

Feb. 23, 1960

W. GUENST

2,926,076

ETCHING

Filed May 14, 1957

2 Sheets-Sheet 1

Fig. 1.

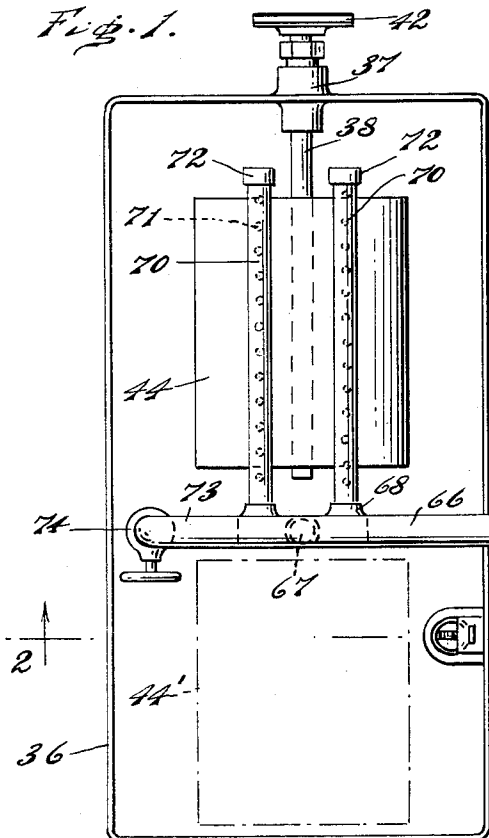
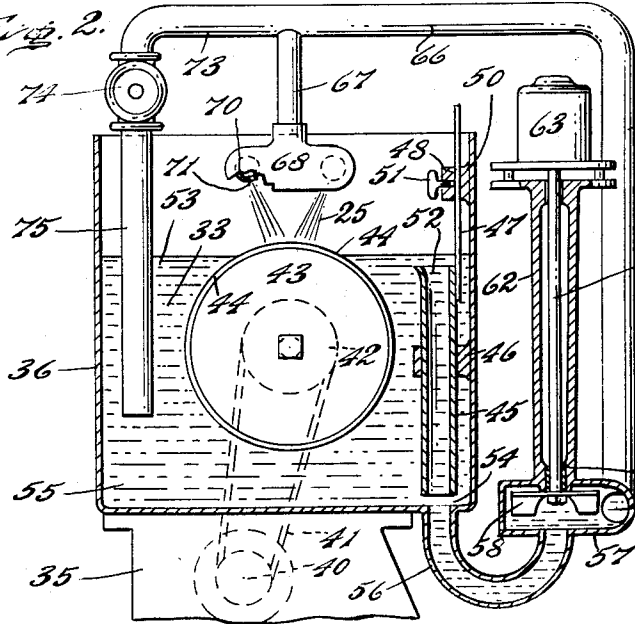


Fig. 2.



Prior Art
Fig. 3.

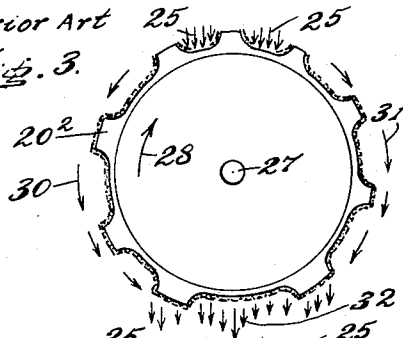


Fig. 5.

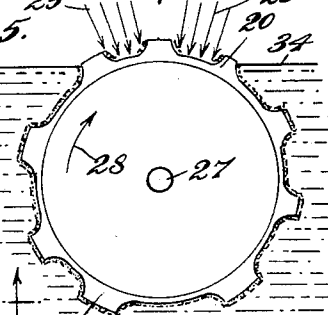


Fig. 4.

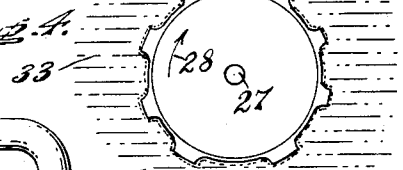


Fig. 6.

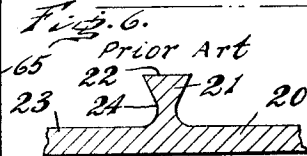
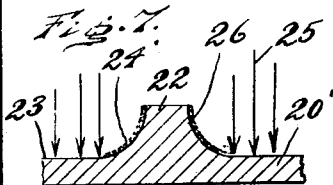


Fig. 7.



INVENTOR
William Guenst
BY
ATTORNEYS

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W. GUENST

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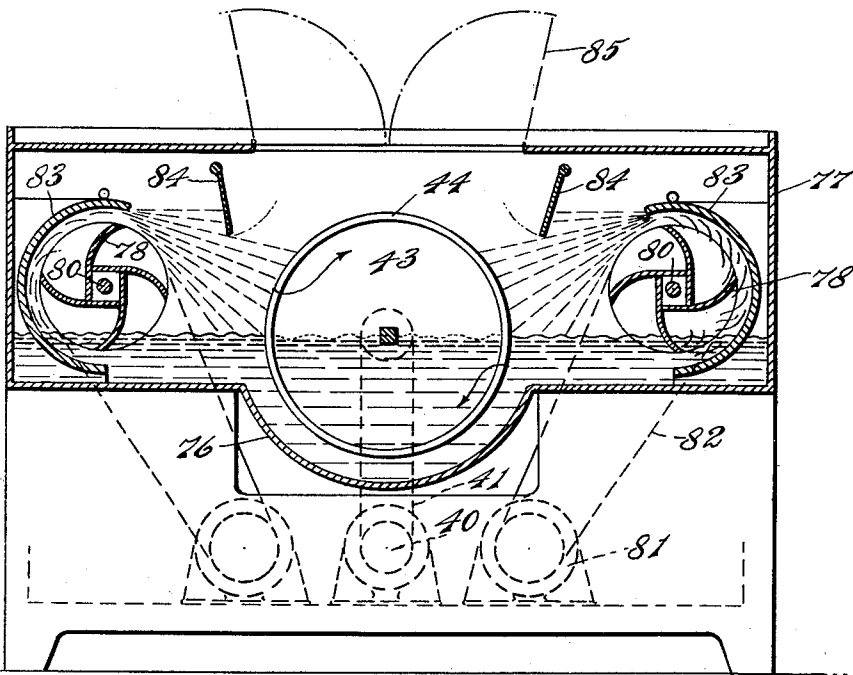


Fig. 8.

INVENTOR
William Guenst
BY *[Signature]*
ATTORNEYS

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2,926,076

ETCHING

William Guenst, Elkins Park, Pa., assignor to Master Etching Machine Company, Wyncote, Pa., a corporation of Pennsylvania

Application May 14, 1957, Serial No. 659,168

3 Claims. (Cl. 41—42)

The present invention relates to etching machines and processes of etching, particularly applicable to etching using etchants which are effective primarily on direct impingement.

The present application is a continuation-in-part of my copending application Serial No. 596,190, filed July 6, 1956, for Etching, now abandoned.

A purpose of the invention is to obtain more effective etching on the relief surfaces of a printing plate, especially of cylindrical form, while avoiding undercutting.

A further purpose is to avoid improper distribution of retardant on portions of the printing plate which are undergoing spraying of etchant and to avoid air hardening of retardant on the surface.

A further purpose is to avoid nonuniform etching on a printing plate, especially a cylindrical printing plate, by virtue of the difference in etching between a surface which is rising toward a source of liquid flow and a surface which is descending with the liquid flow; for example, to avoid the difference in etching effect between the ascending side of a rotating cylinder and the descending side of the cylinder, where spray is being applied at the top with the cylinder axis horizontal.

A further purpose is to substantially completely, or completely, submerge the plate in an etchant bath, spray etchant at one part of the plate, and manipulate the plate to expose successive parts to the spray, the immersion or partial immersion of the plate in the bath protecting against nonuniform etching and against hardening of the retardant.

A further purpose is to regulate the flow through the spray.

A further purpose is to draw etchant to be sprayed simultaneously from both the upper and lower parts of the bath, and preferably to regulate the ratio between the quantity drawn from the upper portion and the quantity drawn from the lower portion.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the numerous embodiments in which the invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figure 1 is a fragmentary diagrammatic top plan view of an etching machine according to the invention.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a diagrammatic end elevation, highly exaggerated, showing the edge of a cylindrical plate in the prior art.

Figure 4 is a view similar to Figure 3, showing the etching in accordance with one embodiment of the invention.

Figure 5 is a view similar to Figure 3 showing the etching according to another embodiment of the invention.

Figure 6 is an enlarged and exaggerated transverse

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section of a printing plate showing the effect of etching in the prior art.

Figure 7 is a view similar to Figure 6, showing the effect of etching according to the invention.

Figure 8 is a diagrammatic central vertical section of a modified embodiment of the invention.

Describing in illustration but not in limitation and referring to the drawings:

In the prior art, difficulty has been encountered in etching printing plates uniformly. Nonuniformity of etching has occurred and a specialized type of nonuniform etching known as "undercutting" has been a problem. Thus, as shown in Figure 6, a printing plate 20 having a dot 21 has a dot facing 22. The plate proper is etched away at 23 but also the side of the dot becomes undercut by the etchant at 24, weakening the dot structure or destroying it completely. This difficulty occurs in etching with nitric acid and numerous other etchants.

To overcome this difficulty, improved etching techniques have been developed, in some cases introducing retardants which tend to make etching more uniform and reduce undercutting. While the principles of the invention are applicable to all types of printing plates, whether the metal used is copper base alloy, aluminum base alloy, magnesium base alloy or otherwise, it will be sufficient to refer to the protective techniques described in Easley and Swayze U.S. Patents Nos. 2,640,763 to 2,640,767, granted June 2, 1953, for Etching. These patents relate particularly to plates of magnesium, zinc and their alloys.

According to the etching techniques above referred to, the etchant is primarily effective on direct spray impingement, and is not substantially effective on lateral contact. Thus as shown in Figure 7, a printing plate 20' receiving spray indicated by arrows 25 is etched at 23 in the area between dots 22, but the side of the dot at 24' is protected and is not undercut. The protection at 24' is accomplished by a film of retardant 26', which is removed by direct impingement of the spray at 23, but is not removed by lateral contact at 24'. The particular retardant used may, for example, be diethylbenzene—wetting agent, having the property of forming a film on the plate, and separating from the etchant solution, usually nitric acid solution, by reason of the lighter specific gravity of the retardant.

Efforts have been made to apply spray to a printing plate, such as cylindrical printing plate, in such a way as to obtain the etching effect indicated in the theoretical discussion in reference to Figure 7. Thus, as shown in Figure 3, a cylindrical plate 20² has been mounted on a horizontal axis 27 and rotated in air in the direction of the arrow 28 while being sprayed across the top by jets 25, using an etchant and a retardant. The results obtained under these conditions have been very unsatisfactory. The etchant and retardant flow down both sides at 30 and 31 and drop off the bottom at 32. On the side having the flow 30, however, the downward flow of the etchant and retardant is opposite to the upward motion of the side of the plate as it rotates, while on the side having the flow 31 the downward flow is in the same direction as the motion of the side of the printing plate. On the side having the flow 30 there has been relatively nonuniform etching. Also the retardant film has tended to form a hardened deposit due to the long air exposure, so that it was difficult for the direct spray to remove the film and accomplish etching.

I have discovered that this difficulty can be overcome by placing the printing plate on its side and manipulating it partially or wholly submerged under the etchant bath. The bath surrounding the plate tends to carry away the etchant flow as soon as the spray meets the bath and when the plate is completely submerged beneath the bath it tends to soften or mitigate the etching and prevent hardening

of the retardant film. As shown in Figure 4, the plate 20³ is wholly immersed in the etchant bath 33, and the spray 25 strikes the top of the rotating plate through a fraction of an inch or a few inches of etchant bath. Thus, though the spray is forcefully impinged to break the retardant film and accomplish etching on direct impingement at points where etching is to be accomplished, there is no difficulty through irregular etchant action beneath the bath, nor is trouble caused by hardening of the protective film.

Figure 5 shows a modification in which the level 34 of the bath is just below the portion of the rotating cylindrical plate which is being sprayed. Here again the bath prevents nonuniformity of etching and protects against undue hardening of the film. Only the portion of the plate adjoining the spray is exposed to the air.

The etching machine illustrated in Figures 1 and 2 comprises a base 35 supporting an etchant tank 36 suitably of rectangular form. The one end of the etchant tank mounts a combined stuffing box and bearing 37 which supports a horizontal rotating shaft 38 driven by motor pulley 40 and belt 41 to pulley 42 on the end of shaft 38 outside the tank.

Suitably mounted on the horizontal shaft axis is a plate holder 43 which supports a cylindrical printing plate 44 being rotated by the shaft. Space is provided at one end of the tank to remove the plate to the position 44' from which it can be lifted out of the tank.

The tank is covered in any suitable way not shown.

Mounted at one side of the tank is a vertical outlet tube 45 in a vertical sliding guide 46 on the tank. The tube has a supporting rod 47, which passes up through opening 48 in retainer bracket 50 on the tank wall and is held in any suitable position by set screw 51. The tube has an inlet opening near the top at 52 in the area 53 of the bath 33 which will predominantly contain lighter retarding agent. The tube 45 terminates at the bottom, leaving a clearance 54 from the bottom so as to permit withdrawal also of the predominantly heavy etchant 55. It will be evident that by moving the tube up or down less or more of the retardant compared to the etchant will be withdrawn by the pump. In line with the tube is a U bend outlet pipe 56 which communicates at the bottom with a pump chamber 57 containing pump rotor 58 which turns on shaft 61 on bearing 60, and turning in housing 62 under the action of motor 63.

Tangential to the pump housing is a pump outlet pipe 64 which extends upward at 65 and across the top of the etching machine at 66 and then down at 67 to a header 68. The header mounts and connects with spray pipes 70 extending along horizontally above and close to the cylindrical printing plate and the pipes have spray openings 71 at their lower sides directed downwardly and radially of the cylindrical plate. The spray pipes are closed by caps 72 at the far ends.

For the purpose of regulating the flow through the sprays, a branch pipe 73 connected to pipe 66 communicates with a by-pass valve 74 which discharges through a by-pass pipe 75 back into the bath.

In operation, the printing plate is secured in any suitable way on the drum 43 with its outer surface partially or preferably wholly immersed in the etchant bath. If the plate is not to be wholly immersed, it should be immersed to about the outer confines of the spray. The tube 45 is then adjusted by moving it up or down to obtain the proper proportion of etchant and retardant in

the spray. The pump 58 is then operated and the by-pass valve 74 is opened or closed to obtain the desired flow through the spray nozzles.

The etching then continues, the spray clearing away the retardant film on direct impingement and thus etching areas 23, but the retardant protecting the sides of the dots against undercutting and also protecting against etching while the plate is removed from the spray and is travelling beneath the bath.

Thus in effect the spray selectively etches the parts which are not protected by the resist or other means applied in the etching process, and are not subjected to the direct impingement.

In some cases, the spray may be obtained from an impeller or impellers rather than a spray head. In Figure 8 I illustrate a plate holder and plate mounted and manipulated in the manner previously described, in a well 76 of a tank 77 which is provided with etching spray impellers 78 driven by shafts 80 through motors 81 and belt and pulley combinations 82. Impellers are backed up by a spray directing shields 83, and the spray is confined by direction vanes 84. The plate may be submerged to any of the extents referred to. While in this case spray is directed on the plate from both sides, it will be understood that in a suitable design the spray can be received from only one side if desired.

The plate is removed by opening a cover 85.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art to obtain all or part of the benefits of my invention without copying the method and structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

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

1. The method of etching a cylindrical printing plate, using a chemical etchant which is effective primarily on direct impingement, which comprises maintaining a pool of etchant, immersing the cylinder at least partially beneath the pool with a portion of the cylindrical surface upwardly exposed, directing a spray of etchant on the upwardly exposed surface of the cylinder, and rotating the cylinder.

2. The method of claim 1, which comprises maintaining the cylinder fully immersed in the pool.

3. The method of etching a cylindrical printing plate using a chemical which is effective principally on direct impingement, and which includes ingredients of different specific gravity, which comprises maintaining a pool of the etchant, at least partially immersing a printing plate beneath the pool of etchant, withdrawing liquid from the pool at both the lower and upper portion of the pool, spraying the liquid withdrawn against a portion of the printing plate and rotating the cylinder to expose successive portions of the circumference of the cylinder to the spray.

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