

April 21, 1970

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3,507,652

DIRECT THIN EMULSION STENCIL SCREEN METHOD AND ARTICLE

Filed Dec. 29, 1966

3 Sheets-Sheet 1

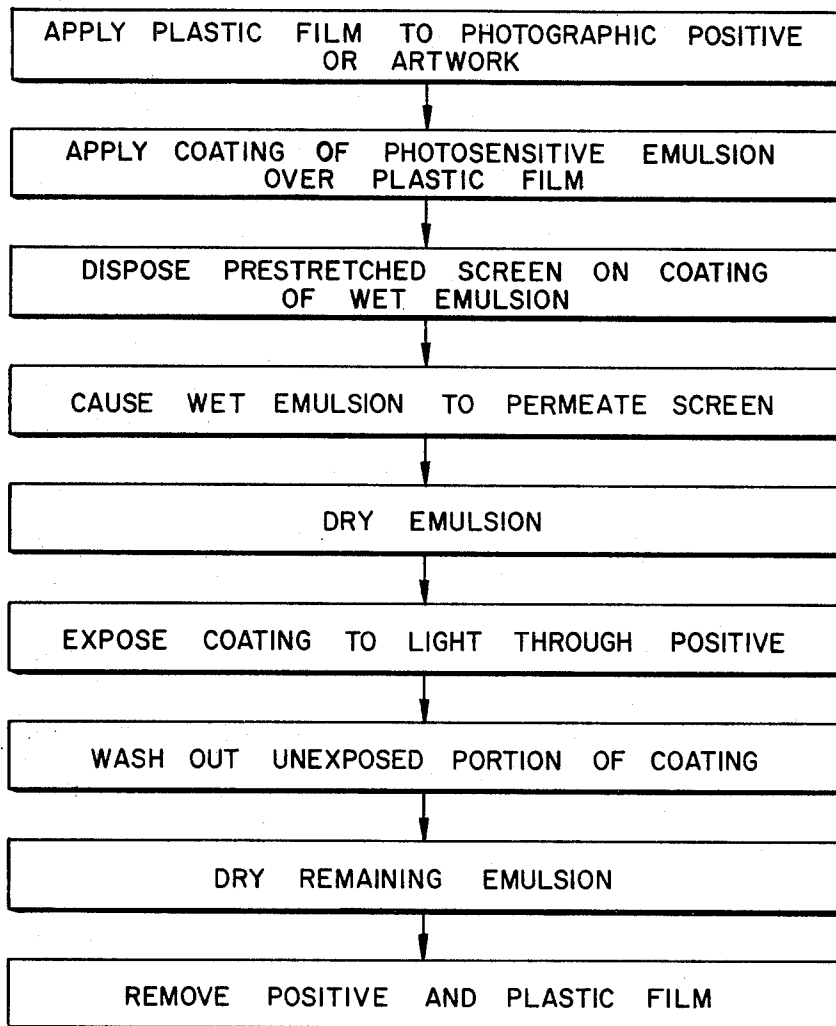


Fig. 1

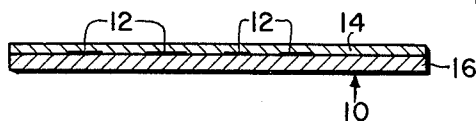


Fig. 2

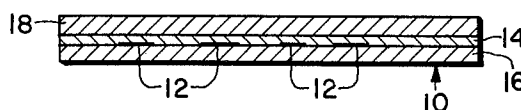


Fig. 3

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3 Sheets-Sheet 2

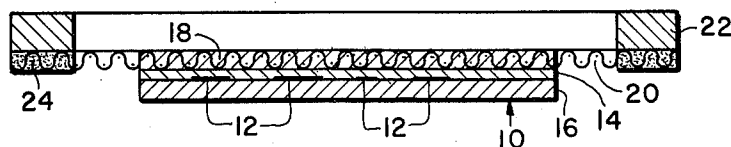


Fig. 4

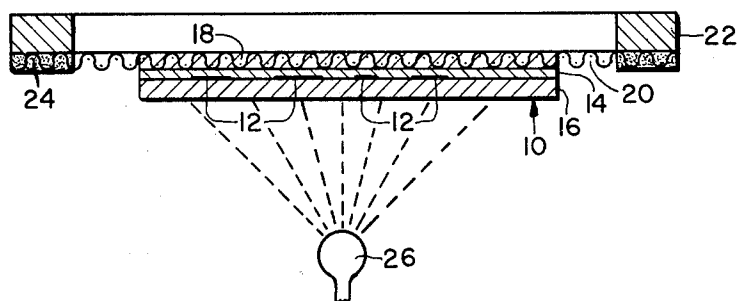


Fig. 5

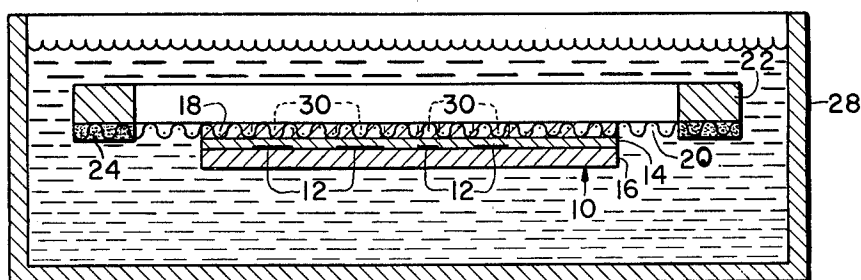


Fig. 6

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3 Sheets-Sheet 3

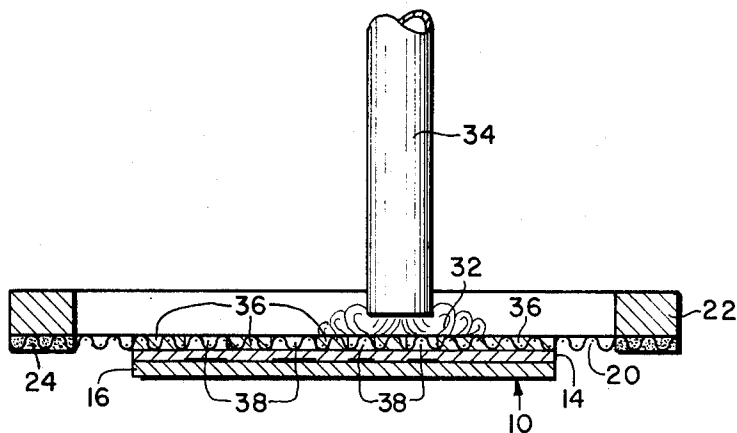


Fig. 7

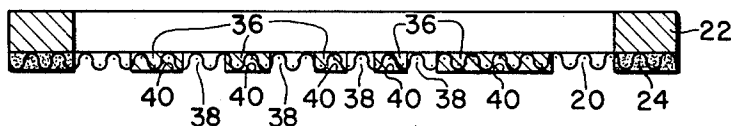


Fig. 8

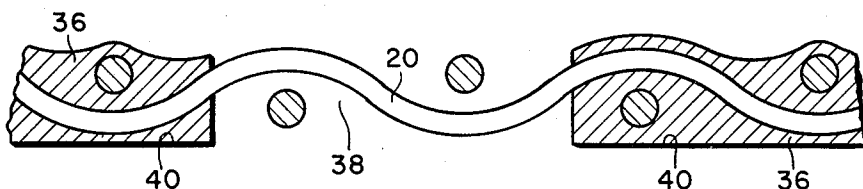


Fig. 9

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DIRECT THIN EMULSION STENCIL SCREEN METHOD AND ARTICLE

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10 Claims

ABSTRACT OF THE DISCLOSURE

Stencil screens used for printing and a direct, single exposure method of producing precision stencil screens which permit high print definition are described. The photosensitive emulsion which forms the stencil screen blockage is applied to a photographic positive and then is caused to permeate a screen to form an assembly. It is then exposed, developed, and dried while part of such assembly. Thereafter the positive is removed leaving a finished screen.

BACKGROUND OF THE INVENTION

Stencil screens, commonly referred to as silk screens, have heretofore been fabricated by a method which requires the application of a coating of a photosensitive emulsion to a prestretched screen, which coating is thereafter dried. A photographic positive is formed having an opaque area, corresponding to the information to be printed by the screen, surrounded by a transparent area. The positive is then placed against the back side of the screen and the assembly is subjected to a suitable light which passes through the transparent portion of the positive and exposes the photosensitive emulsion applied to the screen. The positive is thereafter removed and the emulsion on the screen is developed so that the unexposed portion of the emulsion, corresponding to the information to be printed, is washed out leaving an open area in the screen through which the printing medium can thereafter pass.

Stencil screens formed by this method permit formation of line widths which are limited to about 5 mils, which lines can be fabricated to a tolerance of only about ± 1.5 mils. In addition, such stencil screens often result in printed line edges having a saw tooth effect. Further, the emulsion contains craters and pits due to the slow drying of the photosensitive emulsion contributing to the relatively poor quality of the resulting printed matter. Lines having widths of about 2 mils, such as are desired for microcircuit conductive path applications for example, cannot be printed by a screen formed by such a method.

SUMMARY OF THE INVENTION

The objects of the present invention are to provide an economic stencil screen having a crater and pit free emulsion and a method of fabricating such a screen that overcomes the heretofore noted disadvantages whereby smooth edged lines can be printed having small widths and spacing therebetween as well as having a very close dimensional tolerance.

According to the present invention, a stencil screen may be formed by providing a member or article having an opaque first area corresponding to that of the desired print surrounded by a light transmitting second area, applying a coating of a photosensitive emulsion over one surface of the member, disposing a prestretched screen over said emulsion causing the emulsion to permeate the screen, illuminating said emulsion through the member with a suitable light thereby exposing an area of the emulsion corresponding to the transparent second area while leaving an area of the emulsion corresponding to

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the opaque first area substantially unexposed, removing the unexposed portion of the emulsion, drying said emulsion while said member remains adhered thereto, and thereafter removing said member.

Additional objects, features, and advantages of the present invention will become apparent, to those skilled in the art, from the following detailed description and the attached drawing, on which, by way of example, only the preferred embodiments of this invention are illustrated.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a flow diagram illustrating the steps of the method of this invention.

FIGURES 2-8 are diagrammatic views illustrating the various steps of one embodiment of this invention.

FIGURE 9 is a fragmentary cross sectional view of a completed screen.

DETAILED DESCRIPTION

By the term stencil screen as used herein is meant a stretched screen, having a substantially impermeable emulsion applied to a portion thereof while the balance is uncoated permitting a printing medium to pass through, at least a portion of which balance corresponds in shape and configuration to that which is desired to be printed.

By the term printing as used herein is meant to form an impression or print of letters, characters, patterns, designs, artwork, and the like of any desired shape and configuration on any substrate.

By the term screen as used herein is meant a mesh, fabric or cloth formed of any weavable material such as silk, nylon, Dacron, and the like fibers as well as metal wires such, for example, as stainless steel.

In accordance with this invention, a photographic positive 10 or the like having an opaque area 12 of substantially the same configuration as that which is desired to be printed is covered with a thin plastic film or sheet 14 of a synthetic resinous material such as, for example, Mylar or the like. Mylar is a polyester material. Opaque areas 12 of photographic positive 10 may be formed of a common photographic emulsion applied to an ordinary plastic backing 16. The thin plastic film acts as a release agent for the subsequently applied photosensitive emulsion and is adhered to positive 10 by any suitable means such as an acrylic cement, or the like, or by taping it down with a waterproof tape. Such a film must be clear, smooth, transparent or translucent, wettable by a photosensitive emulsion, and be capable of being formed in very thin films. Care should be taken to avoid entrapment of air between film 14 and positive 10. After film 14 is suitably adhered to positive 10 as illustrated in FIGURE 2, a coating 18 of a photosensitive emulsion is applied over film 14 as illustrated in FIGURE 3. Suitable examples of photosensitive emulsions are sensitized polyvinyl acetate, sensitized polyvinyl alcohol, sensitized gelatin or the like, which hereinafter will be simply referred to as polyvinyl acetate, polyvinyl alcohol, gelatin or the like. Coating 18 may be applied by any suitable means known in the art, such as by placing the photographic positive on a rigid support and thereafter knife coating the emulsion over the surface.

While the emulsion of coating 18 is still wet a pre-stretched screen 20 is disposed on coating 18 and the wet emulsion is caused to permeate the screen as illustrated in FIGURE 4. Screen 20 is prestretched and maintained in place by bonding it to a suitable frame 22 by any suitable cement 24, such for example as epoxy cement, as is well known to one familiar with the art. In order to prevent the screen from coming to rest directly on film 14 after coating 18 is caused to permeate it, shims of suitable thickness may be placed about the periphery of

coating 18 so that the screen is maintained away from film 14 by the thickness of such shims.

After coating 18 has been suitably dried, the assembly so formed is exposed to a suitable light 26 to expose that portion of coating 18 which surrounds opaque areas 12 as shown in FIGURE 5. Light 26 is schematically illustrated. While any carbon arc lamp or an ultraviolet light source may be used for this purpose, a collimated light is preferred. The length of time for the exposure of coating 18 will depend on the thickness of the coating as well as the composition thereof.

Referring now to FIGURE 6, the exposed emulsion coated assembly is then placed in a suitable water bath 28, or simply flooded with water by placing the assembly under a gentle stream of water, as the first step in washing out the unexposed portion 30 of coating 18. To facilitate washing out unexposed portions 30, bath 28 may be subjected to the action of an ultrasonic agitator.

Thereafter, as illustrated in FIGURE 7, the assembly is subjected to a water stream 32 emitted from a suitable nozzle or hose 34 which is held close to the back side of screen 20 as a final step of washing out the unexposed portions of the coating. After such washing out, exposed portions 36 of coating 18 remain behind and channels 38 extend through screen 20 separating these portions.

The exposed portions 36 of coating 18 are then dried with positive 10 and film 14 in place. Thereafter, positive 10 and film 14 are stripped from the assembly leaving a finished stencil screen suitable for printing as illustrated in FIGURE 8. Since positive 10 and film 14 are adhered to the outer surfaces 40 of portions 36 while they are drying, these surfaces dry flat and smooth to prevent craters and pits from forming therein and so that they form sharp corners with the sidewalls of channels 38. Such flat surfaces and sharp corners permit the subsequent printed matter to have sharp edges and high definition by keeping the printing medium from flowing between these surfaces and the substrate being printed.

FIGURE 9 illustrates a greatly enlarged view of a screen where the printing surfaces 40 of portions 36 are flat and form sharp corners with channel 38. As is seen, the back side of the emulsion shrinks somewhat when it dries and tends to assume the contour of the screen fibers. If the emulsion was dried without positive 10 and film 14 adhered to the printing surface, the emulsion would dry and shrink from both sides whereby the emulsion on the printing surface would also tend to assume the contour of the screen fibers causing relatively poor quality of the resulting printed matter.

A typical example of one method of carrying out the present invention is illustrated by the following description. A photographic positive having an opaque first area corresponding to that of the desired print or impression surrounded by a light transmitting second area is provided. A film or sheet of Mylar having a thickness of 1/2 mil is adhered to the emulsion side of the photographic positive to form a transparent release film. The photographic positive is then placed upon a smooth, flat, rigid surface with the film surface exposed. Then a coating of polyvinyl alcohol, a photosensitive emulsion, having a wet thickness of about 5 mils is applied over the Mylar film by means of knife coating.

A prestretched screen is formed by providing a metallic frame having at least one flat surface, adjacent to which a nylon screen is disposed. The screen is stretched in all directions and bonded to the frame by means of an epoxy cement, which cement is thereafter permitted to dry while tension is maintained on the screen.

While the emulsion on the positive is still wet, the prestretched screen is disposed thereon and the emulsion is caused to permeate the screen. The assembly is then permitted to dry at room temperature for about 2 hours.

The assembly is then exposed to a collimated carbon arc light through the positive for approximately 60 seconds. In this manner an area of the coating of emulsion

corresponding to the transparent area on the photographic positive, that is the area surrounding the opaque area of the positive, is exposed to the light.

The screen assembly is then soaked in water having a temperature of about 110° F. for approximately 30 seconds and the unexposed portion of the emulsion layer is washed out by means of a water stream or spray. A 1/4" hose having water under about 10 p.s.i. pressure is held very close to the back side of the screen so that sufficient force is developed to wash out all of the unexposed portion of the emulsion coating. After all of the unexposed emulsion is removed, the surface water is thoroughly blotted with a chamois. The assembly is then permitted to dry for about sixteen hours at room temperature. After the assembly is thoroughly dried, the photographic positive and the Mylar film are removed by stripping them off producing a completed stencil screen.

A screen produced as described in the typical example is capable of printing lines of a slurry of electrically conductive material having a width of about 2 mils and very smooth edges. The printing surface of the exposed and developed emulsion on the screen is free of craters and pits.

It is obvious that a stencil screen formed by the method of this invention is suitable for printing microcircuit paths, decorative artwork, ordinary printing matter, or the like.

Although the present invention has been described with respect to the specific details of certain embodiments thereof, it is not intended that such details be limitations upon the scope of the invention except insofar as set forth in the following claims.

What is claimed is:

1. A method of forming a stencil screen comprising the steps of:
 - forming an article having an opaque first area corresponding to that of the print desired surrounded by a light transmitting second area,
 - applying a film of a release agent to one surface of said article,
 - applying a coating of photosensitive emulsion over said film of release agent,
 - providing a prestretched screen,
 - disposing said screen over said coating of emulsion while it is still wet and causing said emulsion to permeate said screen,
 - illuminating said emulsion through said article with a suitable light thereby exposing an area of said emulsion corresponding to said light transmitting area while leaving the area thereof corresponding to said opaque area substantially unexposed,
 - removing the unexposed portion of said emulsion, drying said emulsion, and thereafter removing said article.
2. The method of claim 1 wherein said article is a photographic positive.
3. The method of claim 1 wherein said photosensitive emulsion is polyvinyl alcohol.
4. The method of claim 3 wherein said light is ultraviolet light.
5. The method of claim 3 wherein said unexposed emulsion is removed by washing out with water.
6. The method of claim 5 further comprising the step of drying said coating of emulsion before the illuminating step.
7. The method of claim 6 wherein said article is a photographic positive.
8. The method of claim 1 wherein said film of release agent is a thin sheet of polyester material.
9. The method of claim 8 wherein said light is ultraviolet light.
10. The screen formed by the method of claim 1.

(Other references on following page)

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