Feb. 1, 1966 J. D. RUTTAN ETAL 3,232,814

ETCHING APPARATUS FOR CYLINDRICAL PRINTING PLATES

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Fig. 1.

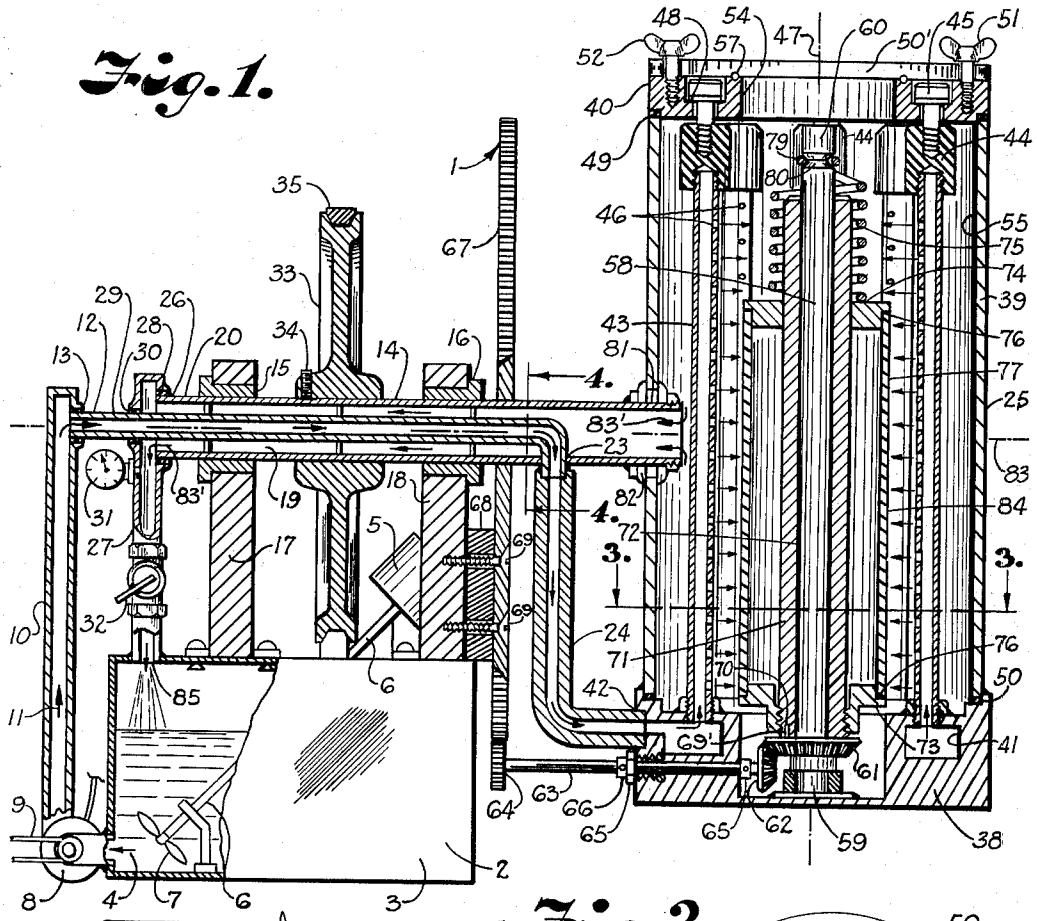
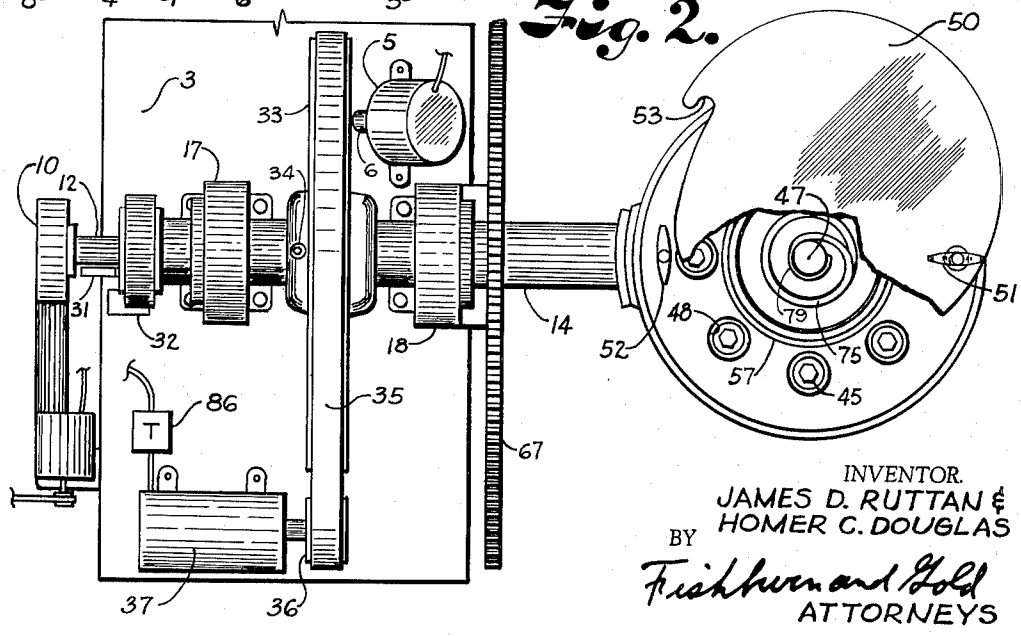


Fig. 2.



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Fig. 3.

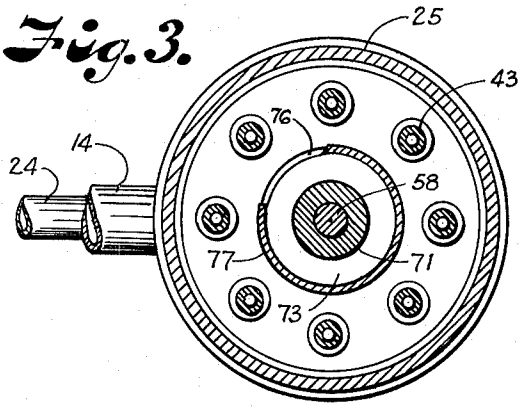


Fig. 4.

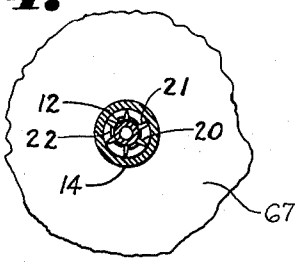


Fig. 5.

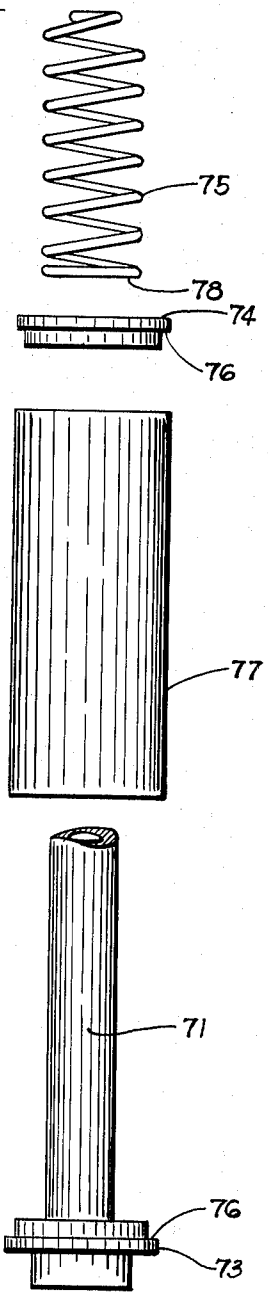
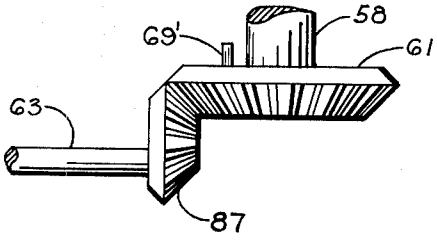


Fig. 6.



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ETCHING APPARATUS FOR CYLINDRICAL PRINTING PLATES

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4 Claims. (Cl. 156—345)

This invention relates to the art of etching, and more particularly to the etching of cylindrical printing plates with liquid etchants effective primarily upon direct impingement.

Etching solutions effective primarily on direct impingement have been developed in an effort to obtain uniform accurate etching on the relief surface of a printing plate while avoiding undercutting which weakens or destroys the printing surface. Such etchants include a fraction which forms a film of retardant on the surface of the plate which film is removed under conditions of direct impingement against the surface of the plate but displays a resistance to removal under the usual conditions of lateral flow contact, thus decreasing the tendency to undercut the dot or line structure being formed by the etching process. It has been found that in using such impingement etchants, it is highly desirable to avoid non-uniform flow of the etchant over the surface of the plate such as run-off directed primarily in a single direction. It has also been recommended to avoid unnecessary exposure of the plate to the air during etching which tends to produce a hardened deposit thereon interfering with further etching.

Attempts have been made heretofore to avoid these difficulties (for example, see Guenst U.S. Patent No. 2,926,076, February 23, 1960); however, such attempts have generally not produced the optimum quality of printing plate thought to be obtainable with direct impingement etchants and particularly with cylindrical printing plates which present difficult problems due to the curved printing surfaces.

The principal objects of the present invention are: to provide a method and apparatus for etching cylindrical printing plates with etchants effective primarily upon direct impingement which produces non-undercut printing plates of higher quality and uniformity than heretofore; to provide such a method and apparatus which obtains highly uniform distribution of the etchant solution over the surface of the printing plate; to provide such a method and apparatus wherein eddy currents formed during etchant impingement are uniformly distributed and dispersed so as to avoid unwanted recurring paths of run-off flow lateral to the impingement angle; to provide such an etching apparatus wherein the spray velocity and static pressure of the etchant solution can be easily controlled; to provide such apparatus wherein the etching solution is completely contained so as to avoid the dangers of escaping fumes or etchant splashing into areas occupied by personnel; to provide such an apparatus which is adapted to easily receive cylindrical printing plates of various sizes without significant alteration; and to provide such an apparatus which is simple and inexpensive in construction and highly efficient in use.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain embodiments of this invention.

FIG. 1 is a vertical cross-sectional partially fragmentary view of etching apparatus embodying this invention particularly showing the relationship of parts therewithin.

FIG. 2 is a fragmentary plan view of the etching apparatus showing a cover plate partially broken away and in partially open position.

FIG. 3 is a fragmentary cross-sectional view through

the apparatus taken on the line 3—3, FIG. 1, showing the interior of the container for receiving a cylindrical printing plate to be etched.

FIG. 4 is a fragmentary cross-sectional view taken on the line 4—4, FIG. 1, particularly showing the coaxial tubing shaft for rotatably mounting and feeding etchant into the container.

FIG. 5 is an exploded view of the mandrel assembly for rotatably mounting the printing plate within the container.

FIG. 6 is a fragmentary elevational view on an enlarged scale showing a modified form of gearing for use in the plate container to produce an axial reciprocation as well as rotation of the plate during etching.

Referring to the drawings in more detail:

The reference numeral 1 indicates generally a preferred form of apparatus embodying this invention. The apparatus 1 includes connected walls 2 forming a tank 3 adapted to hold a quantity of liquid etchant 4 of the type effective primarily upon direct impingement. Since such etchants include fractions of varying specific gravity which tend to settle out, a suitable motor 5 is provided which is operatively connected to a rotatably mounted shaft 6. The shaft 6 terminates in a blade 7 located beneath the surface of the etchant 4 in the tank 3 for maintaining the etchant in a violently agitated condition during use of the apparatus 1.

The interior of the tank 3 communicates near the bottom thereof with a suitable liquid impelling pump 8 driven by a belt 9 powered by suitable variable speed apparatus (not shown) for controlling the output from the pump 8. The output from the pump 8 is delivered into a stationary pipe 10 which carries the etchant upwardly as indicated by the arrow 11, FIG. 1. The pipe 10 communicates at the upper end thereof with a tube 12 and a suitable seal 13 permits relative rotation therebetween without etchant leakage. The tube 12 extends coaxially into an elongated sleeve 14 which is rotatably mounted on spaced bearings 15 and 16 mounted in respective pillow blocks 17 and 18 which, in the illustrated example, are anchored to a wall of the tank 3.

The sleeve 14 has a substantially greater inside diameter than the outside diameter of the tube 12 producing a passageway 19 therebetween. Suitable locator or retainer members 20 are spaced along the passageway 19 for maintaining the tube 12 in coaxial relation within the sleeve 14. The retainer members 20 are each composed of a plurality of radial arms 21 having openings 22 therebetween whereby the passageway 20 is unobstructed to liquid flow therethrough. The tube 12 turns laterally and extends through a sealed junction in the wall of the sleeve 14 at 23 where it communicates with the input tube 24 of a container 25 described hereinafter.

The sleeve 14 communicates at one end 26 thereof with a stationary return pipe 27 which communicates with the tank 3. A suitable seal is provided at 28 to permit relative rotation between the return pipe 27 and the sleeve 14 without etchant leakage. The tube 12 extends past the end 26 of the sleeve 14 and transversely through the return pipe 27 at 29. A suitable seal 30 permits relative rotation between the tube 12 and return pipe 27 without leakage. A pressure gage 31 is mounted on and communicates into the return pipe 27 and a suitable adjustable flow restricting valve 32 is mounted in the return pipe 27 for reasons described hereinafter. A pulley 33 is fixed to the sleeve 14 between the pillow blocks 17 and 18 by a suitable set screw 34 and is engaged with a drive belt 35. The drive belt 35 is in turn engaged with a pulley 36 fixed to the shaft of a suitable reversible motor 37, in the illustrated example, mounted on a wall of the tank 3. The motor 37 thus rotates the sleeve 14 and tube 12 as a unit in either a clock-

wise or counterclockwise direction for reasons discussed hereinafter.

The container 25 includes a base ring 38, a cylindrical wall 39 preferably of transparent material such as a suitable synthetic resin, and a cover assembly 40. The base ring 38 has an annular cavity 41 formed therein which communicates with the input tube 24 at 42. A plurality of spray tubes 43 are secured at one end respectively thereof to the base ring 38 and communicate with the annular cavity 41. The spray tubes 43 are sealed at the other ends respectively thereof with suitable caps 44 which are bored and tapped axially of the tubes 43 for receiving cap screws 45 thereinto. The spray tubes 43 have spaced nozzles or openings 46 located therealong and adapted to discharge etchant therefrom radially inwardly of the container 25. In the illustrated example, the spray tubes 43 extend parallel to the cylindrical wall 39 and are equally spaced circumferentially and radially about the cylindrical axis 47 of the container 25. The openings 46 are preferably longitudinally staggered with respect to the openings in adjacent spray tubes 43 so as to avoid undue concentration of spray stream pressure at any one longitudinal position within the container 25.

The cap screws 45 extend into and through the cover assembly 40 at circumferentially spaced positions 48 for anchoring the cover assembly with respect to the cylindrical wall 39 and producing sealing pressure therebetween. Suitable seals 49 and 50 are located between the cylindrical wall 39 and the cover assembly 40 and base ring 38 to prevent leakage between the respective junctions. It is noted that tightening the cap screws 45 produces a tensile force on the respective spray tubes 43 which is transmitted to the cover assembly 40 and base ring 38 for urging them toward each other. A lid or cover 50' is pivotally secured to the cover assembly 40 with a wing bolt 51 extending through the cover 50' and threadedly engaged in the cover assembly 40. A second wing bolt 52 is also threadedly engaged in the cover assembly 40 but diametrically opposed to the wing bolt 51. The cover 50' pivots about the wing bolt 51 and has a receiving notch 53 adapted in the periphery thereof to engage the wing bolt 52 for securing the cover 50' in closed position on the cover assembly 40. When pivoted away from the cover assembly 40, the lid or cover 50' exposes a cylindrical bore 54 which opens axially into the interior 55 of the container 25. An O-ring seal 57 is mounted on the cover assembly 40 surrounding the bore 54 and is adapted to engage against the lid or cover 50' when closed to prevent leakage. The two wing bolts 51 and 52 are rotated when the lid or cover 50' is in closed position to insure firm engagement against the seal 57 and both wing bolts are turned in the opposite direction in order to release the cover for pivoting about the wing bolt 51.

A shaft 58 is cantilever mounted at one end 59 thereof to the base ring 38 and extends coaxially within the interior 55. The other end 60 of the shaft 58 is free and terminates adjacent the cylindrical bore 54. A bevel gear 61 is rotatably mounted on the shaft 58 and engages with a bevel pinion 62 secured to one end of a shaft 63. The shaft 63 is rotatably mounted in and extends transversely through the base ring 38 and terminates at the other end thereof in a pinion 64. A suitable sealing assembly 65 prevents leakage past the shaft 63 and a pair of collars 66 prevent undue longitudinal motion of the shaft 63. The pinion 64 engages with a stationary gear 67 which, in the illustrated example, is fixed by means of a suitable spacing block 68 and screws 69 to the pillow block 18.

The bevel gear 61 has an upstanding lug 69' adapted to mate with a recess 70 in a mandrel assembly broadly designated 71. The mandrel assembly 71 comprises a cylindrical hollow core 72, a pair of opposed collars 73 and 74 and a helical coil spring 75. The core 72 is adapted to be longitudinally received over and rotate about the shaft 59 in response to the rotation of the bevel gear 61. The collar 73 is threadedly engaged with the core 72 and rotates therewith. The collar 74 slides longitudinally axially over the core 72 and is radially positioned thereby.

The collars 73 and 74 present facing annular ledges 76 for receiving the opposite ends of a cylindrical printing plate 77 to support same within the interior 55 for etching. The spring 75 bears at one end 78 thereof against the collar 74 for urging same toward the collar 73 and terminates at the other end thereof in a reduced diameter loop 79. The loop 79 is adapted to resiliently slide longitudinally over the free end 60 of the shaft 58 and engage into a shaft groove 80 to maintain the spring 75 under compression but permit rotation thereof about the shaft 58. The mandrel assembly and printing plate are removed by simply urging the loop 79 longitudinally toward the shaft end 60 which releases the entire mandrel assembly and plate 77 for withdrawal through the cylindrical bore 54. Printing plates of various diameters and lengths may be supported in the container 25 by varying the diameter of the collars 73 and 74 and, where necessary, varying the length of the spring 75.

The other end 81 of the sleeve 14 extends through the cylindrical wall 39 approximately in the longitudinal center thereof and communicates with the interior 55. A suitable collar and seal assembly 82 rigidly mounts the cylindrical wall 39 to the sleeve end 81 and thereby rotatably supports the container 25 on an axis 83 which extends transversely of the axis 47 and approximately centrally of the container 25 and of the printing plate 77, FIG. 1.

In operation, the pump 8 withdraws etchant from the tank 3 and urges same through the tube 12 and into the annular cavity 41. The etchant in the cavity 41 is urged into the respective tubes 43 where under the pressure exerted by the pump 8 it is discharged in a plurality of spaced minute streams from the openings or nozzles 46 radially against the outer cylindrical surface 84 of the printing plate 77. The rapid discharge of the etchant from the nozzles 46 substantially fills the interior 55 of the container 25 and the fluid pressure built up therein is released by rearward or return flow through the end 81 into the sleeve 14 (arrows 83') from which it is directed into the return pipe 27 for discharge back into the tank 3 at 85. The pressure of the etchant in the interior 55 (which pressure affects etching characteristics) may be controlled by selectively closing or opening the valve 32 which selectively retards the return flow. The desired pressure in the container 25 may be monitored by means of the pressure gage 31.

During the above-described etchant flow, the motor 37 drives the pulley 33 rotating the sleeve 14 which, in turn, rotates the container 25 about the axis 83. This rotation produces an orbiting of the pinion 64 about the stationary gear 67 which results in a rotation of the bevel gear 61, rotating the mandrel assembly and therefore the printing plate 77 about the longitudinal or cylindrical axis of the container 25. Thus, the printing plate 77 is simultaneously rotated about two transverse axes while being submerged and impinged with etchant.

It is preferable that the container 25 be maintained full of etchant during the etching period, however, a partially filled container also produces a satisfactory etch so long as there is sufficient motion of the printing plate 77 in the manner above described to provide even rapid exposure of the plate surface 84 to liquid and prevent excess exposure to drying gas within the interior. In the illustrated example, any etchant level over one-half filling the container 25 will induce return flow. It is to be noted that gas is generated during the etching process, however, due to the high state of agitation within the interior 55 and the rapid flow of etchant through the container 25, the bubbles of gas generated will be comparatively small in volume displaced and uniformly distributed within the container and will escape rapidly and uniformly through the sleeve 14 for separation within the tank 3. It is further noted that during the etching pro-

cedure there is no exposed etchant to splash out or create fumes and close observation of the printing plate **77** can be maintained through the transparent cylindrical wall **39**.

In order to further insure the uniform etching of the printing plate **77**, a suitable interval timer and switch **86** is provided for periodically altering the power input to the motor **37** to produce reversal thereof and thus reversal of plate rotation about two axes. It is desirable that over a typical etching period of six to ten minutes the rotation of the printing plate **77** about both the cylindrical and transverse axes thereof is reversed at intervals of approximately one minute in length.

Referring to FIG. 6, a modified bevel pinion **87** is illustrated which differs from the bevel pinion **62** in that it is mounted eccentrically or off-center from the longitudinal axis thereof. The substitution of the pinion **87** for the pinion **62** will cause the printing plate **77** to reciprocate longitudinally on its axis while it rotates thereabout during the rotation of the container **25** about a transverse axis. In this manner, even greater uniformity of etch may be obtained, if desired.

The method and apparatus above described are particularly adaptable to etching magnesium or zinc printing plates or alloys thereof and, with the proper etchant, brass printing plates may also be processed. It has been found that high quality uniform etching is obtained without undercutting and without the highly developed skill heretofore required in such work.

It is to be understood that while certain forms of this invention have been illustrated and described, it is not to be limited to the specific form or arrangement of parts herein described and shown except insofar as such limitations are included in the claims.

What we claim and desire to secure by Letters Patent is:

1. Apparatus for etching a cylindrical printing plate comprising:

(a) a tank adapted to hold a quantity of liquid etchant,

(b) a container for receiving the plate, a supporting member in said container and adapted to support the plate for rotation within said container substantially about the cylindrical axis of the plate,

(c) means adapted to support said container for rotation about an axis transverse to the plate cylindrical axis,

(d) drive means operatively connected to said support means and supporting member for simultaneously rotating said plate about the cylindrical axis thereof and rotating said container about said transverse axis,

(e) spray means in said container and adapted to impinge etchant against the plate,

(f) pump means communicating between said tank and said spray means for urging etchant under pressure into said spray means, and

(g) means for returning etchant to said tank from said container.

2. The apparatus of claim **1** wherein:

(a) said transverse axis extends generally centrally of said container.

3. The apparatus of claim **1** wherein:

(a) said drive means is reversible for reversing the rotation direction on said axes, and

(b) timing means connected to said drive means for periodically reversing said drive means.

4. The apparatus of claim **1** including:

(a) valve means associated with said return means for retarding the return of etchant from said container to increase the etchant pressure in said container.

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