

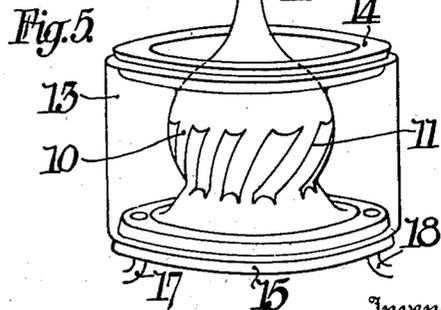
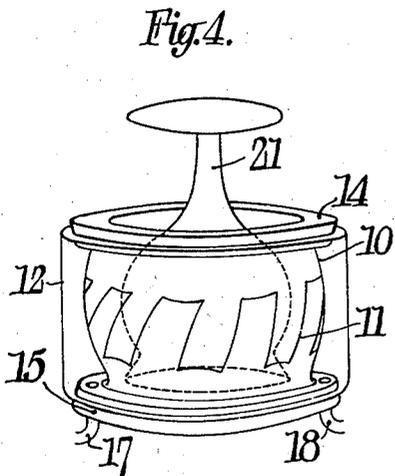
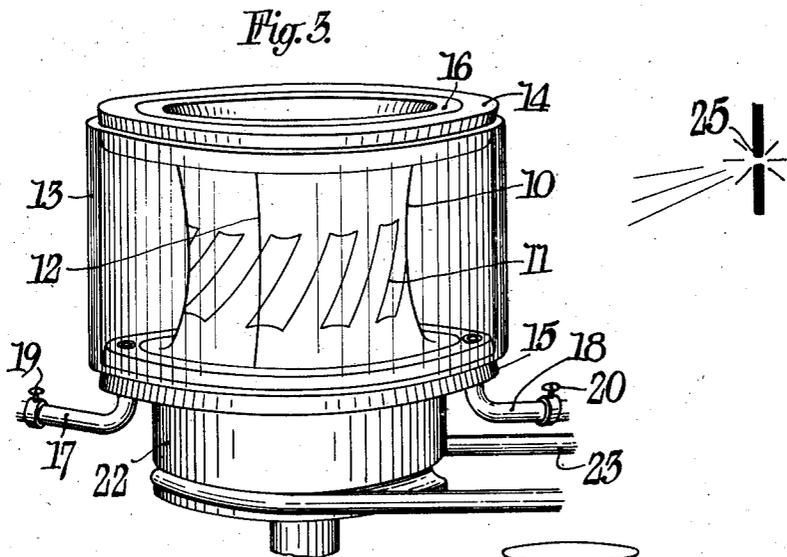
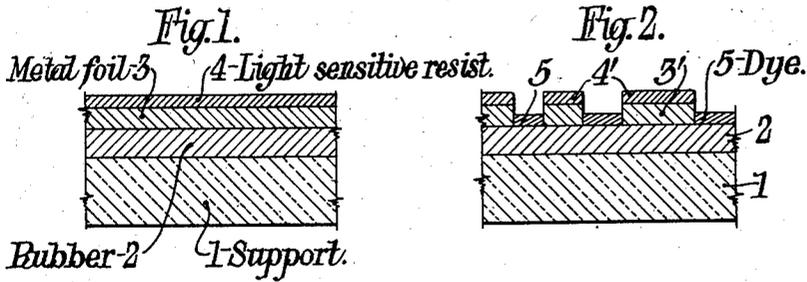
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METHOD AND APPARATUS FOR ORNAMENTING CURVED SURFACES

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METHOD AND APPARATUS FOR ORNAMENTS CURVED SURFACES

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This invention relates to a photographic element and to methods of utilizing the same particularly for the purpose of making etched designs on glass and metal objects, such as bowls, tumblers, vases, cylinders, stem-ware and the like.

It has been difficult to make deeply etched or cut designs of uniformly high quality upon the surface of solid objects such as stem-ware, except by processes requiring a large amount of time consuming and highly skilled hand work. I have invented a method of etching such glass-ware in a simple and comparatively inexpensive manner. This comprises the formation on a freely extensible sheet, such as rubber, of an image that is extensible with the rubber and applying this image bearing stencil or negative, preferably in the form of a closed or tubular band, to the surface of the object to be etched, which also carries a sensitive coating. This is then exposed to uniform illumination from all sides, the negative removed, and the glass or metal etched by a photo-engraving process.

My invention resides in the various methods herein described of making the elastic stencil, in the sensitized elastic element, the completed elastic stencil band, and the various processes and the steps and details thereof for utilizing the band for various purposes as hereinafter more fully described and claimed.

Reference will be made to the accompanying drawing, in the several figures of which the same characters designate the same elements and in which:

Fig. 1 is a section on an exaggerated scale of a sensitized element embodying certain elements of my invention.

Fig. 2 is a similar section of a rubber stencil made from the element of Fig. 1.

Fig. 3 is a perspective view of a frame carrying an endless rubber stencil strip.

Fig. 4 is a similar view showing the band expanded to permit insertion of a goblet to be ornamented.

Fig. 5 is a similar view showing the goblet and band in position for printing.

It is obvious that a prime desideratum in a photographic negative or stencil having a highly flexible or elastic base is that the image shall be fully as extensible and flexible as the support. This is not the case with ordinary photographic emulsions of gelatine, collodion or the like; and the image, if formed originally in such a layer, must be printed or stenciled upon the support itself and the original layer removed.

I will first describe my preferred method of forming such a stencil or negative, reference being made to Fig. 1.

Upon a suitable support 1 which may be a glass plate, a sheet of a cellulosic derivative composition, waxed or otherwise waterproofed cardboard

or any other reasonably rigid sheet, a thin, elastic, soft, translucent, vulcanized rubber sheet 2 is temporarily attached by means of a suitable stripping adhesive, such as wax or a rubber cement. The rubber sheet would be held smoothly but ordinarily not under tension. A suitable cement is a .5% solution of rubber in benzene.

Commercial rubber sheeting having a thickness of .003-.004 inch is preferred but the thickness may vary within wide limits, as between .0005 and .01 inch.

A thin, preferably unelastic stencil material 3, as for instance, a sheet of brass, nickel or other metal foil .001 inch thick, is then attached to the rubber layer by means of a rubber cement. If the element is to be used immediately, brass is preferred, but since brass tends to affect rubber if kept in contact with it, nickel or some other inert material would be used if the plate is to be stored for some time.

To the sheet of foil 3 is then applied a coating 4 of a light sensitive resist, an example being the following:

	Grams	
Dicinnamal acetone-----	32.5	25
Syrian asphaltum-----	97.5	
Phenol-----	1.80	
Solvent naphtha (coal tar)-----	500.0	
Toluene-----	270.0	30

The resist mentioned is of the type covered in my prior Patent No. 1,956,710, granted July 10, 1934, and forms a hard coherent coating.

A line negative or positive is placed in contact with the sensitive coating and exposed to the light of a 30 ampere arc lamp at a distance of 24 inches for 5 minutes. The unexposed parts of the resist are removed by treatment with kerosene. The solvent action is controlled by observation and is stopped by removal of the kerosene by washing with soap and water.

The stencil layer is then etched in the exposed parts of the design with aqueous ferric chloride solution of above 36° Baumé until the brass is removed to the rubber which the etching solution does not affect. After rinsing with water and drying, the etched surface is treated with a stain, solution or dye which deposits, upon the areas of rubber laid bare by etching, a coloring material which becomes physically extensible with the rubber. This may be a "rubber ink" or stain, sprayed or brushed upon the stencil and coating the rubber in the stencil openings. This solution may consist of

	Grams	
Nigrosine (Schulz No. 985)-----	5	55
2% crepe rubber in benzene-----	30	
Ether-----	65	

An enlarged section of the negative at this stage is shown in Fig. 2, where the support is indicated

at 1, and rubber sheet at 2, parts of the metal foil layer constituting stencil areas are shown at 3' and of the resist at 4'. Between these stencil areas are areas 5 of stain or dye directly upon the rubber. The resist areas would also be more or less colored but no use is made of that fact which is merely incidental.

The stencil foil sheet carrying the resist is readily stripped from the rubber by stripping the rubber sheet from the support and then stretching it, whereupon the inextensible foil, not stretching with the rubber and being attached thereto by a stripping layer, separates from it. There is now left a rubber sheet having the properties already enumerated and carrying substantially integral with it and extensible with it, a light absorbent or obstructive pattern formed as a result of a photographic process.

A second method of making the negative is by applying to the rubber layer a bichromated fish glue solution of familiar type such as

Photo-engraving glue (fish glue)-----grams--	360
25 Ammonium bichromate-----do-----	55
Water -----liter--	1

When dry, the plate is exposed to a suitable light design, the print developed by washing in water, and dried. It is now covered with a suitable stain such as the one already described, or

Oil Red C dye (Schulz No. 532)-----	1
Nigrosine-----	4
35 1.0% rubber solution in benzene-----	20

When dry, the rubber sheet is stripped from the temporary support and washed in warm water to remove the remaining glue. This is aided by stretching the rubber. There is left a rubber sheet carrying a stain, which ordinarily will be a line image.

A third method, which is non photographic, of making the rubber negative or positive will now be given. The rubber sheet is placed over a design to be copied. The rubber sheet may be either mounted on a glass sheet as before or placed tightly on the design on a drawing board and both held in place by thumb tacks. The design or pattern is then drawn in water color on the rubber by hand using a suitable fine brush. When dry it is stained with dye solutions of the type already described. The water color is then washed off leaving the stain image.

Still a fourth method is the following. A rubber sheet, mounted as before, is coated with a silver halide-gelatine emulsion, exposed to a light image of the design, and developed in a tanning developer of known type, such as pyro. The untanned gelatine is removed by washing in warm water. After drying the negative is stained as above described and the remaining tanned gelatine stencil removed by any usual means that does not attack the rubber or the stain.

By whichever method is used, there is obtained an elastic negative, the support of which is a thin, elastic, soft, translucent, vulcanized sheet of rubber carrying a perfectly extensible design in or on its surface, and which stretches and contracts with the rubber support without cracking or peeling. Numerous uses of such a negative at once suggest themselves. It may be used for making distorted or cartoon pictures by extending the rubber sheet more in one direction than another. The effects of motion, useful in making animated cartoons, may be made by

constantly changing the extension of the rubber in one or more directions or unevenly. If extended uniformly in all directions, an enlarged print may be made by direct contact printing.

By stretching to a precisely determined degree, a negative having calibration marks on it may be used in the calibration of individual instrument scales where the same scale readings are shown but in somewhat different dimensions on the several instruments.

The principal use which I have in mind, however, is the printing of photographic designs upon the surface of an object having other than a plane surface. Such objects may be glassware, such as bowls, tumblers, jars, stem-ware including goblets, wine glasses and vases, and other dishes; metal cylinders used in printing processes or for any other purpose; molded metal forms, such as picture frames, convex dials, watch cases and furniture parts and other objects too numerous to catalog. In general the print would be made by stretching the negative over or around the object to be ornamented or marked and which would carry upon its surface a light sensitive coating. The rubber sheet would by its own tension hug closely and contact the surface of the object, except for concavities. The first photographic image could be the permanent one if the object were not to be subjected to rough usage but the coating usually would be of a type adapted to act as a resist, and after exposure, would be developed by a wash-off or solvent process, leaving a resist design through which a suitable etching fluid could act on the metallic or glass object, after which the resist would be removed. The particular resist used would have to be one capable of withstanding the etching fluid used. Many such are known for use with metallic surfaces but few photographic resists are known prior to my invention capable of withstanding the action of hydrofluoric acid ordinarily used for glass etching.

In the making of a photographic design around the entire periphery of an object such as a goblet, vase or cylinder, I have invented a novel technique which comprises the making of a tubular or endless rubber negative band carrying the desired image, holding this in an extended position, larger than the object to be ornamented or marked, placing the object within the negative and then releasing the tension on the band, permitting the band to contract and embrace the object closely.

Reference will now be made to Figs. 3, 4, and 5 which show a device for applying the negative to the surface of an object such as a goblet. A negative strip 10 bearing a repeat design 11, has its ends secured by a suitable rubber cement in an air tight seam 12, thus forming an endless or cylindrical rubber negative, the size of which, when unextended, is less than the article to be etched or ornamented. The edges of this negative are secured between clamping blocks of a suitable frame. This frame consists of a glass cylinder 13 having tightly fitting metal or rubber annular rings 14 and 15 in its opposite ends. These rings have cut out annular rabbets within which fit smaller rings 16 on their outer surfaces. The ring 16 is removed from ring 14 and, while one edge of the negative band is held stretched, is replaced, clamping the edge between the rings 14 and 16. The other edge of the band is then clamped to the ring 15 in a similar way. The normal position of the band is shown in Fig. 3. Through the ring 15 pass two tubes 17 and 18, 75

with stop cocks 19 and 20, the first tube being connected to a source (not shown) of compressed air or, preferably, of a compressed inert gas and the other to a suction device (not shown), or both may be connected to a circulating supply of an inert cooling fluid. When the stop cock 20 is opened and the cock 19 closed, air will be withdrawn from the annular space between the glass cylinder 13 and the rubber negative 10 and the latter will be drawn outwardly as shown in Fig. 4. The goblet 21 or other article carrying a sensitive coating on that portion of its surface to be ornamented is then placed within the casing as shown in the same figure and stop cock 19 opened while 20 is closed.

Even if the tube 17 were open to the air, the contraction of the rubber negative band 11 would ordinarily cause it to contact closely with the surface of the goblet, but in order to insure uniform close contact throughout, the tube 17 is preferably connected to a source of compressed air, and this is necessary if the article to be marked has concavities in its surface or if the article has portions of somewhat smaller diameter than the normal diameter of the band 11.

Since the exposures are made under rather high light and heat conditions, the rubber, if continuously exposed, tends to deteriorate rapidly. For this reason I prefer to use an inert fluid rather than air and to circulate this through the space between the rubber negative and the glass cylinder. This fluid may be an inert gas or a liquid such as water.

The whole device containing the article 21 is then rotated at a uniform rate before a light source for as long a time as may be required for the exposure, depending on the intensity of the light and sensitivity of the particular coating on the article 21. The light passes through the glass which is unobstructed and through the negative producing a print on the sensitized surface.

With the sensitive resist given below, a continuous exposure of five minutes to a 35 ampere arc light 25 at a distance of 18 inches is necessary. The article should, however, be rotated for 20 minutes to give each point the equivalent of 5 minutes direct exposure. Ordinarily, the tubes 17 and 18 will be long and flexible and permit the turning of the article through a single complete revolution. It may either make one very slow revolution or a series of slow oscillations, each a complete revolution. As a means for effecting this turning, the frame is mounted on a rotatable table 22 which may be rotated or oscillated from any suitable power source by means of the belt 23, this being shown merely by way of example.

A sensitive resist suitable for use on glass is the following:

	Grams
Dicinnamal acetone.....	4.5
Syrian asphaltum.....	9.0
Phenol.....	2.0
Chlornaphthalene wax.....	1.5
Solvent naphtha.....	50.0
Toluene.....	33.0

This is developed by mineral oil in the manner described in my prior Patent No. 1,956,710, granted July 10, 1934, and then submitted to hydrofluoric acid etching, 48%, although this may be much more dilute.

By the term "chlornaphthalene wax" mentioned as an ingredient in the above formula is meant a mixture of chlornaphthalenes, predomi-

nantly trichlornaphthalene, having certain physical properties of natural waxes. Various materials of this type are on the market and the particular chemical structure of the wax is not of primary importance. Such materials are sold under the trade-mark Halowax.

In the formula just given, the chlornaphthalene wax, as sold commercially, or other hydrogenated wax or other natural or artificial wax or wax-like body, such as Montan wax, beeswax, or carnauba wax are important in giving much better adherence of the resist to glass. I have also found that adherence may be increased if a certain type of sub-layer is first applied to the glass before the resist layer, which in this case need not contain a wax. This sub-layer comprises as an essential ingredient a triphenylmethane dye such as fuchsine, malachite green, methyl violet and ethyl violet, the Schulz numbers of which are respectively 780, 754, 783, 787.

More or less resin may be added to the dye solution to decrease its solubility in water and improve the flowing properties. A preferred formula for the sub-layer as applied is as follows:

	Grams
Malachite green.....	1.00
Gum mastic.....	.04
Toluene.....	.50
Denatured alcohol.....	90.46
Iso-propyl alcohol.....	8.00

As an alternative developer, kerosene may be used, the action of which may be arrested by the use of soap and water. This is particularly useful for formulae including a wax. Other developers for resists of the types described are iso-propyl alcohol, triethanolamine or mixtures of triethanolamine with glycerine or ethylene glycol, and mixtures of kerosene and isopropyl alcohol.

It is to be understood that the description and formulae herein given are by way of example and that I consider as included within my invention not only all of the subject matter herein disclosed but also all modifications and equivalents thereof that fall within the reasonable scope of the appended claims.

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

1. The method of light printing a photographic image uniformly upon the sensitized peripheral surface of an object that comprises holding in an extended stretched position a tubular, elastic, image bearing band, positioning the object within said extended band, permitting the band to contract into contact with the peripheral surface of the object and exposing the object to light through the applied band.

2. The method of ornamenting the peripheral surface of an object that comprises sensitizing the surface of the object, holding in an extended stretched position a tubular, elastic, rubber image-bearing band, positioning the object within said band, causing the band to contract into contact with the peripheral surface of the object, exposing the sensitive surface of the object to light through the applied band, removing the band and developing an image on the exposed surface of the object.

3. Apparatus for photographically printing upon the sensitized surface of an object and comprising a transparent rigid cylinder, heads having an air tight connection with the ends of the said cylinder, each head having means for

- clamping tightly the edge of an endless tubular elastic band, whereby such a band may be supported by and between such heads, at least one of the heads having an axial opening through
- 5 which an object with a sensitized surface may be inserted within such a tubular band, and means for removing air from and admitting air into the space between the cylinder and a band clamped between the heads whereby the band may be dis-
- 10 tended leaving a large central opening or may be contracted around an object placed within the tubular band.
4. Apparatus for photographically printing upon the sensitized surface of an object and
- 15 comprising a transparent rigid cylinder, annular heads having an air-tight connection with the ends of said cylinder, each head having means for clamping tightly the edge of an endless elastic band, whereby such a band may be
- 20 supported by and between such annular heads leaving a central open space through the apparatus, and means for removing air from and admitting air into the space between the cylinder and a band clamped between the heads.
- 25 5. Apparatus for photographically printing upon the sensitized surface of an object and comprising a transparent rigid cylinder, heads having an air-tight connection with the ends of said cylinder, each head having means for
- 30 clamping tightly the edge of an endless tubular elastic band, whereby such a band may be supported by and between such heads, at least one of the heads having an axial opening through which an object with a sensitized surface may be inserted within such a tubular band, means for removing air from the space between the cylinder and a band clamped between the heads whereby such a band may be expanded and an object placed within it and means for forcing air into the same space whereby the band may be contracted against and forced into close contact with an object placed within it.
6. Apparatus for photographically printing upon the sensitized surface of an object and comprising a transparent rigid cylinder, heads having an air-tight connection with the ends of said cylinder, each head having means for
- 15 clamping tightly the edge of an endless tubular elastic band, whereby such a band may be supported by and between such heads, at least one of the heads having an axial opening through
- 20 which an object with a sensitized surface may be inserted within such a tubular band, means for removing fluid from the space between the cylinder and a band clamped between the heads whereby such a band may be expanded and an object placed within it and means for forcing a
- 25 cooling fluid into the same space and circulating it therein whereby the band may be contracted against and forced into close contact with an object placed within it and will be maintained cool during prolonged exposure to heat.
- 30

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