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G. B. CROUSE ET AL
MANUFACTURE OF TEMPLATES

2,405,090

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Fig. 1

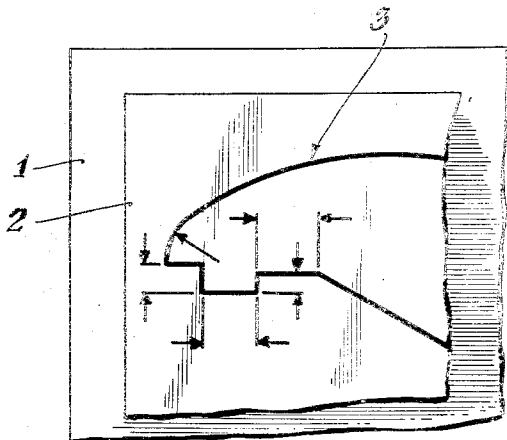


Fig. 2

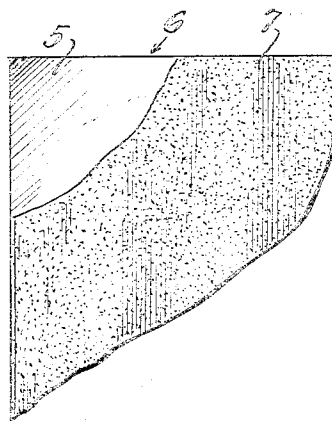


Fig. 3

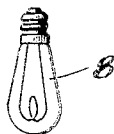
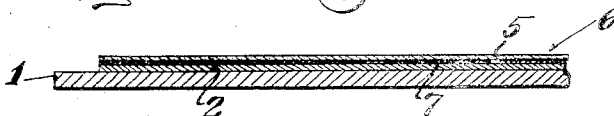
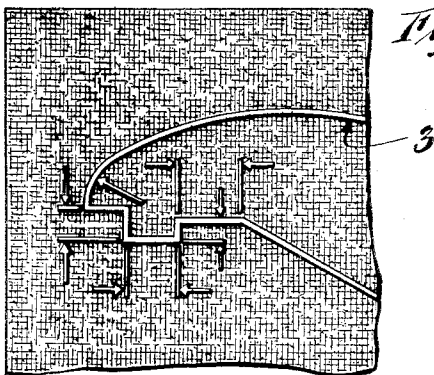


Fig. 4



Fig. 5



INVENTORS
George B. Crouse
Francis A. Holt
BY *Norman A. Holland*
ATTORNEY

UNITED STATES PATENT OFFICE

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MANUFACTURE OF TEMPLATES

George B. Crouse, East Setauket, and Francis A. Holt, Shoreham, N. Y., assignors, by mesne assignments, to Photo-Positive Corporation, New York, N. Y., a corporation of New York

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2 Claims. (Cl. 41-41)

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The present invention relates to the manufacture of templates and more particularly to the production of drawings or designs on template blanks.

Templates or patterns made of metal are used extensively in the aircraft industry to facilitate the manufacture of parts. Extreme accuracy is desirable and generally necessary to assure proper fitting of finished parts and to eliminate excessive strains on rivets and other connecting means. Generally one of the first steps in the manufacture of templates or patterns has been to make a full size drawing of the particular part and then painstakingly copy it, together with all dimensions and notes, by hand to a sheet of metal or blank from which a template is to be made. Extreme accuracy is important in the drawing on the template blank, which increases the time and effort required. After the drawing has been copied on a blank, the blank is cut or shaped according to the drawing thereon and the template is then used as a guide or pattern in the manufacture of parts. Accurately copying a drawing by hand on a template blank requires considerable time and is quite expensive.

The present invention aims to overcome the above and other difficulties or disadvantages by providing a new and improved method of forming accurate reproductions of original drawings on surfaces such as template blanks without the necessity of laboriously copying lines, dimensions and notes thereto by hand from an original drawing.

An object of the present invention is to provide a new and improved method of making templates.

Another object of the present invention is to provide a method of making photographic reproductions of drawings on metal surfaces.

Another object of the present invention is to provide a method of making templates which is more rapid and less expensive than previous methods.

Another object of the present invention is to provide a new and improved method of forming reproductions of drawings directly upon the metal surfaces of template blanks.

Another object of the present invention is to provide a new and improved article adapted to be used for transferring representations of drawings to template blanks.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various

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advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawing, forming a part of the specification, wherein

Fig. 1 is a fragmentary top plan view showing a drawing of a part;

Fig. 2 is a fragmentary top plan view showing a backing material having a light-sensitive surface;

Fig. 3 is a sectional view illustrating the making of a photographic reproduction of the drawing of Fig. 1 on the light-sensitive surface of Fig. 2;

Fig. 4 is a sectional view illustrating the transfer of a drawing from the material of Fig. 2 to a template blank; and

Fig. 5 is a fragmentary top plan view of the representation of the drawing formed on the template blank of Fig. 4.

Referring again to the drawing, an original drawing for a template is shown in Fig. 1. To avoid inaccuracies due to expansion and shrinkage the drawing should preferably be made on metal, glass or other rigid material which may be coated as desired to facilitate drawing thereon. As illustrated in Fig. 1 a sheet of drawing paper 2 is adhered to a rigid backing 1. In order to avoid wrinkles in the paper, the usual vacuum printing frame may be utilized to hold the paper flat against the surface until the adhesive becomes effective. The backing prevents the paper from material expansion or shrinkage. Preferably the drawing 3 formed on the sheet of material 2 is made full size and constitutes an original or master drawing of the part of which the template is to be made. All of the various dimensions and notes required on a template blank are also preferably placed on the original drawing.

In making a template, a reproduction of the original drawing 3 of Fig. 1, together with all references and notes appearing thereon, must be transferred to a template blank. Previously this operation was tediously and painstakingly performed by hand for each template desired; the operation required much time and was expensive. The drawing formed on a template blank must correspond exactly with the original master drawing, otherwise costly errors are likely to result in connection with the manufacture of parts from the resulting template. It is hence important that the transferring means and method be as accurate as is reasonably possible, which is

achieved herein by an improved method of reproduction.

The problem of obtaining a suitable material 5 for receiving and retaining a light-sensitive emulsion 7 as shown in Fig. 2 is difficult. It is desirable that the material 5 be transparent where a direct print is to be made and translucent where a reflex print is to be made. In addition, the material has to be subjected to processing solutions and to changes in temperature and humidity without expanding or shrinking materially in order to maintain the high dimensional accuracy required. We have found that the synthetic manufactured by the Goodyear Tire & Rubber Company Inc., of Akron, Ohio, under the trade name "Pliofilm," which uses rubber hydrochloride as a base, is particularly suited for the purposes. We have found that in addition to being water repellent the dimensional stability of the synthetic is good over the entire humidity range and the dimensions of the material are not affected by normal conditions of heat and cold. This material, though flexible, can be used as a backing for the light-sensitive emulsion and accurate dimensional characteristics maintained in the reproduction and transfer to the metal blank. We therefore prefer to use this material for carrying the light-sensitive emulsion or material 7. Other materials found to have similar characteristics are thin sheets of vinyl resins which may be obtained from the Carbide and Carbon Chemicals Corporation under the name "Vinylite." While the latter and possibly other materials may be utilized, we prefer Pliofilm by reason of the unusual characteristics it is found to possess, which make it particularly adapted for the purpose.

Where the layer 7 comprises an emulsion or other similar material, it should be spread smoothly and evenly in a uniform layer over the "Pliofilm" backing and allowed to dry thereon. Since the backing material 5 has substantially constant dimensional stability, the emulsion or other material which adheres thereto is likewise subject to a minimum amount of distortion. Preferably the light-sensitive layer 7 of emulsion or other suitable material comprises a metal salt, for example, a silver salt such as silver chloride or silver bromide. A suitable light-sensitive layer 7 may be chosen to give either a negative print or a positive print. Both types of such materials or solutions are well known. The action of materials such as the silver salts will be hereinafter described.

In instances where the original sheet of drawing material 2 is adhered to an opaque backing material, a representation of the drawing may be formed on the transfer sheet 6 by a known reflex printing process, as illustrated in Fig. 3. It has been found that in utilizing a reflex process, better results will be obtained if the "Pliofilm" or other backing material is translucent rather than transparent.

Where the backing 1 for the drawing material 2 is formed of a transparent, translucent or other light-pervious material, the source of illumination 8 may be placed so that light rays from it pass through the backing 1 and drawing material 2 to form a representation or reproduction of the drawing 3 on the light-sensitive layer 7. When this procedure is utilized the dimensionally stable backing material 5 may be opaque. The main difference between the reflex and direct modes of forming a representation of the drawing on the light-sensitive layer 7 is that in one the

light rays first pass through the layer 7 itself to form a representation of the drawing on the light-sensitive layer 7, and in the other instance the light rays first pass through the drawing board 1 and drawing paper 2 to form a representation of the original drawing on the light-sensitive layer 7. The exposure of the drawing by either of the two methods is done while the drawing and light-sensitive layer 7 are in actual contact; this is effective to give a clear, sharp line reproduction on the light-sensitive layer 7. In both cases the transfer is by contact printing which prevents inaccuracies. Since the drawing is in contact with the surface of the emulsion or other suitable material the reproduction must be exact.

The two above described methods of exposure are illustrative merely. After exposure to the original drawing by the above or any other method, the transfer sheet 6, comprising the backing material 5 and light-sensitive layer 7, may be subjected to various processing steps such as developing, fixing and washing to stabilize or fix a reproduction of the original drawing on the transfer sheet. In most instances the reproduction formed on the light-sensitive layer 7 will be rendered visible by this step. For example, where the metal salt in the light-sensitive layer 7 is silver chloride, the transfer medium may be first developed in any usual photographic developing solution; it may then be subjected to the usual hypo (sodium hyposulphite or sodium thiosulphate) fixing bath and thereafter washed in water long enough to free the light-sensitive layer of hypo. It may be then placed in what is commonly referred to as a bleaching bath. As an example of such a bath, the following is found to be satisfactory; water, one litre; potassium permanganate, 5 grams; potassium chloride, 50 grams; concentrated sulphuric acid, 10 millilitres. The transfer medium or sheet 6 is preferably immersed in this bath until all of the developed silver image is reconverted into silver chloride, as evidenced by the fact that the black color of the silver disappears and is replaced by the white opalescent appearance of silver chloride. The transfer medium 6 is then transferred without washing to a clearing bath which may be, for example, water, one litre; sodium sulfite, 7½ grams; neutral potassium oxalate, 5 grams. This latter clearing bath removes any pink stain left by the bleaching bath. The fixing bath is for the purpose of getting rid of the silver salt in the lines or those portions of the image which are to be clear in a final transferred image.

The following is an alternate bleaching bath which may be utilized with good results: water, one litre; potassium ferricyanide, 50 grams; potassium chloride, 50 grams. With this bleaching bath no clearing bath is necessary, a short rinse in water being all that is required.

A further example of a bleaching bath which may be used with good results is: water, one litre; potassium ferricyanide, 50 grams; potassium sulphocyanate, 50 grams. With this bleaching bath no clearing bath or rinse is necessary. However, a transfer medium must not be left in the bleaching bath for too long a period of time or the lines which form the reproduction of the original drawing will be cut back and widened.

If desired, a "wash-out" method may be utilized to make the transfer medium. In these known wash-out methods the sensitized layer generally comprises gelatine formed of potassium bichromate or ammonium bichromate which hard-

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en when exposed to light; the unexposed portions of the gelatine may be washed off with warm water and the hardened portions will remain adhered to a backing material. By putting into the gelatine a silver or some other suitable metal salt the electrolytic process hereinafter set forth may be used to transfer the design to a metallic surfaced template blank.

After being processed by the desired developing, fixing, washing, bleaching or clearing baths, the transfer medium 6 is placed while still moist, emulsion side down, against the metal surface of a template blank. Template blanks are usually made of metal and are frequently zinc coated. When the emulsion has been in contact with the metal surface for a proper time, depending to some extent upon the particular type of bleaching and clearing baths utilized, it may be removed from the metal surface and a representation or reproduction of the original drawing 3 will be visible on the zinc or other surface of the metal template blank. With the first mentioned bleaching and clearing baths, a contact period of a few minutes between the light sensitive layer 7 and metal surface of a template blank is sufficient to form a clear and sharp representation of the original drawing on the metal. With the first alternate bleaching bath hereinabove described, the transfer to the metal requires about 4 to 5 minutes. The second alternate bleaching bath described above transfers a good sharp image more rapidly, but the transfer medium must not be allowed to remain in the bleaching bath for too long a period of time or, as pointed out above, the lines of the negative will be cut back and widened. The representation of the original drawing may thus be transferred directly to the surface of a template blank; the template blank need not be first coated or chemically treated in any way. Furthermore, it is not necessary to subject the template blank to any development, fixation, or washing steps. The image forms directly on the metal surface by chemical reaction. This is a distinct advantage for it eliminates the necessity of such operations or steps and greatly speeds up the manufacture of templates.

In some cases it may be desirable to make the drawing with a special ink or pencil containing a metal salt or the like, directly upon the surface of a dimensionally stable material. For example, the pencil or ink may contain a salt of copper such as copper carbonate. When the design formed with this pencil or ink is moistened with an electrolyte such as a solution of sodium carbonate and placed in contact with a template having a surface of a baser metal, e. g., zinc (or some other metal chosen from the group higher in the electromotive series than the metal of the salt) a representation of the design will be chemically transferred directly to the surface of the template blank.

Another modified form of the invention comprises first coating the entire surface of a dimensionally stable material with a metal salt or other suitable material and thereafter making a design on the coating by drawing it directly on the coating with a medium that will cover the surface of the metal salt or other suitable coating material only at the places where the lines of the design are made. Thus, if a lead pencil is used to draw a design on a photographic emulsion such as is shown in Fig. 2 and then the entire emulsion coating is moistened with sodium sulphite and placed into contact with the surface of a baser metal, an image or representation of

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a design will be transferred to the metal surface by chemical reaction. A similar result may be obtained by making the design with a sharp instrument that will scratch through the coating and expose the underlying material; in this instance either an underlying material or the coating material may be the one which reacts with a template blank to form an image thereon.

In the alternate methods, the distinctness or clarity of the original design on the transferring media decreases with successive reproductions. There are cases, however, in which only one or two templates are desired; in such cases the loss or decreasing clarity of the original design made on the transferring media is not serious, particularly where the original may be stored for record purposes, as the lines made of copper carbonate or similar material still remain visible even after portions of the copper are deposited on the metal surfaces of two or three different template blanks. The two modifications are particularly useful in connection with the making of an original type of airplane for a good many original drawings have to be discarded due to changes made during the designing of the plane; by using a copper carbonated ink in making the original drawings, the first step of the preferred method wherein a drawing 3 is transferred from a drawing material 2 to a transfer medium 6, may be eliminated and yet the transfer sheet with the original drawing formed upon it may be stored available for record purposes. In the event that templates are desired for commercial production thereafter, the photographic method may be used to obtain prints or reproductions from the original and these latter reproductions utilized to transfer the design to template blanks.

Where the light-sensitive material 7 is suitably treated and placed in contact with a zinc or other similar metallic surface the image formed is clear and distinct. It is accurate because it was made by contact with the photographic print, which in turn was made by contact with the original drawing, or because made by direct contact with the transfer sheet of one of the above modified methods. Representations of the original drawing may also be formed in a similar manner by applying the light-sensitive layer 7 of the transfer medium 6, or the layers of the modifications, against various other metals such as tin plate, cadmium, polished iron and steel, and aluminum. In the case of aluminum, however, the protective oxide film should first be removed; this may be done by dipping the aluminum for a short period of time in a hot caustic soda solution. In general, transfers may be obtained to any metal which is more electropositive than silver. Where templates are to be made of plywood, plastic materials, etc., the surfaces of such non-metallic blanks may be metallized by coating them with a suitable electropositive metal. The template design may thereafter be transferred to the metallized surface as above described and the blank cut away to form a template. When the sheet 7, having thereon a positive or negative image in the form of a silver (or other relatively noble metal) salt, is in contact with a relatively base metal such as zinc, the zinc and silver interchange, the zinc being converted to a salt and the silver being reduced on the surface of the zinc and becoming affixed thereto. In general, the transfer of the silver to a metal surface will be more rapid and more complete if the light-sensitive layer contains a solvent for the silver salt. Examples of such

solvents are those contained in the bleaching baths hereinabove referred to—for example, sodium sulphite, potassium chloride, and potassium sulphocyanate.

If the template blank or template is to be subjected to rubbing or rough usage, a coating of lacquer or some other protective material may be applied to prevent the image from being marred.

In practicing the present method, a full size drawing is first made on a rigid material or on a sheet of material secured by adhesive or other suitable means to a relatively rigid backing material. The backing material may be either opaque or light-pervious. A sheet of light-pervious, moisture resistant, dimensionally stable material such as "Pliofilm" or "Vinylite" is next provided with a light-sensitive material or emulsion at one side thereof; since the backing for the light-sensitive material or emulsion is not subject to change in dimensions, it likewise minimizes changes in dimensions of the material or emulsion adhered thereto. The next step in the method is to transfer a representation or reproduction of the original or master drawing to the transfer sheet or medium. This may be done by the reflex method in which the light passes through the negative onto the drawing. If the relatively rigid backing for the drawing material is formed of a translucent or transparent material, light may be passed through the backing material and the drawing to form an image or representation of the original drawing on the negative or transfer medium. In this instance, the transfer medium will be located at the opposite side of the rigid backing from the light source. After exposure the transfer medium is subjected to the desired developing, fixing, bleaching or clearing baths to form an image in the form of a metal salt. While still moist, the transfer medium may be laid with the light-sensitive or emulsion side down against the surface of a metal template blank. After the negative and transfer medium have been in contact for an appropriate length of time, they may be separated and a representation of the original drawing will have been formed on the surface of the metal template blank. In some instances, it may be more convenient to allow the transfer medium to dry and to form a representation of the original drawing on a template blank at a later date. In such instances, the dry transfer medium or the surface of the template blank may be moistened before placing them in contact. While the present invention has been described chiefly with reference to the manufacture of templates, it will be clear that it may be readily used in applying drawings or designs to metal surfaces generally. Where the drawing is formed directly upon a surface as described in connection with the modified forms of the invention, this surface may be applied against a template blank as in the preferred embodiment, in the same manner as to form a design on said blank. These modified methods have the advantages of eliminating the necessity of first transferring a design to a transfer medium from an original drawing.

The equipment for applying a transfer medium carrying a design to a template blank may be of the simplest sort. For example, the Pliofilm with the drawing or design on it may be laid on the surface of a template blank and a sheet of material, for example, Vinylite, placed over it and pressed downwardly. There is less chance of dimensional error where a supplemental sheet

is laid over the transfer medium. A convenient manner of pressing a Vinylite or other sheet against the transfer medium is to use a squeegee to press the two firmly into contact. It is not necessary that the transfer sheet be pressed with any substantial force against the template blank; all that is required is a good surface contact.

With any of the methods, the entire transfer operation from the original drawing to the template is simple and accurate because it is performed by contact operations. The several steps may be performed in a few minutes regardless of how complicated the drawing is.

It will be seen that the present invention provides a new and improved method and article adapted to be used in the manufacture of template blanks. The moisture resistant and dimensionally stable backing utilized in the transfer medium or negative holds the drawing, light-sensitive material or emulsion against change in dimensions and thus minimizes any possibility of variation from the original drawing. A design is either created or re-created in the form of a metal salt and placed while in the presence of an electrolyte in which the salt is at least partially soluble, in contact with a template blank having a surface comprising a metal of greater degree of baseness than the metal of said salt. Actual contact between the various materials during each of the design-transferring steps of either the preferred or modified methods provides a clear, sharp line, accurate reproduction of the original drawing on a final template blank. With the modified forms of the invention wherein a design is made directly upon the transfer mediums, the latter may be placed face down directly against a metallic surface to form a design on a template blank. The preferred and modified methods are rapid and relatively inexpensive and may be practiced without the use of skilled and highly trained help. An accurate representation or reproduction of the original drawing is formed directly on the metal surfaces of template blanks. The blanks may then be cut along the lines thereon to complete the templates.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the scope and spirit of the invention and without sacrificing any of its advantages, it is to be understood that the matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. The method of transferring a drawing to a template blank, which comprises applying a light-sensitive emulsion containing a metal salt to a dimensionally stable backing material comprising a moisture-resistant base such as rubber hydrochloride, exposing said emulsion to a drawing, treating said emulsion to form a reproduction of the drawing, placing the emulsion side of said backing in contact with a template blank having a metal surface higher in the electromotive series than the metal of said salt, while the surface of one of said materials is moist, and maintaining said surfaces in contact until a representation of the lines of said drawing forms on the flat surface of the template blank by chemical reaction of the salt.

2. The method of transferring a drawing to a template blank, which comprises applying a light-sensitive emulsion containing a silver salt to a backing material comprising a moisture-resistant base of rubber hydrochloride, exposing said emulsion to the drawing, treating said emulsion to

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obtain a reproduction of the drawing, placing the emulsion side of said backing in contact with a template blank having a surface coating containing a metal such as zinc, while the surface of one of said materials is moist, and maintaining said surfaces in contact until a silver represen-

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tation of said drawing forms on the flat coated surface of the template blank by chemical reaction.

GEORGE B. CROUSE.
FRANCIS A. HOLT.