Jan. 4, 1944. J. B. BRENNAN ET AL 2,338,091

SCREEN STENCIL AND METHOD OF MAKING SAME

Filed April 18, 1939

Fig. 1

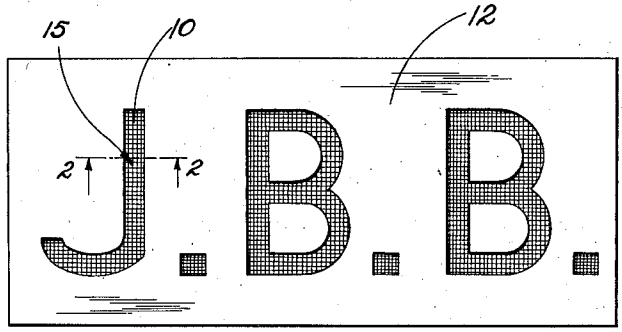


Fig. 2

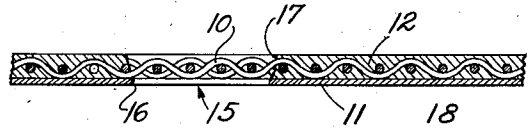


Fig. 3

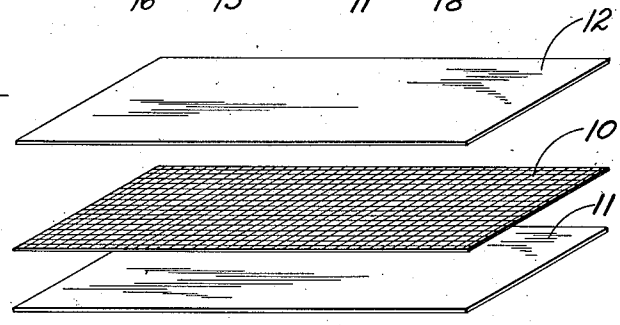


Fig. 4

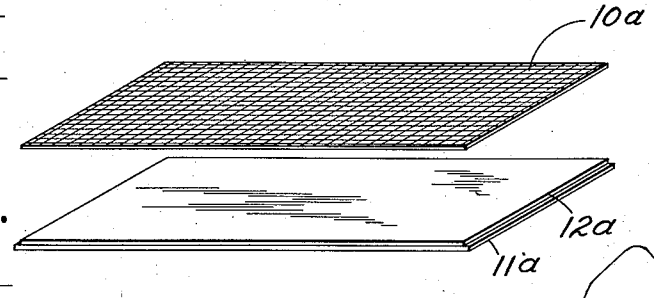
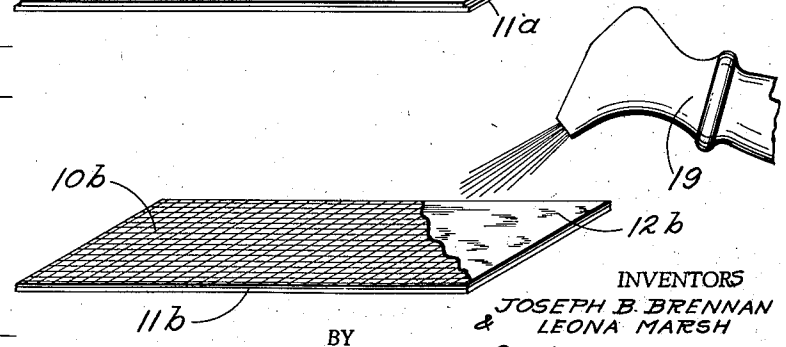


Fig. 5



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SCREEN STENCIL AND METHOD OF MAKING SAME

Joseph B. Brennan and Leona Marsh, Euclid, Ohio; said Marsh assignor to said Brennan

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18 Claims. (Cl. 101—128.2)

This invention relates to screen stencils and methods of making same and the present application is a continuation in part of our copending applications Serial No. 115,208 and No. 175,240 filed December 10, 1936, and November 18, 1937, respectively.

As described in our copending applications aforesaid screen stencils having very important advantages over those heretofore known can be produced by blocking the interstices of a screen such as a fine woven wire mesh with a metal chemically different from the material forming the screen, applying a resist to the plate so formed, for example by a photographic method, and then etching away the blocking metal in those portions of the plate which are not covered by the resist. The etching operation is carried out preferably by a re-agent which will attack and dissolve the blocking metal but will not substantially attack the material of the screen. Screen stencils so produced are accurate and durable and may be advantageously used for many purposes as, for example, for applying designs in enamel to metal or for applying designs to glass for various printing and dyeing operations as well as for signs and dials.

In our prior applications the preferred forms of screen stencils comprised metallic screens filled with or attached to a metal chemically different from the material forming the screen. In screen stencils made according to this application we preferably employ three different metals of different chemical characteristics including a perforate member such as a woven wire screen formed of one inorganic material such as a metal, a metallic sheet of a different metal which is secured to the perforated member by a metallic bond formed of still another metal. By this combination of elements and by the proper selection of materials it is possible to provide screen stencils by which a design can be reproduced with great accuracy and fidelity even down to very minute details. Further, it is possible to provide screen stencils of varying thickness so that deposits of varying amounts of material can be made in the subsequent screening operations. By the methods described herein screen stencils made according to our invention can be effectively and economically produced.

Further novel features and advantages of our invention will become apparent from the following description of preferred forms thereof, reference being made to the accompanying drawing. The essential characteristics are summarized in the claims.

In the drawing Figure 1 is a plan view of a preferred form of screen stencil plate made according to our invention and having a design etched therein; Figure 2 is a sectional view of the plate indicated in Figure 1 taken along the line 2—2 of Figure 1 on a greatly enlarged scale; Figures 3, 4, and 5 are diagrammatic illustrations showing steps of preferred methods of producing our screen stencils.

As shown in Figures 1 and 2 a screen stencil made according to our invention preferably comprises a perforate member such as a woven wire screen 10 having a thin metal plate 11 secured to one side thereof, the plate being bonded to the screen by another metal 12 which at least partially fills the interstices of the screen. The materials comprising the screen, the filling in metal 12 and the sheet 11 are preferably chosen so that they can be subjected to selective etching action whereby the material of the sheet 11 may be etched away until the underlying material 12 is exposed and thereafter the bonding material 12 may be dissolved by a reagent which will attack neither the sheet 11 nor the wires making up the screen 10.

As an example of a procedure which we have found to be very satisfactory a stainless steel screen 10 of about 150 mesh woven of wires about 0.002" in diameter may be sandwiched between a piece of tinfoil 12 of about 0.004" thickness and a piece of copper foil 11 of about .002" thickness as indicated diagrammatically in Figure 3. The three pieces may then be pressed tightly between steel plates or rolls, one or both of which may be heated sufficiently to cause the tin to melt. If desired, the tin can be pressed into the screen by a fluid under pressure, or by a resilient or yieldable material such as rubber, and thereafter subjected to heat. The result of this process is that the interstices of the stainless steel screen are filled as shown in Fig. 2, with tin, which also functions to secure the copper foil to the stainless steel screen.

In utilizing such a plate in the manufacture of a screen stencil a resist may be applied to the flat surface of the copper in a manner known to those skilled in the art for example by the usual photographic methods. Then the plate may be etched by an etching solution or solutions which will attack the copper and tin without substantially affecting the stainless steel wires. A solution of ferric chloride in water is suitable.

Preferably the plate is removed from the ferric chloride solution as soon as the copper has been etched through in the areas of the design which are not protected by the resist. The etching may then be completed in a solution, such as a cupric chloride solution, which will dissolve the tin without attacking the copper or the stainless steel. By this method the possibility of side etching of the copper foil is eliminated and thus fine details may be accurately preserved. The result of the etching is indicated diagrammatically in Figure 2, wherein it will be seen that the copper and the tin have been removed in region 15, leaving only the stainless steel wires. The copper foil is etched with sharp edges as at 16, thus accurately preserving the detail of the design, even though the tin may be subjected to some side etching as shown at 17 in Figure 2.

It will be noted that the screen is preferably spaced slightly above the flat surface of the copper foil as shown in the drawing. When such screen is used for example in applying an enamel design the flat surface 18 of the copper sheet is placed in contact with the article to which the design is to be applied and powdered enamel or frit is rubbed through the screen onto the surface which is to receive the design through the apertures such as the opening 15. The sharp, clearly defined edges 16 of the etched areas insure the production of accurate designs with all details properly reproduced. Also by varying the thickness of the copper foil, the distance between the screen and the flat surface 18 can be varied which will result in a corresponding variation in the amount of material or pigment deposited on the surfaces being decorated during the screening operation; that is, if the distance between the surface 18 of the copper foil and the screen is increased, a greater thickness of enamel or frit can be deposited while, if the distance is reduced, a thinner layer will be deposited. In carrying out enameling operations we are able, by employing foils of sufficient thickness, to deposit enamel in such quantities that the design will appear definitely in relief after it has been fired, and yet by reason of the sharpness of the edges of the etched-away portions and the smoothness and flatness of the surface 18, there is practically no loss of definition.

Various other methods of securing the screen to the plate may be employed. Foa example, as shown diagrammatically in Figure 4 a screen 10*a* may be employed in conjunction with a sheet of copper foil 11*a* tinned as indicated at 12*a*. The screen is placed against the tinned surface of the copper foil and pressed into the tin preferably by a roll or plate heated to a sufficient temperature to cause the tin to melt or to become plastic. The amount of pressure required will, of course, be increased if the degree of heating is reduced. The tin may also be cold pressed in or hammered in as by a drop hammer. By varying the thickness of the tin and by subjecting the screen and plate to varying pressures, the amount to which the interstices of the screen are filled may be changed. If desired, for example, the tin may be only sufficiently thick to partially fill the interstices, instead of completely filling them as shown in Figure 2.

A further method is indicated diagrammatically in Figure 5. According to this method a stainless steel screen 10*b* may be superposed upon a copper plate 11*b* and then the assembly sprayed with finely divided molten particles of tin for example by a Schoop pistol indicated at 19. By this means the sprayed tin will cause the copper sheet to adhere to the screen. If desired, the sprayed assembly may be subjected to heat or pressure or both to compact the spray deposited metal and to bond the three metals more firmly together.

Various modifications and changes may be made in the methods and articles described herein. For example, the screen may be partially or completely filled in by dipping the screen in molten tin and then removing the excess or by electro-plating the screen with tin. Thereafter the coated screen may be assembled with a sheet of copper and subjected to heat, and pressure if desired, to form a unitary assembly. In every case, suitable flux may be employed to cause the materials to adhere properly. Various other materials may be substituted for those described herein. Thus the copper sheet or foil may be replaced by an iron sheet or foil in which case the iron may be etched by a solution of copper sulfate and hydrochloric acid, and thereafter the tin may be removed by a solution of iron chloride ($FeCl_3$).

Zinc foil or nickel foil may also be employed, with the selection of proper etchants. Other metals, such as low melting point alloys, may be substituted for the tin described herein. The screen may be made of various materials such as Monel metal or bronze. The screen may be composed of any suitable perforate material such as a thin perforated metallic sheet or, if desired, parallel closely spaced wires may be used in place of woven wires. Variations may also be made in the methods of bonding. These and other modifications of our invention will be readily understood by those skilled in the art. Therefore it is to be understood that our invention is not limited to the preferred forms thereof disclosed herein, or in any manner other than by the appended claims when given the range of equivalents to which our patent may be entitled.

We claim:

1. A method of making screen stencils which includes the steps of forming a screen stencil plate comprising a screen having the openings therethrough at least partially closed by a filling-in metal chemically different from the material forming the screen and having an imperforate metallic sheet bonded to said screen by said filling-in metal, and subjecting certain areas of the plate to the action of a reagent adapted to dissolve said metallic sheet and said filling-in metal without substantially attacking the material of the screen, thereby dissolving the metallic sheet and the filling-in metal without dissolving the screen in such areas.

2. A method of making screen stencils which includes the steps of forming a screen stencil plate comprising a screen of corrosion-resisting material having the openings therethrough at least partially closed by a layer of tin adhering thereto, and having an imperforate copper sheet bonded to said screen by said tin, and subjecting certain areas of said plate to the action of a reagent adapted to dissolve said copper sheet and said tin without substantially attacking the screen, thereby dissolving the copper and the tin without dissolving the screen in such areas.

3. A method of making screen stencils which includes the steps of forming a screen stencil plate comprising a stainless steel screen having the openings therethrough closed by a layer of tin adhering thereto, and having an imperforate iron sheet bonded to said screen by said tin, and sub-

jecting certain areas of said plate to the action of a reagent adapted to dissolve said iron sheet and said tin without substantially attacking the stainless steel screen, thereby dissolving the copper and the tin without dissolving the screen in such areas.

4. A method of making screen stencils which includes the steps of forming a screen stencil plate comprising a screen having the openings therethrough closed by a filling-in metal chemically different from the material forming the screen and having an imperforate metallic sheet bonded to said screen by said filling-in metal, applying a resist to a portion of the area of said plate, subjecting the plate to the action of a reagent adapted to dissolve said metallic sheet until said metallic sheet is dissolved away in the areas of said plate which are not protected by said resist, and thereafter subjecting the plate to the action of a reagent adapted to dissolve said filling-in metal without substantially attacking said metallic sheet, the material of the screen, or the resist.

5. The method according to claim 4, wherein the screen is composed of stainless steel, the filling-in metal consists of tin, and the metallic sheet consists of copper.

6. A method of making screen stencils which includes the steps of forming a screen stencil plate comprising a stainless steel screen having the openings therethrough closed by a layer of tin and having an imperforate copper sheet bonded to said screen by said tin, applying a resist to a portion of the area of said plate, subjecting the plate to the action of a solution of ferric chloride until said copper sheet is dissolved away in the areas of said plate which are not protected by said resist, and thereafter subjecting the plate to the action of a solution of cupric chloride to dissolve said tin without substantially attacking said copper sheet, the screen or the resist.

7. The method of making screen stencils which includes the steps of bonding a metallic sheet to a metallic screen composed of a metal different from the metal of the sheet by means of a bonding metal different from both the metal of the sheet and the metal of the screen, applying a resist to a portion of the exposed surface of the sheet, and etching away the sheet and the bonding metal in the areas not protected by the resist without substantially etching the screen.

8. The method according to claim 7 wherein a copper sheet is bonded to a stainless steel screen by tin.

9. The method of making a screen stencil which includes the steps of placing a sheet of metal having a relatively high melting point in contact with one side of a metallic screen composed of a different metal, placing a sheet of metal having a relatively low melting point adjacent the other side of said screen, fusing the low melting point metal without fusing the metal of the screen or the high melting point metal, to thereby fill the interstices of the screen and to bond the relatively high melting point metal thereto, and thereafter etching away the metal of the sheet and the bonding metal in certain areas without substantially etching the screen in such areas.

10. The method of making a screen stencil which includes the steps of assembling a sheet of metal having a relatively high melting point with a metallic screen composed of a different metal and a sheet of a metal having a relatively low melting point, and fusing the low melting point metal without fusing the metal of the screen or the high melting point metal to thereby fill the interstices of the screen and bond the relatively high melting point metal thereto.

11. The method according to claim 10 wherein the high melting point metal consists of copper and the low melting point metal consists of tin.

12. The method of making screen stencils which includes the steps of disposing a metallic screen upon a sheet of another metal, spraying finely divided molten metal thereon to bond the screen and sheet together, and thereafter etching away the metal of the sheet and the bonding metal in certain areas without substantially etching the screen in such areas.

13. The method of making screen stencils which includes the steps of disposing a stainless steel screen upon a sheet of copper, spraying finely divided tin thereon to bond the screen and sheet together, and thereafter etching away the tin and the copper in certain areas without substantially etching the screen in such areas.

14. The method of making screen stencils which includes the steps of bonding a layer of metal to a sheet composed of a metal having a higher melting point than the metal of the layer, heating the layer to soften it and embedding a metallic screen therein, the metallic screen being composed of a metal different from the metal of the layer and the metal of the sheet, and thereafter etching away the sheet and metallic layer in certain areas without substantially etching the screen in such areas.

15. In the manufacture of screen stencils of the type embodying a design etched therein, the steps of bonding a layer of metal to a sheet composed of a different metal, and embedding a metallic screen in said layer, the metallic screen being composed of a metal different from the metal of the layer and the metal of the sheet.

16. In the manufacture of screen stencils of the type embodying a design etched therein, the steps of tinning a smooth sheet of copper, heating the tin and embedding a stainless steel metallic screen therein.

17. A screen stencil blank or plate adapted to have a design etched therein comprising a stainless steel screen bonded to a sheet of copper metal by a bond composed of tin.

18. A screen stencil blank or plate adapted to have a design etched therein comprising a layer of tin embedded in a fine meshed metal gauze attached to a thin layer of copper.

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