Sept. 9, 1941. W. R. SHERMAN 2,255,440

ELECTROFORMING METHOD OF PREPARING STENCILS

Filed Feb. 20, 1939

Fig. 1.

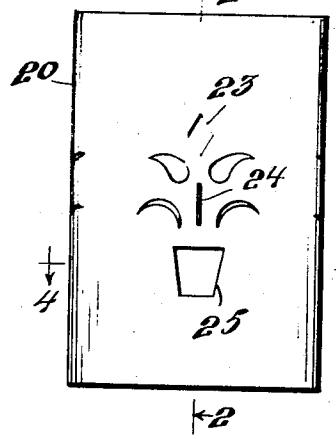


Fig. 2.

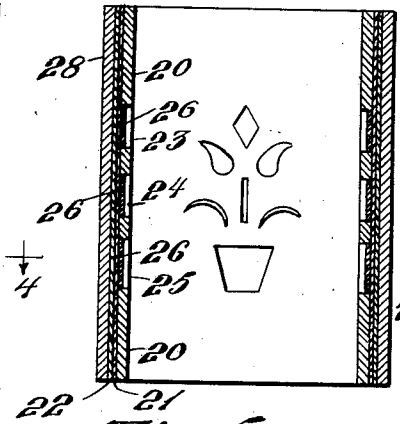


Fig. 3.

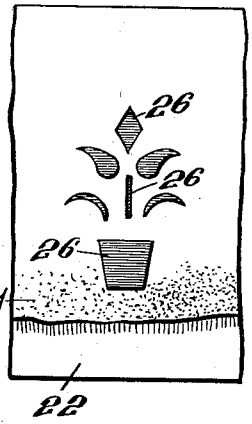


Fig. 4.

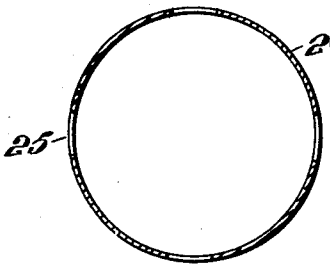


Fig. 5.

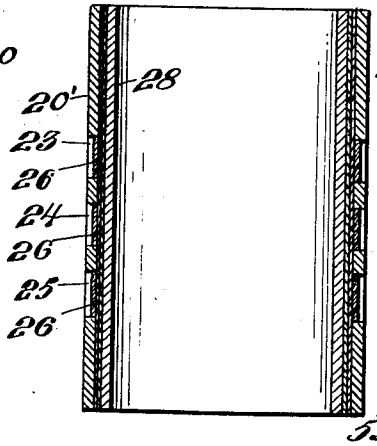


Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9.

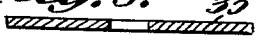


Fig. 10.



Fig. 11.

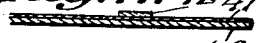


Fig. 12.

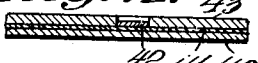


Fig. 13.

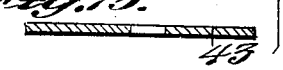


Fig. 14.



Fig. 15.



Fig. 16.



Fig. 17.

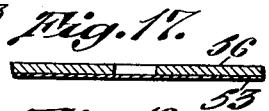
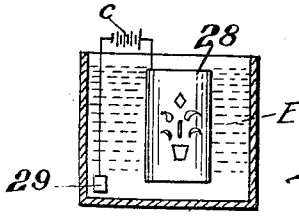


Fig. 18.



Fig. 19.



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ELECTROFORMING METHOD OF PREPARING STENCILS

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Application February 20, 1939, Serial No. 257,324

3 Claims. (Cl. 204—11)

This invention relates to printing stencils, and in particular to a printing stencil of the type used for printing on or decorating sheet material, such as paper, fabric, etc., which may or may not be fed as a continuous web past the stencil, and has for one of its objects to provide an improved printing stencil and a simple and inexpensive method of making the same.

Another object of the invention is to provide a printing stencil in which the holes constituting the design or pattern to be printed are formed without mechanically punching out the material of the stencil.

Another object of the invention is to provide a method of forming a stencil in which the complete stencil including the holes forming the design or pattern to be printed will be produced at the same time and during electro-deposition of a deposit of metal upon conductive surface portions of a support carrying non-conductive areas in the pattern desired to be holes in the final stencil.

With these and other objects in view, the invention consists of certain novel features of construction, as will be more fully described, and particularly pointed out in the appended claims.

In the accompanying drawing:

Fig. 1 is a side elevational view of a seamless cylindrical printing stencil made in accordance with my invention;

Fig. 2 is a central longitudinal sectional view taken on the line 2—2 of Fig. 1 showing one feasible method by which the stencil may be produced within a hollow cylindrical support;

Fig. 3 is a fragmentary view of the matrix, in flat form, ready to be shaped into cylindrical form and mounted either within or over a cylindrical support for receiving an electro-deposit of metal which is to be the final stencil;

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a central longitudinal section view similar to Fig. 2 but differing therefrom by depicting the final stencil as being produced upon the exterior cylindrical surface of the cylindrical support;

Figs. 6, 7, 8 and 9 are diagrammatic sectional views illustrating the various steps of my preferred method of making a printing stencil;

Figs. 10, 11, 12 and 13 are sectional views illustrating diagrammatically the various steps in carrying out a modified method of making a printing stencil;

Figs. 14, 15, 16, 17 and 18 are diagrammatic sectional views illustrating the various steps in carrying out another modified process of making a printing stencil; and

Fig. 19 is a vertical sectional view diagrammatically illustrating one form of electro-plating process for producing one of the printing stencils in which the stencil and the anode are outside the support carrying the stencil.

Printing stencils such as those of the type now employed for printing patterns on or decorating fabrics, paper, and various sheet materials, which may or may not be supplied in continuous lengths, usually consist of a thin walled hollow copper cylinder, the entire cylindrical surface of which is perforated by small holes arranged to form the desired pattern or design to be printed. At present such stencil rolls are usually made by taking a piece of sheet metal stock in flat form and punching out the holes to form the desired pattern by means of suitable dies. The perforated sheet, thus formed, is then bent into tubular or cylindrical shape, after which the abutting side edges are united, as by being suitably brazed, welded or soldered to securely hold them together. Such a construction, however, is not entirely satisfactory since it produces an objectionable seam, the avoidance of which requires the careful locating of the design to be applied on the cylinder. In many instances, this difficulty cannot be overcome and since the seaming cannot be machine punched without causing possible injury to the seam it has been necessary to cut out such portions by hand. As to the procedure of making such a stencil cylinder by a machine punching operation, such a process has been very costly owing to the fact the individual parts of each figure of the pattern, which are to be holes in the final stencil, necessarily have to be separately cut out in relief on the stamping surface of the cutting die. While the cutting out of the stock of the die to form projections for punching out such holes is practicable, nevertheless, for certain types of work, particularly where the corners of the holes in the design terminate in fine filament-like lines, it is often impossible to form a cutting element on the die that is capable of reproducing some of the delicate forms of perforated patterns because of the design and dimensional limitations of various cutting portions of the die necessary to insure the proper strength and cutting action thereof on the sheet metal stock; and in order to overcome the aforementioned disadvantages and to provide a simple and relatively inexpensive process whereby a printing stencil may be produced, either as a seamless cylinder or in substantially flat sheet

form, in which the arrangement of holes forming the pattern or design required to be printed are produced without the use of stamping or punching dies, I have provided a process wherein the entire stencil including the holes therein, which form the pattern or design, is produced electrolytically; and I produce these holes by initially preparing a surface of a support so as to provide electrically conductive portions thereon interrupted by or interspersed with other portions which are electrically non-conductive, the arrangement of such non-conductive portions being in the desired pattern which are to be holes in the final stencil whereby the holes result due to the electro-deposition of the metal, which is to form the final stencil, at only the electrically conductive surface portions of the support; and the following is a more detailed description of the present embodiment of this invention, illustrating the preferred means by which these advantageous results may be accomplished.

Insofar as the practice of the present invention is concerned, it is to be understood that the invention is applicable in whole or in its several aspects to the production of printing stencils of any desired shape, such as, for example, in the form either of a thin hollow cylinder or as a substantially flat sheet. In the embodiment which I have shown in the drawing, Figs. 1, 2, 4 and 5, and chosen because of its simplicity of representation for illustrating one feasible process for making one of the printing stencils, the stencil is there shown in the form of a thin hollow cylinder or shell **20**, which is produced by the electro-deposition of a layer of some readily palatable metal, such as copper, on electrically conductive surface portions **21** of a suitable matrix carried by a support **28** which may be either a hollow or a solid body, and made either of a metallic or of a non-metallic material. As illustrated in Figs. 2, 3 and 5, the matrix used in this method consists of a foundation member **22** made of an electrical insulating material, preferably a composition of relatively low fusibility, such as paraffin or other suitable wax or waxy material, or any non-conductive material of low melting point which will permit the exterior layer **20** of electro-deposited metal forming the required stencil to be readily stripped from the support **28** by heating such non-conductive material of low fusibility to soften or melt the same, and at a temperature of a lower degree than the melting point of the material which forms the support **28**.

While it is feasible that the foundation member **22** can assume the form of a wax coating directly applied on either the inside or on the outside of the support **28** various difficulties are encountered that render this method impracticable, particularly where the design or pattern desired to be reproduced is to be applied to such a coating if the same is located inside of the support **28**. In actual practice it is preferred to produce the cylindrical printing stencil on the inside of a hollow cylindrical support since the final stencil member when thus formed will be found to have a much smoother exterior cylindrical surface better suited for direct contact with the material to be printed than would be produced if the stencil were formed on the outside of the support where the inside peripheral surface of the stencil, and not the outside, would be next to the conductive surface **21**. To this end, I employ a matrix of the character shown in the present illustrative process represented in Figs. 2, 3 and 5 for making a cylindrical printing stencil, in which the foundation member **22** is preliminarily prepared separately from the support **28** and consists of a piece of sheet material, such as paper or other suitable thin flat material, on which there is carried an exterior layer of wax which is suitably applied thereto, as by impregnating or coating the sheet material. Applied to said wax surface of the foundation member **22** is a thin layer or coating of graphite or a metal powder to provide the conducting surface **21**, the graphite or powdered metal being dusted over the entire outer surface of the foundation member **22** intended to receive the required layer of electro-deposited metal forming the shell **20**. I then coat portions or areas **26** of the outer surface of the electrically conductive surface **21**, thus formed, with a material incapable of conducting electricity and applied in the design or pattern which are to be holes in the final stencil, such as, for example, the holes **23**, **24** and **25**, as shown in Fig. 1. By making the matrix as described above, the holes which constitute the required perforated design or pattern in the final stencil cylinder will be produced electrolytically during the subsequent electro-plating process hereinafter to be described for electro-depositing the metal layer to form the shell **20**, said holes being produced by reason of the non-deposition or non-adherence of the plating metal upon the electrically non-conductive areas **26** which interrupt the continuity of the conductive surface **21** and are carried by the conductor surface at locations thereon corresponding to the design or pattern arrangement intended to be reproduced. To this end, the non-conductive areas **26** are made of a suitable electrical insulating material, such as asphalt or a casein paint, which is applied as a surface coating to cover portions of the electrically conductive surface **21** in the same pattern and at locations thereon which are to be the holes desired to be produced in the final stencil. The electrically non-conductive coatings **26** may be applied to the conductor surface **21** in any suitable manner, such as by a printing process, or by being painted thereon with or without the use of a stencil, or by spraying the coating material through a stencil, the manner of application being readily effected by reason of the flat form of the foundation member. The complete matrix, thus made, may be either wrapped around the exterior surface of the cylindrical support **28**, as indicated in Fig. 5, or it may be rolled into cylindrical form and inserted inside the hollow cylindrical support **28** as shown in Fig. 2, in which instance the circumferential length of the rolled sheet being such as to enable the sheet to fit closely against the inner peripheral surface of the hollow support **28** to completely cover the same and also expose complete hole patterns or designs. The support **28** thus prepared with the matrix is then suspended within a tank containing a suitable electrolyte, such as copper sulphate, and by the action of electric current an electro-deposit or plating of copper to the thickness desired is deposited by the usual electro-plating process on the portions of the electrical conductive surface layer **21** that are not covered by the insulated coatings **26**.

In Fig. 19, I have illustrated diagrammatically the electro-plating process in which a support **28** with the matrix mounted on the outside thereof, is suspended in the plating bath containing an electrolyte solution E, a metal anode

of the metal to be plated, such as copper, and source of electric current C in order to produce ıe metal deposit by electro-deposition. In this stance, the stencil cylinder is produced electro-tically on the outside of the support and the ıode **29** is disposed exteriorly of the support. :owever, when the stencil cylinder is to be ›rmed inside of the support **28**, the anode **29** ıen will be disposed within the hollow support, nd the electro-plating process will be carried ıt in the general manner as just described above › obtain the desired deposit of the plating metal. 'he deposited metal layer **20**, thus formed and 'hich constitutes the final stencil cylinder, may hen be removed from the support **28** when the equired thickness of the plating is obtained hereon, by melting or softening the wax layer **2** to an extent sufficient to effect separation of he metal layer **20** from the support **28**. In the mbodiment illustrated in Fig. 5, the metal de-›osit **20'** is shown as being formed over the out-ide of the support **28**, thus distinguishing in this ›articular from the process just described in ›onnection with Figs. 1 to 4 in which the final ;tencil is shown as being produced within the ;upport **28**. In other words, the metal deposit **!0'** is produced in the same manner as the forma-;ion of the layer **20**, above described, and the ›rocess steps utilized to obtain electro-deposition ›f the metal may be the same as those described in connection with the formation of the stencil within the cylindrical support **28** except that the wax layer **22** carrying the layers **21** and **26** is wrapped around the exterior surface of the cylinder **28** instead of being placed inside thereof as in the previously described embodiment shown in Fig. 2. If desired, the outer surface of the cylinder **28** may be coated with a layer of wax and the conducting layer **21** and the insulating coating **26** applied in succession thereto.

In Figs. 6 to 9 inclusive, I have illustrated diagrammatically my preferred process in which I first prepare a base or support **30**, which may be in the form of either a sheet or as a solid, or as a hollow cylinder, and made either of a metal or a non-metal, with an outer surface coating **31** of wax upon the top surface of which is then applied coatings **32** of a material which is a non-conductor of electricity and arranged in the design to be holes in the final stencil. The coatings **32** may comprise a suitable paint, such as a casein paint, which is susceptible to attack by suitable chemicals or soluble in a liquid such, as for example, water. The entire body including the whole surface with the painted design is then coated with a coating **33** of graphite or a metallic powder to form an electrical conducting surface and the body then immersed into a liquid of a character capable of acting on the paint to remove the surface of the paint to release the graphite or metal powder attached thereto at such locations, thereby destroying the electrical conducting surface **33** of the sheet or solid at the coated areas so that during subsequent electroplating of the sheet or solid by the usual electroplating process, the layer **35** of plated metal, such as copper, will be deposited only where the graphite or powder is present. When the desired thickness of plated copper is obtained, the support **30** is then removed from the plating bath and the metal layer **35**, which may be of cylindrical shell-like shape, separated and removed from the support by melting the wax layer **32**.

In Figs. 10 to 13 inclusive, I have shown a different modified process for providing a stencil, in which I first provide a base **40**, made of material of low fusibility such as wax, in a sheet or a solid form, with a layer **41** of an electrically conductive material, such as graphite or a metal powder, to which I then apply on parts of the outer surface of the layer **41**, a coating **42** which is arranged in the same pattern or design which are to constitute the holes in the final stencil, and applied in a suitable manner, such as by being printed or painted on the outer surface of the layer **41** with a substance which will resist electro-deposition of metal, such as asphaltum or a lacquer. The sheet or solid, thus prepared, may then be immersed into an electroplating bath containing a solution of copper sulphate as the electrolyte, the composition of which may be that usually employed in the art of copper plating, and the desired thickness of an electro-deposit of copper deposited on the portions of the sheet or solid uncoated with the resist coating **42**. The electro-deposited metal layer **43**, which is the final stencil, may then be separated from the base in any desired manner, such as by melting or softening the wax base **40** to permit the metal deposit **43** to be peeled off or disconnected successfully.

In another modified process, as represented in Figs. 14 to 18 inclusive for electrolytically producing a stencil, I first coat a base **50** in the form of a sheet or a solid, which may be either a metallic or a non-metallic material, with a layer **51** of wax after which the outer surface of the wax coating is dusted with graphite or a metallic powder to provide an outer electrical conductive coating **52**. The metal coated product, thus formed, may then be subjected to treatment in a copper plating bath on which a thin "flashing" or layer **53** of copper is electro-deposited over the graphite or metal powder coating **52**. This deposit or "flashing" layer **53** may then be covered with the resist coating **55** of paint, such as asphalt, or a varnish, or a lacquer, in the desired arrangement of pattern or design where it is desired that holes appear in the finished stencil. The laminated body may then be immersed in a copper plating bath and the electroplating operation carried out for a sufficient time to build up the desired thickness of copper to form the layer **56** with the arrangement of holes appearing at positions where the pattern is required and which will be the final stencil. Where the required thickness of metal deposit is obtained, the metal layer **56** forming the final stencil may then be detached from the support by heating the wax coating **51** after which the thin "flashing" layer **53**, at the points covered by the resist paint coating **55** is applied, may be removed by disrupting the thin flashing in a suitable manner, such as by a harsh brushing operation to break out the holes so that there will remain the complete holes through the stencil arranged in the design which is required.

The foregoing description is directed towards the methods and constructions illustrated, but I desire it to be understood that I reserve the privilege of resorting to all the equivalent changes to which the constructions and methods are susceptible, the invention being defined and limited only by the terms of the appended claims.

I claim:

1. The method of producing a printing stencil comprising the steps of providing a base having a waxed surface, coating portions of the waxed

surface of said base with a material which is soluble and removable from said waxed surface by being dissolved therefrom, said coatings forming areas on the waxed surface corresponding to the desired pattern and at locations which are to be holes in the final stencil, covering the whole of said exposed waxed surface of the base and also the surface of said soluble coatings with a metallic material which is a good conductor of electricity and in a finely divided state, then removing said soluble coatings from the waxed surface of the base by treatment with a liquid of a character capable of dissolving said soluble coatings and which does not dissolve the wax to release the finely divided electrically conductive material attached thereto and leave areas of wax exposed to view in the conductive metallic layer at the locations formerly occupied by said soluble coatings and at locations which are to be holes in the final stencil, electrically depositing a metal on the metal coated surface of the base to form the final stencil, and then removing the deposited metal from said base.

2. The method of producing a printing stencil comprising the steps of providing a wax-coated base member, coating parts of the waxed surface of said base with casein paint, said coatings being applied to areas on the waxed surface corresponding to the desired pattern and at locations which are to be holes in the final stencil, coating the whole of said exposed waxed surface of the base and also the surface of said casein coatings with a metal powder having good electrically conductive properties, removing said casein coatings from said waxed surface by the action of a liquid of a character capable of acting on casein paint to destroy the same and release the metal powder on the surface of the casein but which does not act on the wax to thereby leave areas of wax exposed to view in the conductive metal layer at portions thereof formerly occupied by said casein paint and at locations which are to be holes in the final stencil, then electrically depositing copper on such metal surface of the base to form the final stencil and then removing the deposited metal from said base.

3. The method of producing a printing stencil comprising the steps of providing a support having a waxed surface, coating portions of the waxed surface of said support with casein paint, said coatings being applied to areas on the waxed surface corresponding to the desired pattern and at locations which are to be holes in the final stencil, covering the whole of said exposed waxed surface of the support and also the surface of said casein-coated areas with powdered graphite to provide an electrically conductive surface, removing said graphite-coated casein areas by dissolving the same with a material in which the wax is insoluble to disrupt the continuity of said conductive surface and leave openings therein exposing to view the wax-coated surface of the support at the locations formerly occupied by said casein material and corresponding in design to the pattern arrangement desired to be produced as holes in the final stencil, thereafter electrically depositing copper upon the graphite-coated portions of said support and then removing the deposited metal from the base.

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