

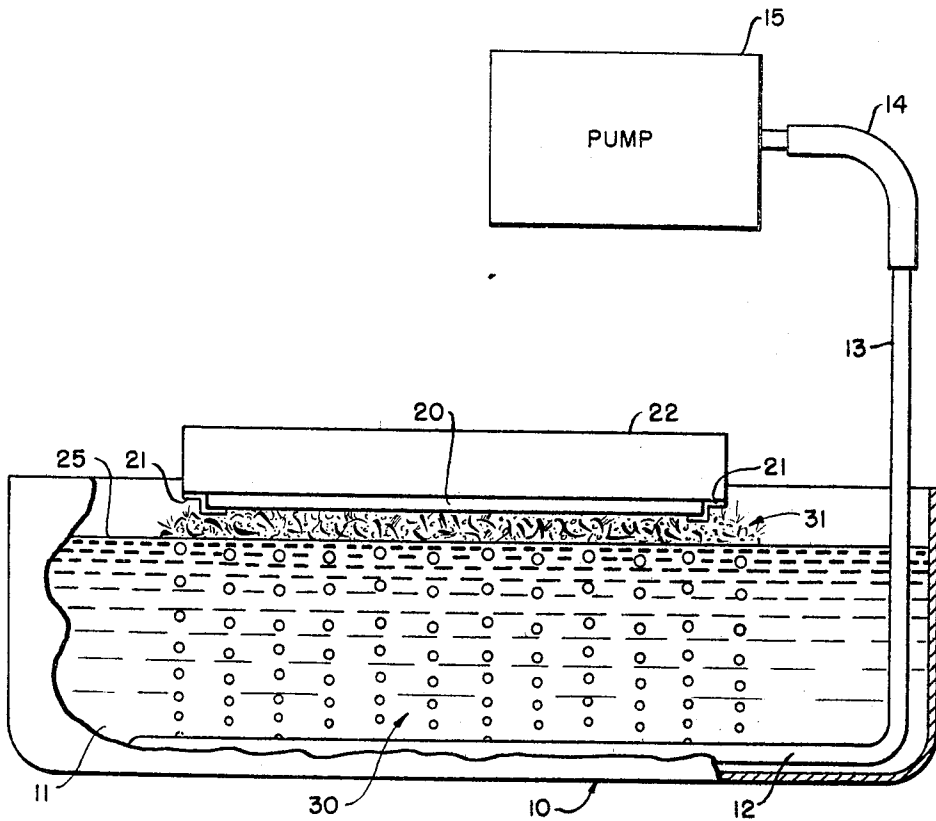
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METHOD OF FROTH ETCHING

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## METHOD OF FROTH ETCHING

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9 Claims

### ABSTRACT OF THE DISCLOSURE

A method of etching workpieces including the steps of bubbling air through a container of liquid etching reagent to form a froth or foam of reagent on the surface of the liquid, attaching the workpiece to a buoyant member and floating the buoyant member on the foam with the workpiece in contact with the foam.

In etching a flat, resist-coated workpiece, the workpiece is usually suspended in a vertical plane in front of a spray of etching reagent. Reagent that is partially spent by etching the areas at the top of the workpiece flows down the face of the workpiece and mixes with fresh reagent sprayed onto the bottom of the workpiece thereby etching the bottom of the workpiece with a less-active reagent than that used to etch the top of the workpiece. This results in a workpiece with an uneven amount of etching of the uncoated areas of the workpiece.

It is an object of the present invention to vigorously deposit etching reagent uniformly on the surface of a workpiece to be etched.

It is another object of the present invention to maintain a substantially uniform concentration of etching reagent on all portions of the surface of a workpiece.

In accordance with the preferred embodiment of the invention, a container of liquid reagent is provided with a plurality of orifices placed at or near the bottom of the container. Air under pressure is passed through the orifices to bubble up through the body of the liquid reagent, forming a foam or froth of reagent on the top surface of the body of liquid reagent. A workpiece that has been coated with a pattern of etch-resistant material is fastened to a buoyant support which is then floated, workpiece down, on the froth of reagent.

A more complete understanding of the invention may be had from the following detailed description when considered in conjunction with the accompanying drawing which shows a cut-away view of a tank of liquid reagent with a workpiece floating on top of the froth formed at the surface of the liquid reagent.

Referring now to the drawing, a tank 10 made of an etch-resistant material is half filled with a liquid etching reagent 11 (such as a ferric chloride solution). A manifold 12 having many minute holes in its upper surface is immersed in the liquid reagent 11 and is positioned near the bottom of the tank 10. One end 13 of the manifold is connected by tubing 14 to a pump 15 which pumps atmospheric air to the manifold 12 where it is expelled through the minute holes on the upper surface of the manifold.

A workpiece 20 that is coated on at least one side with a pattern of etch-resistant material is secured by clamps 21 to a board 22 which is made of wood or some other buoyant material that is not adversely effected by the reagent 11. The buoyant board 22 is placed on the

exposed surface of the reagent with the resist-coated surface of the workpiece 20 facing the surface 25 of the liquid reagent. When the pump 15 is turned on, the air escaping from the minute holes in the manifold 12 forms bubbles 30 that rise through the liquid reagent 11 and form a foam or froth 31 on the top surface 25 of the reagent 11. The buoyant board 22 with the workpiece 20 facing downwardly is allowed to float on this froth formed on the surface of the reagent. The workpiece 20 may be placed on the surface 25 of the reagent 11 before or after the pump 15 is started so long as it is floated on top of the froth most of the time during which etching takes place.

The volume of air provided by pump 15 to manifold 12 determines the rate at which bubbles 30 rise through the reagent 11 and thus determines the quantity of froth 31 appearing on surface 25 of the reagent. The thickness of froth between the resist-coated surface of the workpiece and the surface 25 of the reagent 11 is preferably one to two inches. The volume of air provided by the pump 15 is varied until approximately this thickness of froth is obtained.

As the bubbles of the froth touch the resist-coated workpiece, they burst. This action causes spent reagent to be wiped from the surface of the workpiece and fresh reagent carried by the bubbles to be deposited uniformly over the workpiece. This keeps a quantity of uniformly concentrated reagent at the surface of the workpiece.

Although only one embodiment of the invention is shown in the drawing and described in the foregoing specification, it will be understood that the invention is not limited to the specific embodiment described, but is capable of modification and rearrangement and substitution of parts and elements without departing from the spirit of the invention.

What is claimed is:

1. A method of etching a workpiece with a liquid etching reagent comprising:

forming a froth of reagent on the surface of the liquid reagent; and

floating the workpiece on the froth.

2. The method according to claim 1 wherein the step of forming a froth includes the step of bubbling a gas through the liquid reagent.

3. The method according to claim 1 wherein the step of floating a workpiece on the froth of reagent is carried out by:

fastening the workpiece to a buoyant member, and floating the buoyant member on top of the froth with the workpiece engaged with the froth.

4. A method of etching a workpiece with a liquid etching reagent including the steps of:

filling a container with a quantity of liquid reagent; forming a froth of reagent at the surface of the liquid reagent in the container; and

holding the workpiece against the froth of reagent.

5. The method according to claim 4 wherein the step of forming the froth of reagent includes the steps of:

delivering a gas to the bottom of the container; forming the gas into a plurality of bubbles, and passing the bubbles through the liquid in the container.

6. The method according to claim 4 wherein the step of holding the workpiece against the froth of reagent includes the steps of:

attaching the workpiece to a buoyant member, and supporting the buoyant member on the reagent froth

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with the workpiece facing the froth thereby constantly delivering fresh reagent to the workpiece.

7. A method of etching a workpiece with a liquid etching reagent including the steps of:

continuously generating a foam of the reagent, and floating the workpiece on the generated foam.

8. The method according to claim 7 wherein the step of generating a foam includes the step of passing a gas through a quantity of liquid reagent.

9. The method according to claim 8 wherein the step of passing a gas through the liquid reagent includes the step of forming the gas into a plurality of bubbles each of small size relative to the workpiece.

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