

Nov. 20, 1945.

G. E. GUELLICH

2,389,504

PROCESS OF MAKING RETICULES OR THE LIKE

Filed Feb. 11, 1943

2 Sheets-Sheet 1

Fig. 1.

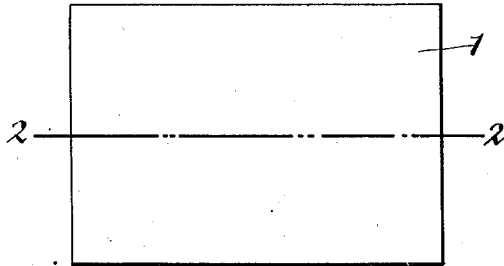


Fig. 2.

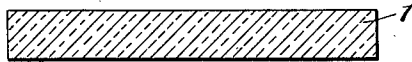


Fig. 3.

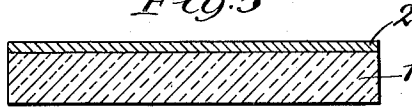


Fig. 4.

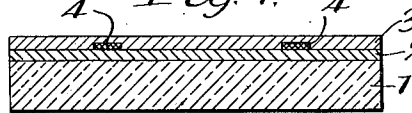
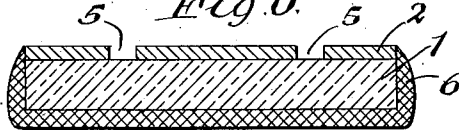


Fig. 5.



Fig. 6.



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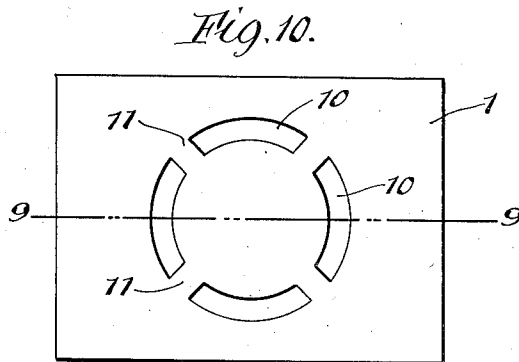
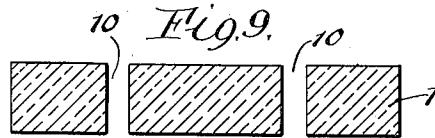
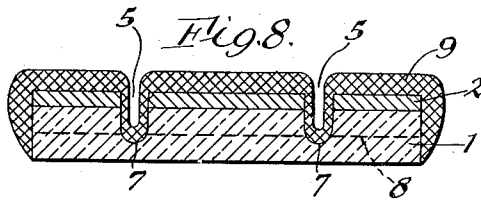
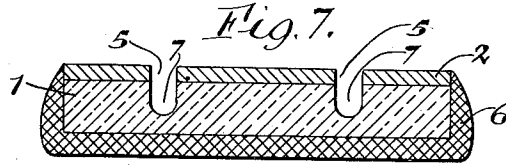
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PROCESS OF MAKING RETICULES OR THE LIKE

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2 Sheets-Sheet 2



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# UNITED STATES PATENT OFFICE

2,389,504

## PROCESS OF MAKING RETICLES OR THE LIKE

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mesne assignments, to American Optical Com-  
pany, Southbridge, Mass., a voluntary associa-  
tion

Application February 11, 1943, Serial No. 475,556

### 1 Claim. (Cl. 95-5.7)

This invention relates to a new and improved process for making reticles and other devices that may be made by this process, and has particular reference to a new and improved photo-etching process for making such devices.

An object of the invention is to provide a new and improved photo-etching process for making devices of the type set forth which is relatively simple efficient and economical.

Another object of the invention is to provide a new and improved process for making devices of the type set forth which allows the producing of intricate designs and patterns without the necessity of special tools and dies, and which is applicable to a wide variety of materials and uses.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that many changes may be made in the details of construction and steps of the process without departing from the spirit of the invention as expressed in the accompanying claim. I, therefore, do not wish to be limited to the exact details of construction and steps of the process shown and described as the preferred form and process has been shown by way of illustration only.

In the present application, for the purpose of illustration, the process has been shown adapted for the production of reticles for optical instruments.

Referring to the drawings:

Fig. 1 is a front view of a plate in which the pattern is to be formed;

Fig. 2 is a sectional view taken along line 2-2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 but showing a step in the process;

Fig. 4 is a view similar to Fig. 3 but showing a further step in the process;

Fig. 5 is a view similar to Fig. 4 but showing a further step in the process;

Fig. 6 is a view similar to Fig. 5 but showing a further step in the process;

Fig. 7 is a view similar to Fig. 6 but showing a further step in the process;

Fig. 8 is a view similar to Fig. 7 but showing a further step in the process;

Fig. 9 is a sectional view similar to Fig. 2 but showing a finished device; and

Fig. 10 is a front view, similar to Fig. 1, but showing a finished device.

Referring more particularly to the drawings wherein similar reference characters designate

corresponding parts throughout the several views, there is shown in Fig. 1, a plate of metal or the like on which the reticle is to be formed. This plate may be of copper, brass, aluminum, zinc, palladium or other suitable material.

First a surface of said plate 1 is cleaned and on said cleaned surface is placed a layer or coating of a photosensitive material such as bichromated shellac or glue or albumin or sensitized furfural resin. The thickness of this layer is preferably between one-thousandth of an inch and one one-hundred thousandth of an inch although this thickness is preferably within the range indicated but is not necessarily restricted to such range.

In contact with the sensitized layer 2 is placed a photographic or other negative 3 and exposed to a light source of sufficient intensity such as a carbon arc lamp or other suitable light source for a length of time sufficient to make insoluble the selected portions of the sensitized layer, which portions correspond to clear areas of the negative 3 and hence permit the light to pass through the negative 3 onto the sensitized layer 2.

The negative 2 contains the desired pattern 4 of the reticle or the like to be formed on the plate 1. These patterns effectively block the passage of light therethrough and therefore the areas of the sensitized layer under these pattern areas 4 are therefore unaffected by the light and hence remain soluble and hence can be dissolved away in the subsequent developing process.

Instead of the contact printing method shown, it is pointed out that projection printing methods may be employed.

After the exposure to light as described above, the negative is removed and the latent image contained in the photosensitive layer is developed and this developing process removes the soluble portions 5 of the sensitized layer. The developing solution and process depend upon the photosensitive material employed and it is not believed necessary to describe such developing solutions and processes as they are well known in the art.

After the latent image has been developed and the soluble portions 5 of the sensitized layer removed, as described above, then a protective layer 6 of an acid resisting varnish is applied to the lower surface of the plate 1 and to the edges thereof, as shown in Fig. 6. One solution suitable for such varnish for the protective layer 6 is a solution of asphalt in turpentine.

Next the portions of the base 1 which are unprotected or exposed through the openings 5 in

the layer 2 are dissolved away by a suitable reagent to a depth almost entirely through the body of said base or plate 1 but not entirely there-through.

The etching can be accomplished either by the action of a suitable acid and depending upon the material of which said plate 1 is formed, different etching reagents may be employed. For example, if the plate 1 were of aluminum a solution of an alkali may be used such as a solution of sodium hydroxide in water. For most of the metals named for the base of plate 1 a solution of ferric chloride in water may be used.

Another method for etching said exposed portions of the base or plate 1 is the electrolytic method whereby said base is connected with the positive pole of an electrical source such as a D. C. generator. Opposite the face to be etched a suitable electrode such as a copper plate is placed but not in contact therewith and connected to the negative pole of said generator. The two plates are then immersed in a suitable electrolytic etching solution such as a concentrated solution of sodium chloride in water and the current applied for a time long enough to allow etching almost completely through said base or plate 1 but not entirely therethrough.

After etching the plate is rinsed in water and dried and the acid resisting varnish coating 6 is removed by a suitable solvent such as turpentine or kerosene.

Then a similar protective layer or coating 9 is applied over the upper surface of the coating 2 and over the sides of the plate 1 and coating 2 as well as over the etched portions 7 of the base 1, as shown in Fig. 8.

After this the metal on the now exposed lower side of the plate or base 1 is etched away up to the point shown by the dotted line 7 in Fig. 8. This etching may be done by any one of the above described etching processes but preferably by the electrolytic etching method.

Then the etching solution is washed off with

water and then the plate is dried and finally the acid resisting varnish coating 9 is removed by a suitable solvent and also the insoluble portions of the sensitized layer are removed mechanically or with chemical solvents such as a mixture of equal parts of alcohol and benzene with or without the addition of an alkali such as potassium hydroxide.

After this the plate is washed and dried and is then as shown in Figs. 9 and 10 ready for use.

It is pointed out that due to the etching of the back surface as shown in Fig. 8 that the lines forming the pattern 11 of the reticle or the like are uniform and are free from burrs or ragged edges produced by mechanical methods.

From the foregoing it will be seen that I have provided a simple, efficient, and economical process which is adapted to obtain all of the objects and advantages of the invention.

Having described my invention, I claim.

The process of making reticles or the like consisting in overlaying a surface of a relatively thin metal workpiece with a photosensitive resistant composition, exposing selected portions of said sensitized layer to light, developing said photosensitive layer and removing those portions thereof which have not been so exposed to light, subjecting the workpiece to an etching reagent while covering the rear surface of the workpiece by a protective layer, the action of said etching reagent being continued for a period of time sufficient to etch the uncovered portions of the front surface only partially through said workpiece, applying a protective coating over said etched portions, and after removing the protective coating from the rear surface of the workpiece progressively and substantially uniformly reducing the thickness of said workpiece by an etching reagent applied to said rear surface until the etched design extends through said workpiece to form the reticle or the like.

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