors for use in the practice of the present invention where the polarizing layer comprises herapathite-like crystals, the vapors rising from a mixture of a solution of 6 grams of sodium bisulphite dissolved in 40 c. c. of water, to which is added 20 c. c. of Solox, mixed with 35 c. c. of isopropyl alcohol and 5 c. c. of concentrated acetic acid glacial, may be employed. The vapors rising from such a solution comprise a mixture of alcohol and SO₂ vapors. These are allowed to act on the surface of the light-polarizing film, which is protected by the resist or relief, and within a short time, for example from four to five minutes, the polarizing properties of the portions of the polarizing surface exposed to the vapors have been so altered or destroyed as to form in the polarizing surface an image corresponding to that formed by the resist, the photographic contrast of which is a function of the direction of vibration of polarized light traversing the polarizing surface.

When mixtures of alcohol vapor and SO₂ vapor are employed in the proportions arising from the use of the solution previously described, the dark portions of the resulting image in the polarizing surface show a clear bluish black in the extinction position, and the entire polarizing surface is substantially neutral, i. e., the image therein is substantially invisible when it is viewed in polarized light vibrating parallel to the polarizing axis of the surface.

Other vapors and mixtures of vapors may be used in the process of the present invention. The formula given may be modified widely without departing from the invention. Other alcohols,

for example, may be used. Other acids than acetic acids may be employed. It is to be understood that the formula given is merely illustrative.

The use of different materials in the production of the vapors employed in the process of the present invention may result in an alteration in the color of the image formed in the polarizer. If, for example, nitric acid is substituted for acetic acid, the polarizing image shows red when viewed through an analyzer in the extinction position.

As examples of other materials which may be employed in the production of suitable vapors for use in the process of the present invention, mention may be made of a water solution of sodium bisulphite; ammonia; formic acid; nitric acid; and methanol. Other substances may be employed, among them sulphuric acid vapor and formaldehyde vapor, for example, but these react somewhat more slowly with the polarizing surface than do the preferred materials.

After the light-polarizing surface protected by the resist has been subjected to the action of the developing vapors for a suitable period, the gelatine relief or resist is removed by washing in warm water until it is softened, and then by mechanical removal. The resulting product is shown diagrammatically in Fig. 5 as comprising a support 14 having thereon a layer 12 comprising areas having differing polarizing properties, which said areas in the aggregate form an image in polarized light.

It may be desirable in most circumstances to subject the polarized print or image to the action of a bleach to render completely colorless the highlights or light areas in the design. A suitable bleach may comprise a solution of 5 c. c. of ammonia and 5 c. c. of ethyl alcohol in 300 c. c. of water. The image may be immersed in this bleach, which may be used as a bath. The print is then dried and is ready for use.

It is to be understood that any suitable photosensitive material may be employed in the practice of the present invention in forming directly on the surface of the polarizing layer a protective relief or resist. The photosensitive gelatine emulsion which has been described is a preferred form of material. So also, in other modifications of the process the protective resist or relief may be formed directly upon the polarizing layer by covering the layer with a substance such for example as paraffin, which may act to protect the polarizing film from the destructive vapors. The resist may under these circumstances be formed as a design by removing portions of the paraffin, as for example by pressing thereagainst a half-tone plate or the like.

It is also to be understood that the relief or resist may be formed away from the polarizing layer and then transferred to the layer. For example, with the use of a photosensitive gelatine emulsion a suitable resist may be employed which is formed in the following manner: A layer of photosensitive gelatine emulsion on a suitable backing may be exposed from the unbacked face of the gelatine layer. It may be developed in the usual manner. The developer may be washed out, as with cold water. The gelatine may be then tanned, preferably, however, without using any sulphuric acid. The tanned gelatine with its backing may then be pressed while wet to the light-polarizing surface. Under these circumstances that portion of the gelatine layer in which the image has been developed will be in direct

contact with the polarizer. Heat is then applied to the backing layer on the gelatine so as to soften the gelatine adjacent the backing. When this has been accomplished the backing may be peeled from the gelatine. The undeveloped gelatine may then be removed by washing with warm water, leaving the developed gelatine relief affixed to the surface of the light-polarizing layer. All such modifications of the process are to be deemed to fall within the scope of the invention.

This application is a continuation in part of my copending application Serial No. 209,060, filed May 20, 1938, for design in Polarizing material and method of manufacturing the same.

Since certain changes may be made in carrying out the above process without departing from the 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 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.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A method comprising providing a resist, corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material and subjecting the said surface to the action of a medium which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the medium.

2. A method comprising providing a resist, corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material and subjecting the said surface to the action of a vapor which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the vapor.

3. A method comprising providing a resist, corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material and subjecting the said surface to the action of a vapor consisting of a mixture of alcohol and sulphur dioxide which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the vapor.

4. A method comprising providing a resist formed from photosensitive material and corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material and subjecting the said surface to the action of a medium which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the medium.

5. A method comprising providing a resist, formed from a photosensitive gelatine emulsion and corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material and subjecting the said surface to the action of a medium which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the medium.

6. A method comprising forming a resist, corresponding to an image to be reproduced, closely

adjacent a surface of light-polarizing material by exposing and developing, while adjacent said surface, predetermined portions of a layer of photosensitive material, and subjecting the said surface to the action of a medium which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the medium.

7. A method comprising forming a resist, corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material by exposing and developing, while adjacent said surface, predetermined portions of a layer of photosensitive material, and subjecting the said surface to the action of a vapor which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the vapor.

8. A method comprising providing a resist, corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material by forming said resist and then positioning it in contact with said surface, and subjecting the said surface to the action of a medium which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the medium.

9. A method comprising providing a resist, corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material and subjecting the said surface to the action of a medium which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the medium, and then removing said resist from said surface.

10. A method comprising providing a resist, corresponding to an image to be reproduced, closely adjacent a surface of light-polarizing material and subjecting the said surface to the action of a medium which alters the polarizing properties of said surface under such conditions that the resist protects predetermined portions only of said surface from the action of the medium, and bleaching said surface.

11. The process comprising applying a layer of photosensitive material to a surface of light-polarizing material, exposing said photosensitive material through said light-polarizing material to form a resist corresponding to an image to be reproduced, subjecting said surface of said light-polarizing material to the action of a medium destructive of the polarizing properties thereof while employing said resist to protect predetermined portions of said surface from the action of said medium, and removing said resist from said surface after there has been formed in said light-polarizing material an image the photographic contrast of which is a function of the direction of vibration of polarized light traversing said image.

12. The process comprising applying a layer of photosensitive material to a surface of light-polarizing material, exposing said photosensitive material through said light-polarizing material to form a resist corresponding to an image to be reproduced, and subjecting said surface of said light-polarizing material to the action of a medium destructive of the polarizing properties thereof while employing said resist to protect

predetermined portions of said surface from the action of said medium.

5 13. The process comprising applying a layer of photosensitive material to a surface of light-polarizing material, exposing said photosensitive material through said light-polarizing material to form a resist corresponding to an image to be reproduced, subjecting said surface of said light-polarizing material to the action of a medium destructive of the polarizing properties thereof while employing said resist to protect predetermined portions of said surface from the action of said medium, removing said resist from said surface after there has been formed in said light-polarizing material an image the photographic contrast of which is a function of the direction of vibration of polarized light traversing said image, and bleaching said light-polarizing material.

10 14. A method comprising forming a film of light-polarizing material on a transparent support, coating said film with photosensitive material, forming a resist in said photosensitive material corresponding to a predetermined image, 15 20 25 subjecting said film to the action of a medium

which alters the polarizing properties of said film while employing said resist to protect predetermined portions of said film from said medium, and removing said resist from said film.

5 15. A method comprising forming a film of light-polarizing material on a transparent support, coating said film with photosensitive material, forming a resist in said photosensitive material corresponding to a predetermined image by exposing said photosensitive material through said film and said support and then developing said exposed coating while in contact with said film, subjecting said film to the action of a medium which alters the polarizing properties of said film while employing said resist to protect predetermined portions of said film from said medium, and removing said resist from said film. 10 15

16. The method of forming in a light-polarizing surface an image corresponding to an image formed in a resist which comprises acting on said surface and through said resist with a medium which alters the polarizing properties of those portions of the surface with which it comes in contact. 20 25

EDWIN H. LAND. 25