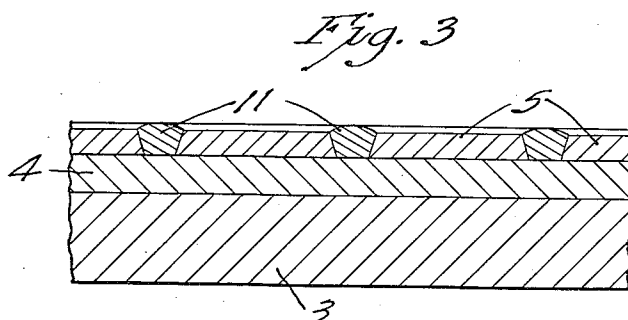
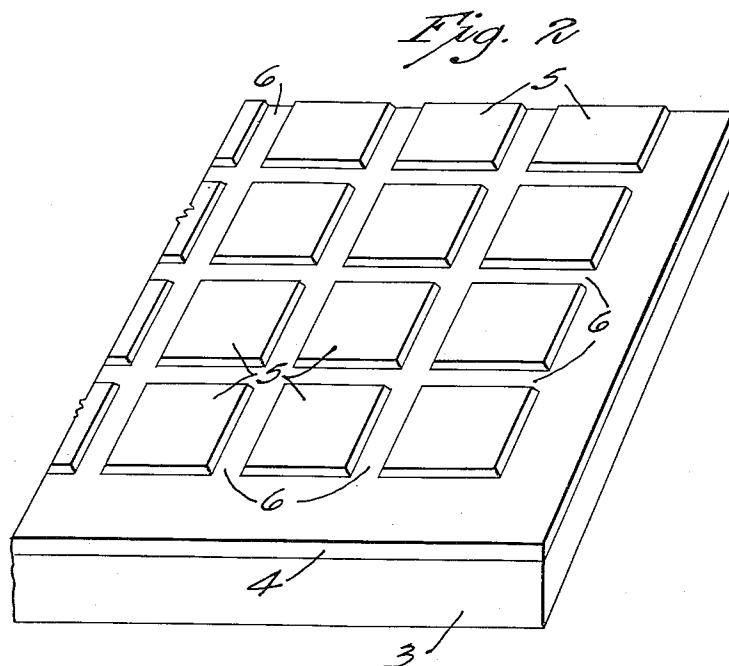
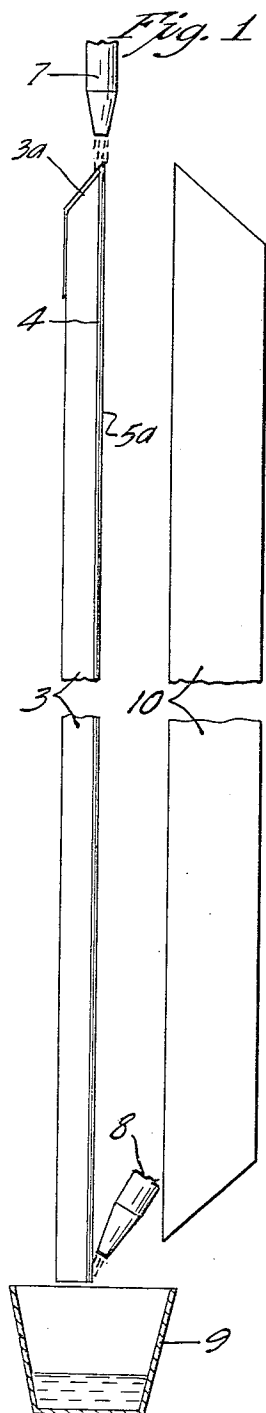


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METHOD OF FORMING MATRICES FOR THE
ELECTRODEPOSITION OF GRIDS
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METHOD OF FORMING MATRICES FOR THE ELECTRODEPOSITION OF GRIDS

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This invention relates to the manufacture of grids for electronic and other devices and particularly to a novel method of forming matrices for use in the electrodeposition of grids of extremely fine mesh, high light transmission and improved strength and uniformity in the shapes and sizes of the component filaments.

It is an object of my invention to provide a novel and economical method for forming matrices of the kind described having electrically non-conductive elements securely bonded to an electrode plate.

A particular object is to produce improved matrices of the character described by a method which includes photomechanical procedure for forming the non-conducting elements of the matrix from a shellac base coating and curing treatment whereby the required durability and secure bonding of the non-conducting elements to the base are obtained.

The invention also includes certain novel technique and procedure which will be more fully pointed out in the following specification and claims.

With these objects in view, I proceed as follows: A metal plate of the required size and of sufficient thickness to retain its shape is prepared with a clean surface suitable for electroplating. Copper is preferred as the principal metal of the blank plate because of its good electrical and heat conductivity. One face of such a blank is nickel plated in a Watts bath according to conventional procedure. Nickel of approximately .001 inch thick is ordinarily sufficient, although a thicker plate may be desirable in some cases. The nickel surface is then ground substantially flat using optical grinding powders and an optical flat in a lapping machine of suitable construction. It is unnecessary to polish the surface to true optical flatness because a substantially flat, fine grain surface is sufficient for good results in the subsequent coating and contact printing operations.

As the next step the fine grained or matte nickel surface is coated with a light sensitive emulsion or solution of uniform thickness and preferably having a shellac base. The common "cold top enamel" used in the photo-engraving industry has been used with excellent results for this coating. It may comprise an aqueous solution or emulsion of shellac, ammonium carbonate and ammonium bichromate with ammonium hydroxide added. Preparatory to the application of this liquid, the blank plate should be chilled. The required uniformity in the thickness of the coat may be obtained by flowing the light sensitive solution or emulsion to and over the surface to be coated while the blank is held in steeply inclined or substantially vertical position and the liquid is distributed along the upper edge of the blank. As more fully hereinafter described, the upper edge of the blank is preferably formed with a bevel angle of about 45 degrees which facilitates the uniform application and flow over the nickel plated surface. When this surface has been coated, the liquid supply is shut off. The blank is then retained in upright or steeply inclined position while the coating liquid is allowed to solidify or substantially dry at room

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temperature. I have discovered that improved uniformity in the thickness of the coating from top to bottom of the blank results if a stream of water is directed against and along the lower margin of the plate in a downward direction during the drying at room temperature. This washes away the excess coating which tends to accumulate along the lower margin of the plate. When the layer of light sensitive emulsion has become stable, the water is shut off and gentle heat is applied to the coated surface, e. g., by the use of infra-red lamps, until the coated blank is thoroughly dry and is ready for photo-printing. For this drying step the temperature of the light sensitive coating should not exceed 140° F.

A master printing plate carrying the image of the grind design required, usually in the form of fine opaque lines, may now be used in suitable contact printing apparatus to reproduce the design photographically on the light-sensitive surface of the work blank prepared as hereinbefore described. The shellac base coating herein described is peculiarly adapted to receive and retain clear cut sharp images of extremely fine lines where such lines are to be reproduced from a master positive plate.

After exposure to actinic light in the contact printing apparatus for the required period of time the image on the matrix plate is developed by the application of a suitable developer, e. g., an alcohol containing a suitable dye. The unexposed portions of the light-sensitive coating are thereby removed and water is applied in conventional manner to remove the developer, leaving on the nickel surface those portions of the coating which have been rendered insoluble by exposure to actinic light of the required intensity.

Following the developing and washing treatment, the work must be heat treated to render the remaining portions of the shellac base coating durable and to cause them to form a secure bond with the nickel surface of the plate. For such heat treatment the work may be placed in an oven in which the temperature is maintained at approximately 400 degrees F. It should be retained in the oven for a period of from five to ten minutes depending on the thickness of the plate and composition of the coating material. Where the common aniline dye of purple color is used in the developer bath, this color is imparted to the developed coating and is dissipated by heat treatment of the proper duration. Since an amber color is imparted to the coating by the heat treatment, the change in color of the work from purple to amber indicates when the heat treatment has progressed the desired degree.

Such curing treatment causes the shellac base coating to form a secure bond with the nickel surface of the backing plate and also renders the coating sufficiently durable so that the matrix may be used for the electrodeposition of a large number of grids. The nickel facing of the electrode plate further contributes to the secure bonding of the non-conducting elements thereto and facilitates the stripping of the grids from the matrix.

Referring to the accompanying drawing:

Figure 1 is a diagrammatic end view showing the arrangement of the work plate during the coating and drying treatment in relation to the principal elements of the apparatus;

Fig. 2 is a diagrammatic perspective view showing a fragmentary portion of one of my improved matrices greatly enlarged, and

Fig. 3 is a fragmentary vertical sectional view of a portion of one of the matrices with elements of an electrodeposited grid in place.

In the drawing the numeral 3 indicates a copper or other suitable metal backing plate having a relatively thin nickel facing 4. The numeral 5 indicates the developed and cured portions of my shellac base coating. These portions of the coating constitute the electrically

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non-conductive elements of the matrix which define recesses 6 adapted to contain electro-deposited grid material extending to the depth of the nickel face 4.

In Fig. 1 the plate 3 having a nickel plated face 4 is shown with a beveled upper edge 3a in position to receive the light sensitive coating liquid from a nozzle 7 which is moved along the beveled edge 3a to distribute the liquid uniformly and so that the stream from the nozzle is split in two, part flowing down the front face and part down the back face of the blank. As shown, a stream of liquid is directed downwardly from the nozzle 7 against the sharp edge formed by the bevel at its junction with the front or nickel coated face of the blank. A single pass of the nozzle 7 along this edge at a uniform rate relative to the work is usually sufficient. The coating before it has dried is indicated at 5a. During the drying at room temperature water is supplied from a nozzle 8 and is so directed, obliquely downward, as to remove excess coating from the lower margin of the plate. A single pass of the nozzle 3 with the stream of water directed along a line which is spaced above the lower edge of the plate a suitable distance may be sufficient to secure the desired results, although a repetition or relatively prolonged application of the water may be desirable with the larger work plates. This stream of water removes the excess coating as it sets and dries and also draws the viscous coating downward from above thereby improving the uniformity of the thickness of the coat at the instant that it sets or becomes stable.

During the coating and drying periods the work may be supported by means of vacuum cups engaging the back surface or other members engaging the end and lower edge surfaces of the work and the excess liquid may be collected in and carried away by a trough 9 extending along and below the lower edge of the plate 3. The drying of the light sensitive coating may be expedited by applying gentle heat by means of a heater 10, preferably containing infra red lamps. As hereinbefore more fully described, the drying of the coating is followed by the photo-printing of the image of the grid design on the coating, the developing of the image and the baking of the remaining portions of the coating to cure them and form a permanent bond with the face of the plate.

In Fig. 3 elements of the grid are indicated by the numeral 11 and the sides of the non-conducting members 5 are shown as converging toward the surface of the nickel face 4 as a result of the photo-mechanical reproduction of the grid image on the shellac coating. The resulting grid elements 11 are easy to strip from the matrix without damage to either the grid or matrix. A further advantage of the procedure hereinbefore described resides in the fact that any desired size and shape of grid aperture and filament may be formed accurately between the non-conductive elements 5, including extremely fine mesh, for example, 1000 lines per inch or more, wherein the individual apertures have square, sharp corners and maximum light transmission by reason of the uniformly fine filaments between apertures.

Known procedures may be followed in electro-forming the grids by the use of my improved matrices. The matrix is first cleaned and then given a thin coating of wax, for example, beeswax dissolved in benzene or other suitable solvent. The waxed matrix is then masked with an electro-plating resist or tape so that only the desired area will receive the plating material. The work is then placed in the plating bath and plated according to conventional procedure thereby forming the grid elements 11, as indicated in Fig. 3. The grid is then stripped from the matrix and the latter may be rewaxed and used in a similar manner many times for forming grids.

Elements 5 of non-conductive coating up to about .00008 inch thickness may be formed and where a substantially thicker grid is required the elements 11 may be built up by prolonged immersion in the plating bath so that each of these filaments projects substantially above

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the surface of the members 5 of the matrix. To further increase the thickness and strength of the grid elements both faces of the grid may be built up by electro-plating after stripping from the matrix.

I have discovered that the shellac base, light-sensitive coating is adapted to take clearer and sharper reproductions of the images of the grids and after the developing, fixing and curing treatment forms more durable non-conducting elements as compared with matrices having glue base coatings. As a result matrices made according to the present invention are adapted to form grids of extremely fine mesh, and having unusually high light transmission and improved strength and uniformity in the shapes and sizes of the component filaments.

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

1. The method of forming a matrix plate of the class described on a metal blank which comprises, applying a layer of nickel to a face of said blank, then forming on said layer a fine grained, substantially flat surface, applying to said surface a light-sensitive coating of uniform thickness comprising an alkaline bichromated shellac, drying said coating, then photo-printing on said coating the image of the design to be formed thereon, removing the unexposed portions of said coating, and heat treating the remaining portions of said coating at a temperature of approximately 400 degrees F. to cure them and form a permanent bond between them and the face of said plate.

2. The method in accordance with claim 1 wherein said light-sensitive coating is applied to said surface of the blank while supporting the metal blank in steeply inclined or substantially vertical position, spreading the liquid coating along the upper margin of the blank, allowing the coating to flow downward over said surface of the blank and allowing said coating to set while removing the excess coating from the lower margin of the blank by the application of a stream of water thereto.

3. The method of forming a matrix plate of the class described on a metal blank having a nickel surface which comprises, applying to said surface while in a steeply inclined or substantially vertical position a light-sensitive coating of uniform thickness comprising an alkaline bichromatic shellac, allowing said coating to set while applying a stream of water along the lower margin to remove excess coating, then photo-printing on said coating the image of the design to be formed thereon, removing the unexposed portions of said coating, and heat treating the remaining portions of said coating at a temperature of approximately 400 degrees F. to cure them and form a permanent bond between them and the face of said plate.

4. The method of forming a matrix plate of the class described on a metal blank having a fine grained, nickel surface which comprises, applying to said surface a light-sensitive coating of uniform thickness comprising an alkaline bichromated shellac, drying said coating, then photo-printing on said coating the image of the design to be formed thereon, removing the unexposed portions of said coating and heat treating the remaining portions of said coating at a temperature of approximately 400 degrees F. to cure them and form a permanent bond between them and the face of said plate.

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