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W. H. GAGE ET AL

2,369,960

METHOD OF MAKING TEMPLATES

Filed Dec. 6, 1943

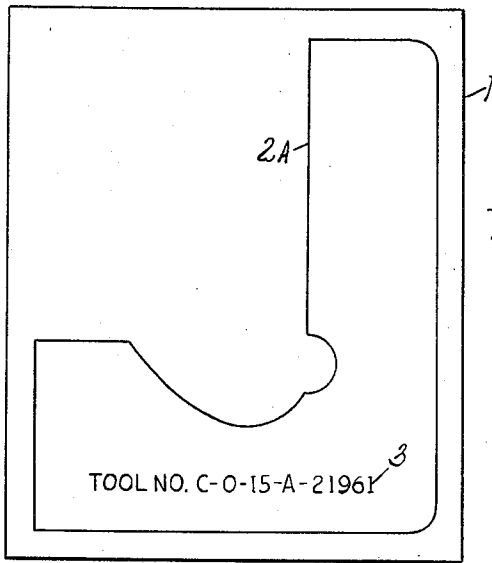


Fig. 1.

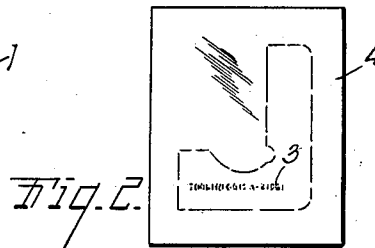


Fig. 2.

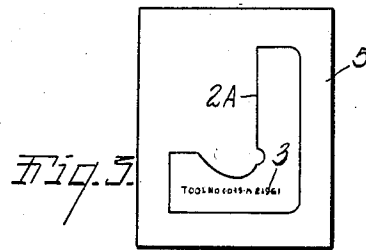


Fig. 3.

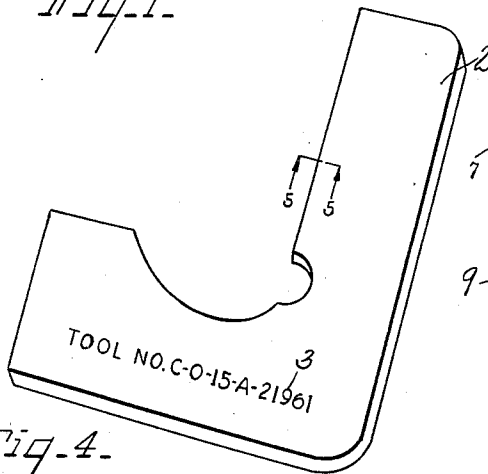


Fig. 4.

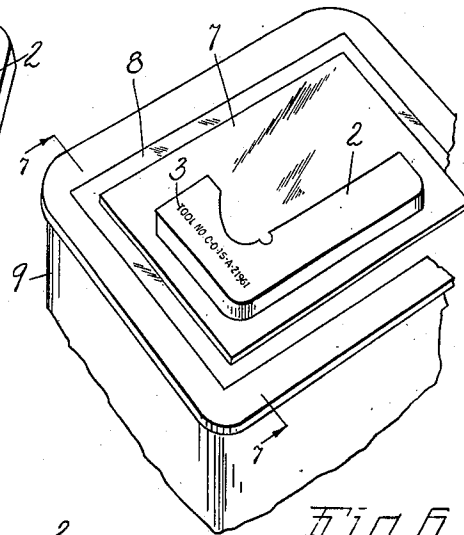


Fig. 5.

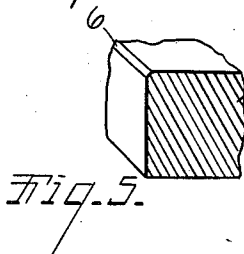


Fig. 6.

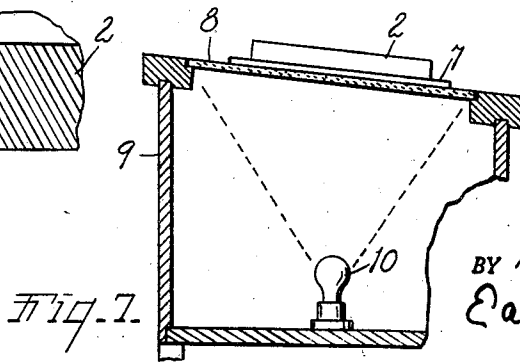


Fig. 7.

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METHOD OF MAKING TEMPLATES

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2 Claims. (Cl. 76—107)

This invention relates to improvements in method for producing profile templates, contour or profile gages, flat profiled tools, cams and the like. This application is a continuation in part of our copending application Serial No. 468,022, filed December 5, 1942.

The main objects of the invention are:

First, to provide a method for producing profile templates for lathe turning grinding, etc.; profile and contour gages for measuring and checking the production of a given shape that has been turned or cut; cams used on the tail stocks of lathes and similar machines for reproducing mechanically a cut or turned shape that corresponds to the profile or shape of the cam; and similar flat profiled shapes for use as small tools and component parts of interfitting parts.

Second, to provide a method in which contour lines, markings and identifications are clearly, accurately and uniformly incised into the metal by etching.

Third, to provide a method in which a portion of an etched contour line remains along the edge of the profile template or similar tool to indicate the degree of accuracy with which said template or similar tool is cut from the metal plate.

Fourth, to provide a method to check as to the degree of accuracy with which a template or similar article is being produced on finish grind of these articles, in the event of there being any distortion of the etched contour lines caused by heat treating for hardening of the template after the same has been preliminarily rough cut from a steel or other plate, along the etched contour line.

Fifth, to provide a method whereby duplicates of the original may be easily and quickly supplied and whereby said duplicates are identical.

Further objects relating to details and economies of our invention will appear from the description to follow. In the accompanying drawing illustrating certain of the steps and a part of the apparatus used in the method of producing a profile template:

Fig. 1 is a plan view of a drawing to be photographically reduced in size, said drawing indicating an enlarged outline of a profile template, with identification marks within the outline.

Fig. 2 is a plan view of a negative showing a photographic reduction of the enlarged drawing of Fig. 1, the reduction being to the exact size of the template or other tool to be produced.

Fig. 3 is a plan view of a flat metal plate having the etched outline of the template thereon, said

etched outline having been produced by steps including the use of the negative shown in Fig. 2.

Fig. 4 is an enlarged perspective view of the template after having been cut from the metal plate along the etched contour line shown in Fig. 3.

Fig. 5 is a fragmentary section on the line 5—5 of Fig. 4 showing a small portion of the width of the etched contour line, greatly enlarged.

Fig. 6 is a perspective view of a light box having a transparent top, with a transparent positive superimposed thereon and with a template superimposed on the positive for comparison with the positive.

Fig. 7 is a sectional view of the light box on the line 7—7 of Fig. 6, looking in the direction of the arrows.

The steps of the method of the invention will now be described in reference to the accompanying drawing, in which the numeral 1 designates an enlarged drawing showing the enlarged outline 2—A of the profile template 2 and the tool number or other identification data 3 within said outline. The enlarged outline 2—A of the template 2 is drawn as a plan, made from a blue print, a part, an engineer's sketch, or any other source of information. The drawing 1 is done first by careful pencil layout methods and then inked in to provide a line drawing, in black and white for photographic reduction to the size of the article to be produced. The outline 2—A is made as many times larger than the template 2 or other flat profiled tool to be produced, as is practical. This can range from several times on larger objects to as many as fifty or seventy-five times in the case of minute shapes. By thus making the drawing of a size many times greater than the article to be produced, in the event of any error in making the same, this error in the photographic reduction is greatly reduced. This greatly enlarged drawing also results in very fine sharp contour lines in the negative, the purpose for which is hereafter described.

The enlarged drawing 1 is photographically reduced in a camera. The reproduction is done by photographic processes which have long been known as component parts of the art of making photo-engravings, and as is disclosed for instance in more detail in the above-mentioned copending application. A wet plate negative 4 is thus carefully made with the contour line accurately sized to the template or gage to be produced, and with shrinkage allowances calculated. This negative may or may not be stripped (reversed from left

to right) as is desired, and depending upon whether or not a reversing prism has been employed on the camera.

The identification data 3 may be either a part of the enlarged drawing 1 or be drawn or type set on a separate sheet, which is photographically reproduced, the negative thereof being inserted within the template contour line of the negative 4.

A positive on glass is then made of these combined negatives or of the single negative 4 of Fig. 2, for the purpose of changing what is black and transparent in the negatives to transparent and black, respectively, in the positive. The positive is an image, to exact size, in black lines on a transparent background of the template 2 or other flat profiled tool to be produced. A very fine, thin black line, reproduced from the very fine thin transparent line of the negative, defines all edges and contours. This line may be one or two thousandths of an inch in width and forms the limit to which the work will be cut.

A metal plate 5, cut from a larger plate, is surfaced smooth by grinding or other means and is then cleaned by mechanical and chemical means for receiving a sensitizing coating of albumen glue or shellac base sensitizer. This sensitized coating is applied to this surface by any of several means, all basically alike in that the plate 5 is flowed with the sensitizer, placed onto a device that whirls it centrifugally, giving a thin even coating which dries onto the surface while whirling.

The metal plate 5, thus sensitized, is placed with its sensitized surface in contact with the image side of the glass positive heretofore described, in a printing frame, the air between the surfaces of the plate 5 and positive being exhausted by vacuum or pressure. The sensitized surface of the metal is exposed to light through the positive, providing for a reproduction of the image on the positive onto the metal. The sensitized surface of the plate 5 is then developed in the manner required for the sensitizer used, hardening and toughening of the developed image being usually effected by heating. The plate 5, with the image of the template 2 and the identification or other data 3 reproduced thereon, is then protected on its edges and back by methods in common use and is placed in an acid bath or etching machine and etched until the lines thereon are incised as deeply as desired. Contour and defining lines, identification data and layout information, are etched into the metal, the background remaining untouched. As above described, the printing onto the photo-sensitized surface of the metal is with a positive, but such printing may also be done with a negative.

After etching, the metal plate 5 is rough machined or cut to above five thousandths of an inch from the outside of the incised contour line 2—A, to produce the template 2, which is then hardened and finally finish ground. Since nearly all profile templates, contour gages, cams and the like are used where they are subject to wear, it is highly desirable to harden the same at least on the working surfaces. The process of heat treating, for hardening, being one which somewhat changes the surface dimensions of tool steel, results in warp and some distortion, even though minute. Therefore the rough machining is not quite to the outside of the contour line as above described, to allow for finish grind to exact dimensions as hereafter described. The hardening can be localized, as is done frequently to provide a gage that has a hard wear resisting surface and a tough base to

resist breakage, or the hardening can be throughout the gage.

After rough machining the template 2 from the plate 5, and the subsequent heat treatment, the same is ready for completion by grinding. Where a number of templates of the same dimensions are to be made, the same may be locked or riveted together and carried through the finishing operations as a unit, thereby resulting in all being completed absolutely identical.

In the case of templates for profiling form gages and most all pieces where there are some square edges, these edges are ground first, to just divide the etched contour line, as shown for instance at 6 in Fig. 5, checking by measured verification. But as a means for checking the accuracy of the final grind as to the shape and dimensions of irregular shapes, such as are found with reverse curves, blended circles and the like, a contact positive 7 from the original negative 4 is produced with which comparison is made. This positive may usually be a dry plate on glass because of the quite tough emulsion that resists scratches. Comparison of the template 2 to this dry plate positive 7 is made by superimposing the template on the positive, as shown in Figs. 6 and 7, the positive being supported on the transparent top 8 of a light box 9, illuminated by any suitable means as by a light bulb 10. The positive 7 is placed with the image side up and by placing the machined template 2 thereon so that the corresponding parts of the template and image on the positive just approach each other, it is possible by allowing a narrow slit of light to pass between the black image line of the positive and the contour edge of the template, to accurately judge and measure the progress of the finish grind to the ideal shape. When the faintest slit of light can be shown evenly all the way across, the operator can be assured that the template has been ground to match the ideal. For comparative purposes all of the outside lines are available on the positive for checking purposes and to maintain assurance of relation to curved or irregular edges. As shown and above described, the template 2 is superimposed upon the positive 7, but their positions may be reversed with the positive superimposed upon the template.

Another important feature of this invention pertains to the production of male and female shapes from the same layout, as well as component parts that must fit together. Because of the very narrow sharp lines on the positive 7 and on the etched plate 5, the lines of both being reproduced from the very fine lines on the negative 4, male and female shapes can be made at will from the same layout, a method which is highly important in making master gages as well as for component parts that must fit together. For producing a female shape a plate is cut along one side of an etched line, and for a male shape another plate is cut along the opposite side of a corresponding etched line, the etched lines on both plates being reproduced from the same negative 4. The same positive 7 then serves to check both shapes for the finish grind. For making one component part of parts that must fit together, one plate is cut along one side of an etched line, and for the other component part another plate is cut along the opposite side of a corresponding etched line, the etched lines of both plates being reproduced from the same negative 4. The same positive serves to check both component parts in the final finish grind, the interfitted edge of one part being checked by being disposed along one

side of the image line thereof on the positive and the component interfitting edge of the other part being checked by being disposed along the opposite side of said line.

The checking of the template 2 or other flat 5 profiled tool as to shape and dimensions by comparison with the positive 7 during the finish grinding, as above described, assures the production of a template to exact shape and dimensions desired, even though there is warpage and distortion of the template caused by heat treatment 10 of the template after the same has been rough cut from the plate 5.

We have illustrated and described this improvement in a method for producing profile templates, 15 flat profiled tools and the like, in an embodiment which is very practical. We have not attempted to illustrate or describe the same in other embodiments, as it is believed this disclosure will enable those skilled in the art to embody or adapt our improvements as may be desired. The term "precision tool" as used in the claims is intended to include gages, templates, cams and any other tools 20 in which precise outlines are essential.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent is:

1. A method of producing precision tools comprising: making a drawing of the tool outline on 25 enlarged scale; photographically reproducing said drawing on actual scale upon the surface of the metal stock from which tools are to be formed; and also photographically reproducing said drawing upon a plate of transparent material; rough-cutting the tool stock approximately to the outline 30 of the drawing reproduced thereon; heat

treating the tool stock and thereafter grinding the same precisely to said outline, while controlling said grinding by comparing the work with the reproduction on said transparent plate by transmitting light through said transparent plate and interrupting said light by the outline of the work juxtaposed to the outline reproduced as aforesaid on said plate whereby transmitted light will indicate any disconformity of the outline of the work with said outline reproduced on said plate.

2. A method of producing precision tools comprising: making a drawing of the tool outline on enlarged scale; photographically reproducing said drawing on actual scale upon the surface of the metal stock from which tools are to be formed; simultaneously photographically reproducing any desired indicia upon said metal stock and also photographically reproducing said drawing upon a plate of transparent material; etching said reproduced drawing and indicia into said metal stock; roughcutting the tool stock approximately to the outline of the drawing reproduced thereon; heat treating the tool stock and thereafter grinding the same precisely to said outline, while controlling said grinding by comparing of the work with the reproduction on said transparent plate by transmitting light through said transparent plate and interrupting said light by the outline of the work juxtaposed to the outline reproduced as aforesaid on said plate whereby transmitted light will indicate any disconformity of the outline of the work with said outline reproduced on said plate.

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