METHOD OF MAKING SINTERED METAL STENCILS

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This invention relates to screen stencils and methods of making the same, and more particularly to screen stencils composed of metal or other relatively strong materials which are insoluble in water and ordinary organic solvents.

Screen stencils of this type are highly advantageous because of their durability, because they are not affected by the inorganic and organic solvents ordinarily used in the inks, enamels and the like which are applied by screen stencils and because their dimensions do not change with variations in atmospheric conditions. In these respects they are vastly superior to the usual silk screen stencils which are at present widely employed in the application of designs and decoration to surfaces.

The general objects of the present invention are the provision of durable and accurate screen stencils which can be manufactured readily and economically, and the provision of efficient and economical methods of making screen stencils. Further objects and advantages of the invention will become apparent from the following description of a preferred form thereof, reference being made to the accompanying drawings which are necessarily somewhat diagrammatic, with thicknesses of materials and mesh of screens exaggerated) in which Figure 1 is a plan view of a completed stencil made according to the present invention; Figure 2 is a section through the stencil of Figure 1 on a greatly enlarged scale, the section being indicated by line 3—2 of Figure 1; Figure 3 is a plan view of a silk screen stencil utilized in the manufacture of the stencil shown in Figure 1; and Figures 4, 5 and 6 are sectional views on an enlarged scale showing steps in the production of the stencil in Figure 1, the section being taken through the region indicated by the line 4—4 of Figure 3.

Briefly, an all metal screen stencil made according to a preferred form of my invention comprises a screen composed of filaments or wires of metal either woven into screen form, or made up of one or more layers of parallel filaments with the filaments in different layers extending in different directions, or thin perforated metallic sheets. All of these various materials are intended to be included within the term "screen" as it is used hereafter. The openings in the screen are filled in with finely divided metal powder, the metallic particles being sintered together to bond them to each other and to the screen. The finely divided metal powder is applied in the form of a design to leave the openings unobstructed in the areas where it is desired to apply pigment or ink to an underlying object when the stencil is in use. According to my preferred method, the metal powder is applied to the screen by producing a silk screen by the usual photographic process and then applying the metal powders to the metal screen through the silk screen. Thereafter, the metallic particles are sintered together by heating the metal screen and powder to sintering temperature, preferably with the screen and powder clamped between rigid, smooth plates to produce the requisite or preferred sintering pressure. These operations result in the production of a durable stencil, embodying an accurate design and having substantially smooth plane surface throughout the filled in areas of the stencil.

Referring to the drawings, in Figure 1 a preferred form of stencil embodying my invention is indicated at 10. This comprises a screen 11 shown herein as a fine mesh, woven screen composed of fine metal wires. The entire area of the screen, except for the design 14 indicated herein as a letter B, is filled in with sintered metal powder as indicated at 12. The drawing is shaded to show the surface of the metal powder in diagrammatic fashion, but the powders employed are preferably so fine that the filled-in areas appear substantially continuous and smooth to the naked eye. Any convenient metals may be employed both in the screen and in the filling-in metal. For example, the screen may be composed of bronze, monel metal, stainless steel, aluminum or other metal or alloy wires. Any readily available powdered metals may be employed to fill in the openings in the screen. Preferably, both the screen and the filling-in metals should be such that they will resist corrosion by the ink, enamel or other materials with which the stencils are intended to be used. Thus, monel metal, tin, aluminum and its alloys, and various non-ferrous alloys may be employed. The sintering temperature of the filling-in metal should be lower than the melting temperature of the material of the screen, and in some instances, it is preferable to employ materials such that the filling-in metal will be sintered or otherwise bonded to the metal of the screen. For example, bronze screens may be employed with finely divided bronze powders of similar composition, and stainless steel screens may be filled in with tin powders.

As shown on an enlarged scale in Figure 2, the filling-in metal 12 surrounds the wires or filaments making up the screen 11 with the result that except in the area of the design 14, the
material of the screen is buried or imbedded in the sintering powdered metal. The surfaces of the powdered metal are substantially flat, and the metal is preferably at least substantially as thick as the overall thickness of the screen with the result that in the completed article there is no roughness or irregularity in the filled-in portions. Furthermore, the fact that the sintered metal surrounds the wires or filaments making up the screen insures proper bonding of the metal to the wires or filaments. Thus the completed stencil can be subject to severe usage and can be bent or otherwise deformed in service conform to irregular objects to be decorated without damaging the screen or separating the filling-in metal from the screen.

The steps of my preferred method of making the screen stencils of the present invention are illustrated diagrammatically in Figures 3 to 6, inclusive. Preferably the powdered metal 12 is applied to the screen 11 through a silk screen stencil indicated generally at 15. As shown in Figure 3, this may comprise a silk or other textile fabric screen 16 supported in a frame 17 in conventional manner and bearing a gelatin or other colloidal design 18. It will be noted that the design 18 is in effect a negative of the design 14 in the completed stencil 10; i.e., in the completed stencil, the design 14 is not filled in, whereas in the silk screen stencil the design 18 is composed of hardened gelatin or the like filling in the interstices of the screen 16 while the remainder of the area of the screen 16 remains open. The silk screen may be produced by conventional methods, photographic methods being employed ordinarily in order to secure accuracy of reproduction and correct detail.

The next step in the process is to place the wire screen 11 upon a rigid supporting plate 20 composed of a metal having characteristics which enable it to withstand the heat of the subsequent sintering operation, and then to superpose the silk screen stencil 15 upon the wire screen 11 as shown in Figure 4. The silk screen may be clamped or otherwise secured in position and then the metal powder making up the filling-in metal 13 is applied to the design 18 preventing the powder from filling in the openings of the screen 11 in the portions thereof which are within the area of the design 14. The powder may be applied either in dry or paste form. Sufficient paste is supplied to fill the openings in the screen 11, and preferably the powder extends slightly above the wires of the screen as shown in Figure 5. This result is readily obtained by the use of the silk screen stencil 15 and insures that in the completed article the screen 11 will be substantially completely enclosed within the sintered metal as shown in Figure 2.

After the metal powder has been applied, the silk screen is carefully removed without disturbing the metal screen 11, leaving the parts as shown in Figure 5. The next step is to sinter the powdered metal to bond the particles to each other and to the material of the screen. This is preferably accomplished by applying a pressure plate 21, which may be similar to the plate 20, over the screen 11 and powdered metal 12, securing the plates together by any convenient means so that pressure will be exerted upon the powdered metal during sintering and then heating the assembly to sintering temperature and maintaining it at that temperature for a sufficient time to secure the proper sintering of the powdered metal. The sintering temperatures of various powders under various pressure conditions are known to those skilled in the art and will not be set forth in detail here. Generally speaking, sintering temperatures are always below fusing temperatures, and the higher the pressure employed, the lower the sintering temperature required.

The screen stencil is completed when the sintering operation is concluded, the assembly permitted to cool and the stencil removed from between the plates 20 and 21, although some of the stencils may advantageously be subjected to heat treatment. If desired the stencil may be mounted in a conventional frame (not shown) for use.

The sintering operation, particularly when smooth pressure plates are employed, compacts the powdered metal into a relatively dense mass having smooth surfaces and of ample strength and flexibility to withstand the stresses ordinarily encountered in the usage of the screen stencils. The stencils are much more durable and resistant to wear than ordinary silk screen stencils and are not effected by atmospheric changes. The method insures the production of accurate stencils by relatively simple operation, and the method is particularly valuable where it is necessary to make several metal stencils bearing identical designs, for in such case it is only necessary to produce one silk screen stencil by the conventional photographic methods.

While I prefer to apply the powdered metal to the inorganic screen by means of or through a silk screen, other methods of application may be employed. For example, where fine detail and accuracy of production are not of utmost importance, a simple pattern may be cut out of thin metal and laid over the inorganic screen and then the powdered metal applied to all or parts of the areas of the screen except those blocked by the pattern. In such an event, I prefer to apply the metal to the inorganic screen through another screen in order to obtain uniformity of thickness throughout.

Various other changes and modifications in my invention will be apparent to those skilled in the art, and it is therefore understood that my patent is not limited to the preferred form of the invention disclosed herein or in any manner other than by the scope of the appended claims.

I claim:
1. The method of making screen stencils which includes the steps of providing a screen member in which substantially all of the openings are unobstructed, filling in some but not all of the openings of the screen member with powdered metal in a divided state at a temperature below the melting point of the metal, leaving the remaining openings unobstructed to provide a pattern, and sintering the powdered metal to bond the particles thereof to the screen and to each other.
2. The method according to claim 1 wherein the screen is composed of fine metal wire woven together.
3. The method according to claim 1 wherein the screen is composed of one or more layers of parallel filaments.
4. The method of making screen stencils which includes the steps of providing a screen member, filling in some but not all of the openings of the screen member with a powdered material in a finely divided state at a temperature below the melting point of the material to provide a pattern, and subjecting the assembly to heat and pressure to bond the particles of powdered material to each other and to the screen.

5. The method according to claim 4 wherein the screen member comprises a layer of parallel, unwoven filaments.

6. The method of making screen stencils which includes the steps of producing a screen stencil carrying a design which is a negative of the design to be produced in the stencil, positioning a second screen in which substantially all of the openings are unobstructed on a supporting surface, positioning the negative screen stencil over the second screen, applying finely divided powdered material through the negative screen stencil and onto the second screen, whereby the openings in the second screen are blocked by powdered material except in the areas blocked off by the design in the negative screen in which areas the openings remain unobstructed, and bonding the particles of powdered material to each other and to the screen.

7. The method of making all-metal screen stencils which includes the steps of producing a screen stencil carrying a design which is a negative of the design to be produced in the stencil, positioning a metallic screen in which substantially all of the openings are unobstructed on a supporting surface, positioning the negative screen stencil over the metallic screen, applying finely divided powdered metal through the negative screen and onto the metallic screen, whereby the openings in the screen are blocked with powdered metal except in the areas blocked off by the design in the negative screen stencil in which areas the openings remain unobstructed, and sintering the particles of powdered metal to bond them together and to the metallic screen.

8. The method of making screen stencils composed of inorganic material which includes the steps of photographically producing a silk screen stencil carrying a design which is a negative of the design to be produced in the inorganic stencil, positioning a metal screen in which substantially all of the openings are unobstructed on a supporting surface, positioning the negative screen stencil over the metal screen, applying finely divided powdered metal through the negative screen stencil and onto the metal screen, whereby the openings in the screen are blocked with powdered metal except in the areas blocked off by the design in the negative screen stencil in which areas the openings remain unobstructed, and sintering the particles of powdered metal to bond them together and to the screen.

9. The method of making screen stencils which includes the steps of producing a screen stencil carrying a design which is a negative of the design to be produced in the completed stencil, positioning a screen in which substantially all of the openings are unobstructed on a flat supporting plate, positioning the negative screen stencil over the screen, applying finely divided powdered metal through the negative screen stencil and onto the screen, whereby the openings in the screen are filled with powdered metal except in the areas blocked off by the design in the negative screen stencil in which areas the openings remain unobstructed, removing the negative screen stencil, applying pressure to the filled in screen by means of a pressure plate engaging the upper surface of the filled in screen, and subjecting the assembly to heat sufficient to sinter the particles of powdered metal together and bond the powdered metal to the screen.

10. The method of making metallic screen stencils which includes the steps of producing a silk screen stencil carrying a colloid design which is a negative of the design to be produced in the metallic stencil, positioning a metal screen in which substantially all of the openings are unobstructed on a flat supporting plate, positioning the silk screen stencil over the metallic screen, applying finely divided powdered metal through the silk screen and onto the metallic screen, whereby the openings in the metal screen are filled with powdered metal except in the areas blocked off by the colloid design in the silk screen in which areas the openings remain unobstructed, removing the silk screen, applying pressure to the filled in metallic screen by means of a pressure plate engaging the upper surface of the filled in metallic screen, and subjecting the assembly of pressure plate, supporting plate and screen to heat sufficient to sinter the particles of powdered metal together and bond the powdered metal to the screen.

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