

L. E. HOLLAND

METHOD OF ETCHING PLATES

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3 Sheets-Sheet 1



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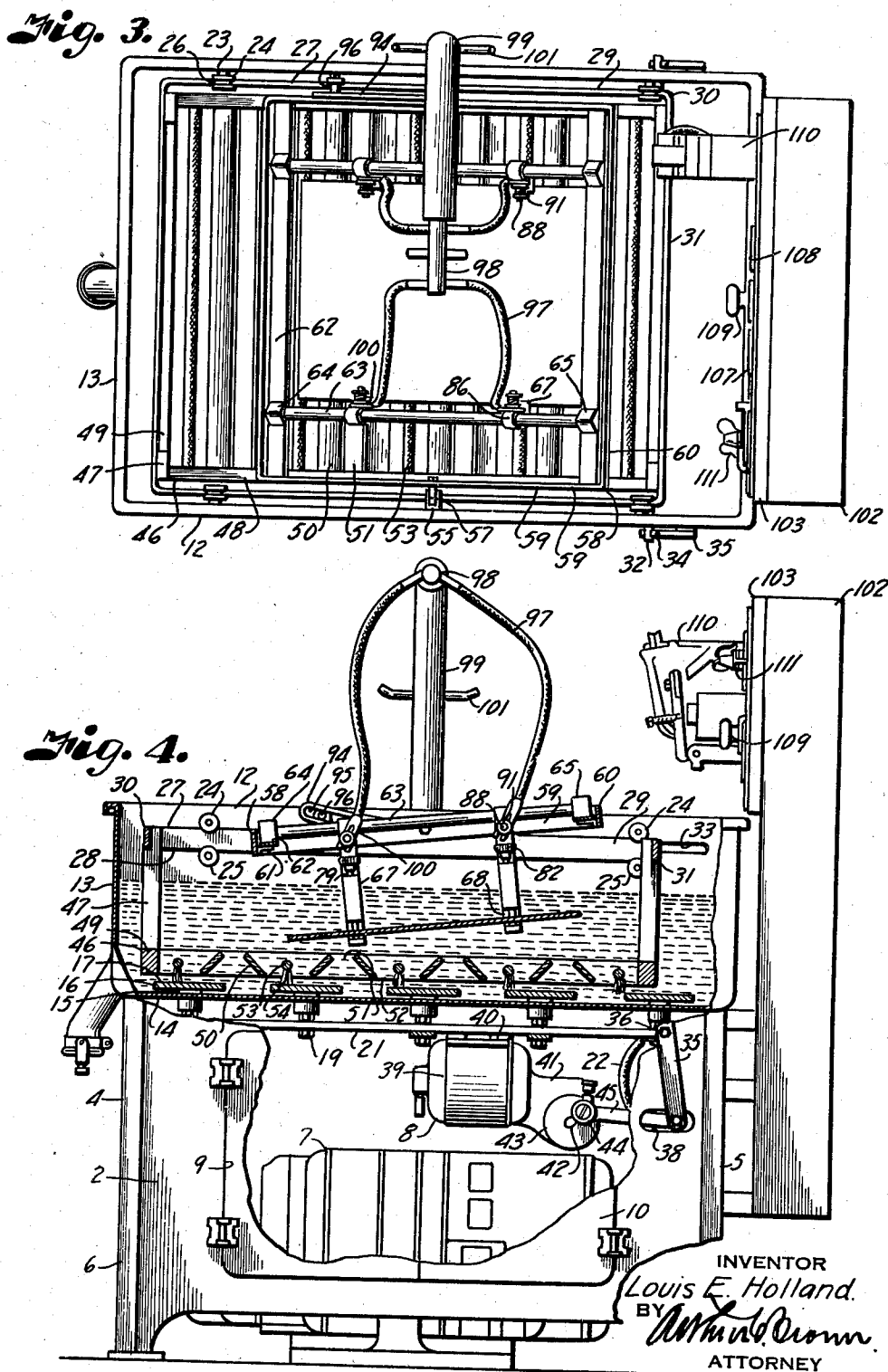
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2,074,221

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3 Sheets-Sheet 2



INVENTOR

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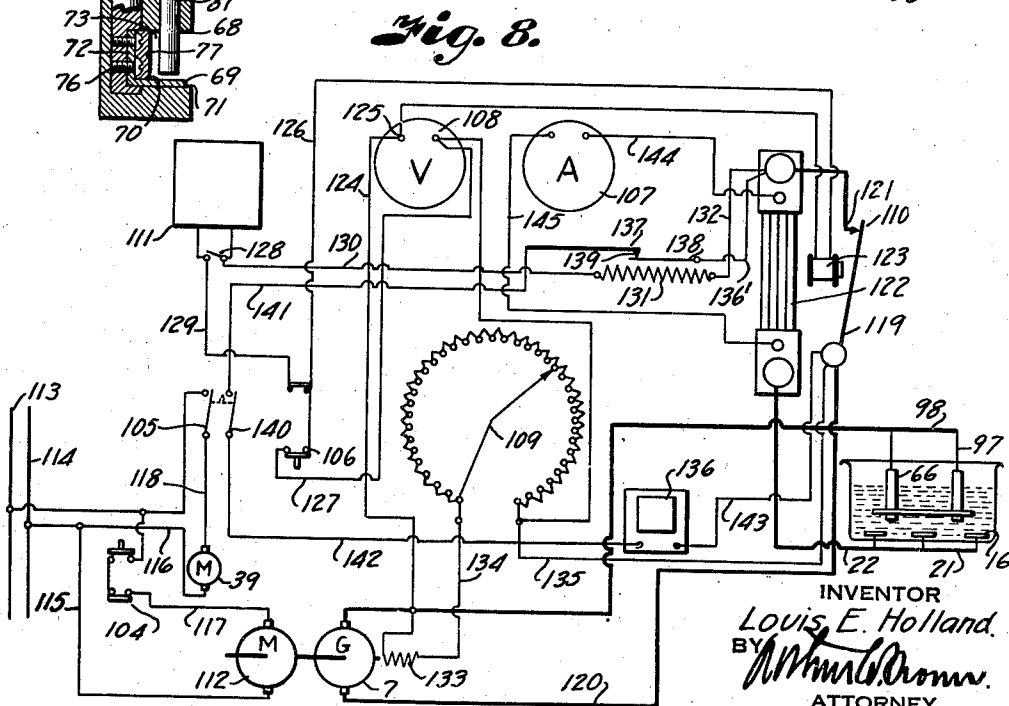
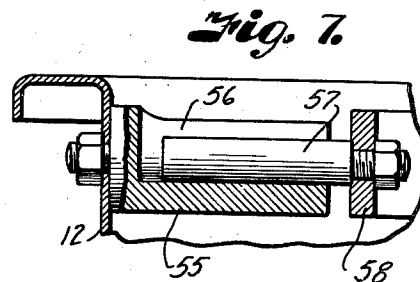
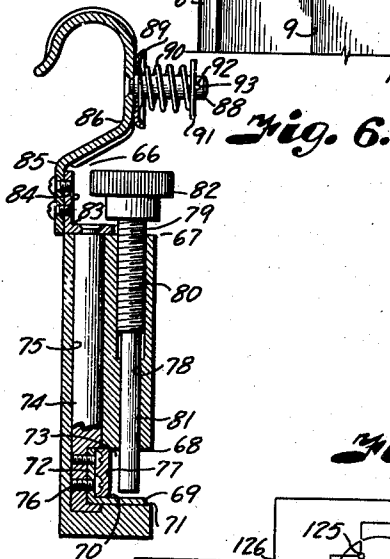
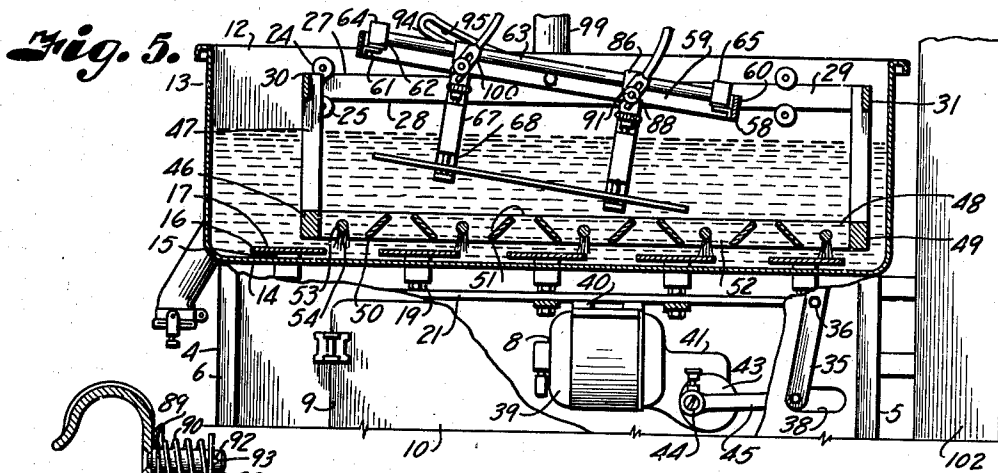
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METHOD OF ETCHING PLATES

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5 Claims. (Cl. 204—1)

This invention relates to a method of etching plates, particularly those of the type employed for printing purposes, and has for its principal object to provide a method of producing etchings of higher quality and sharper detail in a shorter time than is possible by present processes commonly employed in the commercial etching of such plates.

In electrical etching, as heretofore practiced, it has been customary to immerse a plate to be etched in a bath of electrolyte, and to pass a current through the plate and bath to a cathode, also immersed in the electrolyte, so that the portions of the plate exposed to the electrolyte will dissociate from the plate to produce the etching, the plate, in some instances, being reciprocated in a horizontal plane within the bath to wash particles of the metal that have been dissociated from exposed portions of the plate by electro-mechanical action thereby speeding up the etching operation and producing more regular lines.

I have discovered that by agitating the electrolyte relatively to the plate, particularly with a jetting action, washing of the dissociated particles from the plate, and removing of such particles from the region of the plate, is facilitated, and by reason of such constant exposure of the surface to be etched to clean electrolyte, the time of etching is greatly reduced and the quality of the finished product is greatly improved. I have also found that by rocking the plate reversely to flow of the electrolyte, more direct contact of the electrolyte with the surface to be etched is effected, thereby producing a clearer plate with sharper lines.

In practicing my method I employ an improved apparatus illustrated in the accompanying drawings wherein:

Fig. 1 is a perspective view of an etching apparatus embodying the features of the present invention.

Fig. 2 is a cross section through the tank portion of the apparatus particularly illustrating the plate rocker and the agitator for effecting movement of the electrolyte.

Fig. 3 is a plan view of the apparatus.

Fig. 4 is a side elevational view of the apparatus, a side of the tank and lower portion of the supporting cabinet being broken away to better illustrate the plate rocker and agitating apparatus contained in the tank, and the agitator motor and generating unit contained in the cabinet.

Fig. 5 is a longitudinal section through the

tank showing the plate tilted in the opposite direction to its position in Fig. 4, and the agitator at the opposite end of its stroke.

Fig. 6 is a detail section through one of the plate clamp terminals.

Fig. 7 is a detail perspective view of one of the plate rocker trunnions and its bearing.

Fig. 8 is a diagrammatic view of the electrical wiring employed on the apparatus.

Referring more in detail to the drawings:

1 designates a cabinet including front and rear walls 2 and 3, and end walls 4 and 5 that are connected with the front and rear walls by corner legs 6, to form a compartment for a current generator 7, and a motor 8 for driving the agitating mechanism, later described, access being had to the interior of the cabinet through an opening 9 formed in the front wall 2 and closed by doors 10.

Supported upon the cabinet 1 is a tank 11 consisting of integral side, end and bottom walls 12, 13 and 14, preferably formed of metal but completely protected on both the inner and outer sides, from the attack of an electrolyte solution, by a coating of non-corrosive material, such as porcelain. Mounted on the bottom of the tank, and supported in spaced relation therewith on suitable insulators 15, is a series of cathodes 16. Each cathode 16 is constructed of conductive material and includes a bar of sufficient length to extend substantially across the width of the tank, and has a flat upper portion 17 exposed to the electrolyte solution to collect the current passing from the plate across the electrolyte, as later described.

The respective ends of each plate are provided with terminals 18 and 19 that extend through the insulators and connect with bus bars 20 and 21, to which is connected a suitable conductor 22. Mounted on the side walls of the tank adjacent the ends thereof, and above the level of the electrolyte solution contained therein, are brackets 23 carrying vertically spaced pairs of rollers 24 and 25, having grooves 26 within which ride the upper and lower edges 27 and 28 of the side rails 29 of an agitator supporting frame 30.

The agitator frame is of rectangular construction, and also includes end rails 31 that are secured to the ends of the side rails 29, the end rails being located well within the end walls of the tank to permit reciprocation of the agitator proper, which is suspended from said end rails, as presently described.

One end of the frame carries pins 32 that pro-

ject through horizontal slots 33, formed in the side walls of the tank, and are mounted in the notched ends 34 of rock arms 35. The rock arms 35 are pivotally mounted on screws 36 that project from the front and rear walls of the cabinet at a point slightly below the bottom of the tank, as best illustrated in Figs. 1 and 2. The lower ends of the rock arms extend downwardly and are interconnected by a cross bar 37 extending transversely of the cabinet, and having its ends projecting through slotted openings 38. The rock arms 35 are oscillated on the screws 36 to effect reciprocation of the agitator frame by means of a motor 39, suspendingly mounted on a transverse bar 40, having its ends connected to the bus bars 20 and 21, previously described.

Formed in the motor housing is a suitable speed reducing mechanism, indicated at 41, and including a driven shaft 42 which carries a disk 43 having an eccentrically mounted pin 44, to connect a pitman 45, having its outer end connected with the cross bar 37.

It is thus apparent that upon operation of the motor, gyration of the eccentric pin about the axis of the shaft 42, will effect oscillation of the rock arms through the pitman 45, and reciprocation of the agitator supporting frame by reason of its connection with the upper ends of the rock arms.

The agitator proper includes a rectangular frame 46 suspended from the reciprocatory frame by hangers 47, attached to and depending from the end rails 31 thereof. The frame 46 includes side and end bars 48 and 49 having their ends connected to the lower ends of the hangers 47. Connecting the side members 48 are agitating blades 50, arranged in pairs with the members of each pair converging upwardly but spaced apart to provide elongated transverse jet openings 51, the lower edges of the blades of adjacent pairs being likewise spaced to form bottom openings 52, whereby upon reciprocation of the agitator within the electrolyte contained within the tank, the electrolytic liquid will be delivered upwardly in elongated jets and angularly in a direction depending upon movement of the agitator. Likewise similar jets will be directed downwardly and against the upper surface 17 of the cathode bars.

Extending across the side frames, between the pairs of blades, are transverse rods 53, carrying brushes 54 adapted to sweep across the upper surfaces 17 of the cathodes to remove any of the dissociated material that may tend to lodge thereon, so that the upper surfaces of the cathode bars will always remain in clean condition, thereby promoting flow of the current from the plate in the direction of the cathodes.

Mounted centrally on the side walls, and projecting inwardly of the tank above the side rails of the agitator frame to avoid interference therewith, are brackets 55 having upwardly opening sockets 56 for pivotally mounting trunnions 57 of a plate rocking frame 58. The frame 58 is preferably formed of strap metal, with sides 59 and ends 60 arranged edgewise for mounting the trunnions 57 on the sides 59, and for attaching angle bars 61 along the lower edges of the ends 60 to form ledges 62 for supporting the plate carrying bars 63. The bars 63 have triangular shaped heads 64 and 65 secured to the ends thereof, for seating on the ledges 62, as best shown in Fig. 4.

Suspended from the bars 63 are plate clamp terminals 66, which include rectangular blocks

67 formed of insulating material, for example a phenolic resin known as "bakelite", and have notched lower ends 68 to mount an angle shaped jaw 69, having one flange 70 seated across the side 71 of the notch, and its opposite flange 72 inset into the bottom face 73 of the notch to connect with a conductor rod 74 that extends downwardly through a bore 75, formed in the body portion of the clamp, and has its lower end intersecting the notch to permit connection of the rod with the jaw member by means of screws 76 that are threaded through suitable openings in the flange 72, and into threaded openings in the rods 74.

The jaw 70 is constructed of suitable material that is adapted to carry a current from the rods 74 to the plate, but which is not affected by the action of the electrolyte. The rod 74, however, may be formed of copper, or any other suitable conductive material, and for this reason is sealed from contact with the electrolyte by a sealing material 77 covering the heads of screws 76, and closing the intersecting opening between the bore 75 and the face of the notch. Adjustably mounted in a bore 78 that extends longitudinally in spaced relation with the bore 75, is a clamping screw 79 having a threaded portion 80 engaged with a threaded portion of the bore 78, and having a reduced shank 81 which projects from the upper side of the notch to engage the plate that is to be supported by the clamps, as later described.

The upper end of the screw has a knurled head 82, whereby the screw may be moved to and from clamping engagement with the plate. Fixed to the upper end of the rod 74 is an angle member 83 having an upwardly extending flange 84, to which is connected a depending foot 85 of a hook 86. The upper portion of the hook is offset laterally of the foot portion 85 thereof, so that the center of gravity of the body portion of the clamp will align directly with the central portion of the hook 86, whereby the clamp is caused to hang perpendicularly from one of the rods 63.

Fixed to and extending laterally from the hook 86 is a stud 88, and slidably mounted on said stud is a contact washer 89 that is yieldingly retained in clamping engagement with the hook 86 by means of a coil spring 90, sleeved over the stud 89, and having one end engaging the washer 89 and its opposite end a washer 91 that is fixed on the stud by means of a pin 92 extending through an opening 93 in the stud, and engaging the opposite face of the washer 91, as clearly shown in Fig. 6. The insulated body of the clamp is of sufficient length so that, when a plate is suspended thereby from the rocker frame, the plate will be caused to move in the electrolyte during the entire stroke thereof, as later described. The clamps may be arranged in pairs on the respective rods 63 and unless the plate to be etched is extremely large, four clamps are sufficient, one to each corner of the plate, as shown in Fig. 1.

Positioning of the rods 63 on the rocker frame and the location of the clamps on the rods, adapts the clamping elements for supporting plates of different dimensions within the tank. If a larger plate is to be etched in the tank, any number of clamps may be suspended from the respective rods to properly distribute the current to the entire area of the plate, thereby assuring uniform etching action over the entire area.

The rocker frame 58 is reciprocated to alternately tilt the suspended plate in opposite direc-

tions by means of an arm 94 adjustably attached to one of the side rails of the frame, and having a cam shaped slot 95 in which a pin 96 on a side rail of the agitator supporting frame is projected, thus when the agitator supporting frame is reciprocated, the pin moves through the slot and effects a rocking action of the plate supporting frame in reverse movement to that of the agitator.

Each plate clamp is supplied with a suitable etching current by means of flexible conductors 97 having connection with a main conductor 98 that is extended through a gooseneck conduit 99 into the cabinet where it connects directly with the positive output terminal of the generator 7. The free ends of the flexible conductors are provided with slotted terminals 100 that are adapted to be clamped between the hook 86 and the contact washer 89, as best illustrated in Figs. 4 and 5. The conduit may be provided with suitable hook-like arms 101, whereon the flexible conductors, when not in use, may be conveniently supported.

Mounted on the end wall 5 of the cabinet, and projecting above the top of the tank, is a housing 102 for enclosing various electrical connections from the agitator motor, and the generator unit, with the switches and other instruments that are mounted on a switch panel 103 that is carried by the housing 102 directly above the tank, as shown in Fig. 1. Mounted on the front of the panel 103 are push button switches 104, 105 and 106 for controlling the generator motor circuit, the agitator motor circuit, and the generator circuit respectively. Also mounted on the panel is an ammeter 107, a voltmeter 108, a regulator 109 for controlling voltage of the field winding of the generator to regulate output of the generator, an automatic circuit breaker 110 for the etching circuit, and a time switch 111 for effecting automatic opening of the circuit breaker 110.

Referring to the wiring diagram illustrated in Fig. 8, it will be noted that the agitator motor 39, and the actuating motor 112 for the generator 7, are supplied with current from a service line including wires 113 and 114, through branch wires 115 and 116, leading to one of the terminals of the respective motors, and through branch wires 117 and 118 that connect to the other of the motor terminals through the switches 104 and 105.

As previously mentioned, the positive terminal of the generator 7 is connected directly with the conductor 98 leading to the terminal clamps 55 which support the plate to be etched but the negative terminal thereof connects with the switch arm 119 of the circuit breaker 110 by means of a conductor 120. The circuit breaker switch arm, when closed engages a contact 121 forming a part of an ammeter shunt 122 which in turn is connected with the bus bars connecting the cathodes 16 by the conductor 22, previously mentioned. The circuit breaker includes a holding coil 123 that is connected with the positive side of the generator 7 by a wire 124, also connecting with one of the terminals 125 of the voltmeter 106. The other end of the holding coil connects by a wire 126 with the switch 106 and the other terminal of the switch is connected by a wire 127 with the negative side of the circuit breaker switch arm 119. The wire 127 also connects with the other terminal of the voltmeter to complete the circuit therethrough.

It is thus obvious that when the switch 106 is closed, current will flow through the wire 124,

holding coil 123, wire 126, switch 106, wire 127, conductor 120 to the generator 7, completing a circuit through the holding coil to hold the switch arm 119 in closed position. When the switch arm of the circuit breaker is closed upon energization of the holding coil, current flows through the conductor 98, plate terminal clamps 66, through the plate being etched, through the electrolyte to the cathode 16, through the conductor 22, ammeter shunt 122, circuit breaker 110 and conductor 120, back to the generator. The etching, therefore, will continue as long as the circuit breaker 110 is closed. The etching of the plate is so rapid that a matter of a few seconds is often the difference between an over-etched or an under-etched plate, and a perfect one, and I, therefore, provide for automatically suspending the etching action by interrupting the etching circuit, after a predetermined interval. This is accomplished by a timing mechanism including a switch 128 having connection with the wire 126 through wire 129 leading to the switch 106. The other side of the switch is connected by a wire 130 with one end of a resistance winding 131 that is connected by a wire 132 with the fixed contact 121 of the circuit breaker. Therefore, when the time switch is closed, current can also flow from the holding coil through the resistance 131, the path of the current being as follows; from the positive side of the generator through the wire 124, holding coil 123, wire 126, switch 106, wire 129, switch 128, wire 130, resistance 131, circuit breaker switch contact 121, circuit breaker arm 119, and conductor 120 back to the generator.

The resistance 131 is, therefore, in series with the holding coil 123 to prevent injury thereto incidental to the heavy current required in the etching process. When the switch 128 is opened by the timing mechanism, the circuit through the holding coil 123 and 131 is broken to effect release of the arm 119 of the circuit breaker, thereby breaking the etching circuit to suspend etching action of the plate.

In order to control the output of the generator the negative terminal of the generator winding 133 is connected by a wire 134 with the rheostat 109 through which circuit is completed to the negative side of the generator by a wire 135 connecting with the switch arm 119. The positive side of the field winding, of course, is connected to the positive side of the generator as in conventional generator design.

Since the etching time is automatically controlled, it is not necessary for the operation to be in constant attendance, and he may be released for other duties while the plate is being etched. The apparatus is, therefore, provided with a signal to audibly advise the operator when the etching current is suspended. This is accomplished by connecting a buzzer or other audible signal 136, in the generator circuit, as now described.

Connected with the fixed contact 121 of the circuit breaker is a wire 136' leading to a thermostatic element 137, including a temperature responsive blade 138 that is movable to and from fixed contact 139 responsive to temperature of the resistance 131, the contact being connected to a switch 140 by a wire 141.

The switch 140 is coupled with the switch 105 controlling the agitator motor and is closed or opened simultaneously therewith. The switch 140 is connected with one terminal of the buzzer through a wire 142, and the other terminal of the buzzer is connected by a wire 143 with the cir-

cuit breaker arm 119 completing a closed circuit through the electrolyte solution.

The thermostat contact is closed whenever current is flowing through the holding coil 123, but due to the fact that the buzzer circuit is substantially shorted out when the circuit breaker is closed, the full voltage required to actuate the signal is not impressed on the signal circuit. However, when the circuit to the holding coil is broken to suspend the etching operation, a full current sufficient to actuate the signal will then flow from the generator through the wire 98, across the electrolyte to the cathodes, through the wire 124, ammeter shunt 122, wire 136', thermostat 138, wire 141, wire 142, buzzer 136, wire 143, to the circuit breaker arm 119 and conductor 120 back to the generator. This current, however, is not sufficient to produce an etching effect upon the plate because the buzzer is in series with the electrolyte solution. The signal will continue to operate until the switch 105 is opened or until the coil 131 cools sufficiently to effect breaking of the buzzer circuit by means of the thermostat 137.

The ammeter 107 is connected to the shunt by wires 144 and 145, as in customary practice.

In practicing my method with the apparatus constructed as described, the bars 63 are adjusted on the plate rocker frame according to the width of the plate to be etched. The plate clamp terminals are then suspended from the rods and the edges of the plate are engaged between the plates 70 and shanks 80 of the adjusting screws whereupon the adjusting screws are threaded downwardly within the body portions of the clamps to firmly anchor the plate therein.

The clamps will be located relatively to the length of the supporting rods so that they will engage adjacent the corners of the plate, as shown in Fig. 1, however if the plate is of large size, the terminal clamps may be connected with other portions of the plate to effect more uniform distribution of the current. The switch 105 is then closed to energize the motor 39 to oscillate the rocker arm 35 through the eccentric 43 and the pitman 45. The pin and slot engagement of the upper ends of the arms with the supporting frame of the agitator, effects reciprocation of the agitator within the tank, guided by the pairs of rollers 24 and 25. Movement of the agitator through the electrolyte solution will cause a plurality of jets of liquid to be surged upwardly through the jet openings 51 between the agitator blades against the bottom of the plate. Similar jets will also be caused to move against the surface of the cathode bars through the jet openings 52 at the lower edges of the blades. The brushes 54 will also be moved across the upper surfaces of the cathode bars to keep them clean of particles that are removed from the plate during the etching process.

Simultaneously with the oscillation of the agitator, the plate supporting frame is caused to rock oppositely to movement of the agitator. This rocking movement of the plate supporting frame is effected by the arm 94 which has the cam slot 95 engaging with the pin 96 on the side rail of the agitator frame. The arm 94 being adjusted at an angle relatively to the agitator frame, as shown in Fig. 5, effects rocking of the plate supporting frame in an anti-clockwise direction, Fig. 5, when the agitator frame is moved toward the left, and when the agitator frame is moved in the opposite direction the plate supporting frame is caused to tilt in a clockwise

direction, Fig. 5. The switch 104 is then closed to energize the generator motor to drive the generator, after which the switch 106 is closed to effect energization of the holding coil 123, which closes the circuit breaker 110, whereupon current from the generator flows from the plate through the electrolyte solution to the cathode bars, and back to the generator. The time switch will then be set so that the circuit to the holding coil will be broken after a definite time interval.

The value of the etching current is, of course, controlled by regulating the field rheostat so that the ammeter 107 and the volt meter 108 indicate that the desired current is flowing through the electrolyte solution.

While the machine is operating, the electrolyte, acting on exposed surfaces of the plate, decomposes such exposed surfaces, and as the agitator moves back and forth the electrolyte is washed against the plate with the jet action above referred to, thereby flushing the decomposed material from the exposed surfaces and removing such material from the etching area, so that constantly fresh electrolyte is applied to the plate without interference from the removed decomposed particles. Simultaneously with the jetting action of the electrolyte, the plate is tilted first in one direction and then in the other, so that the jets move in more direct contact with the plate than if the plate was held stationary and in a plane parallel with movement of the electrolyte. The material dissociated from the plate falls by gravity toward the bottom of the tank, but that which drops onto the cathodes is readily removed therefrom by means of the brushes.

When the time switch breaks the circuit to the holding coil 123, the switch arm 119 will be released to break the etching circuit, whereupon current is caused to flow through the alarm circuit to energize the buzzer, thereby advising the operator that the etching process has been completed.

If the operator responds immediately to the alarm, he will open the switch 105 to shut down the agitator motor, however if he does not respond immediately to the alarm, the coil 131, which had been in series with the holding coil 123, cools off to cause the thermostat to break the buzzer circuit.

The operator will then suspend the operation of the generator actuating motor and open the switch 106. The etched plate is then removed from its support on the rocker frame, completing the etching operation. It is thus obvious that the etching process is stopped exactly at the desired point and that there is no danger of over or under etching the plate.

I have found that by agitating the electrolyte as above described, a much more rapid and cleaner etching is effected than by movement of the plate alone, and that time, color, and other quality factors are enhanced by simultaneously jetting the solution and tilting the plate, since a more positive and direct application of the solution is provided.

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

1. The method of electrical etching including suspending a plate to be etched within a bath of etching solution, creating flushing currents of the solution in the direction of the plate alternately in opposite directions, and intermittently reversing inclination of the plate to successively

present the face of the plate to the alternating flushing currents.

2. The method of electrical etching including suspending a plate to be etched within a bath of etching solution, creating flushing currents of the solution in the direction of the plate alternately in opposite directions, and intermittently rocking the plate reversely to movement of the flushing currents to successively present the face of the plate to direct contact by the alternating flushing currents.

3. The method of electrical etching including oscillating a plate to successively position the plate in oppositely inclined planes in a bath of electrolyte, passing a current of electricity through the plate and electrolyte, and imparting a cyclic turbulence to the electrolyte against the plate in directions successively reverse to inclination of the plate for removing electrolyte that

has contacted the plate from the region of the plate.

4. The method of electrical etching including suspending a plate to be etched face down within a bath of etching solution, creating flushing currents of the solution beneath and in the direction of the plate alternately in reverse directions, and intermittently reversing inclination of the plate to present the face of the plate to the flushing currents.

5. The method of electrical etching including suspending a plate to be etched within a bath of etching solution, creating flushing currents of the solution in the direction of the plate alternately in reverse directions, and intermittently reversing inclination of the plate in timed relation to change in direction of the flushing currents.

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