

Aug. 18, 1942.

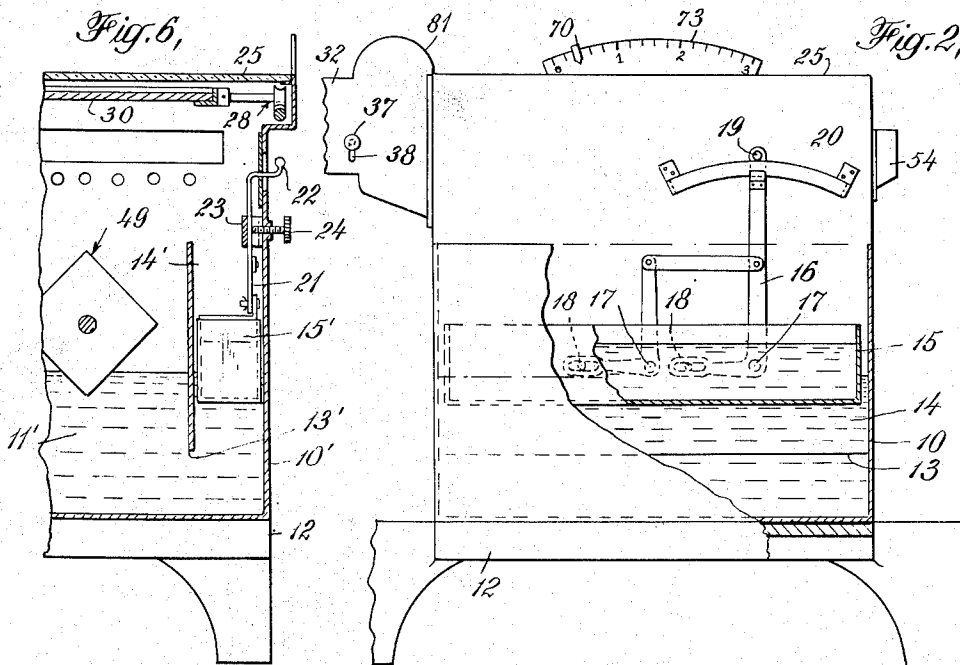
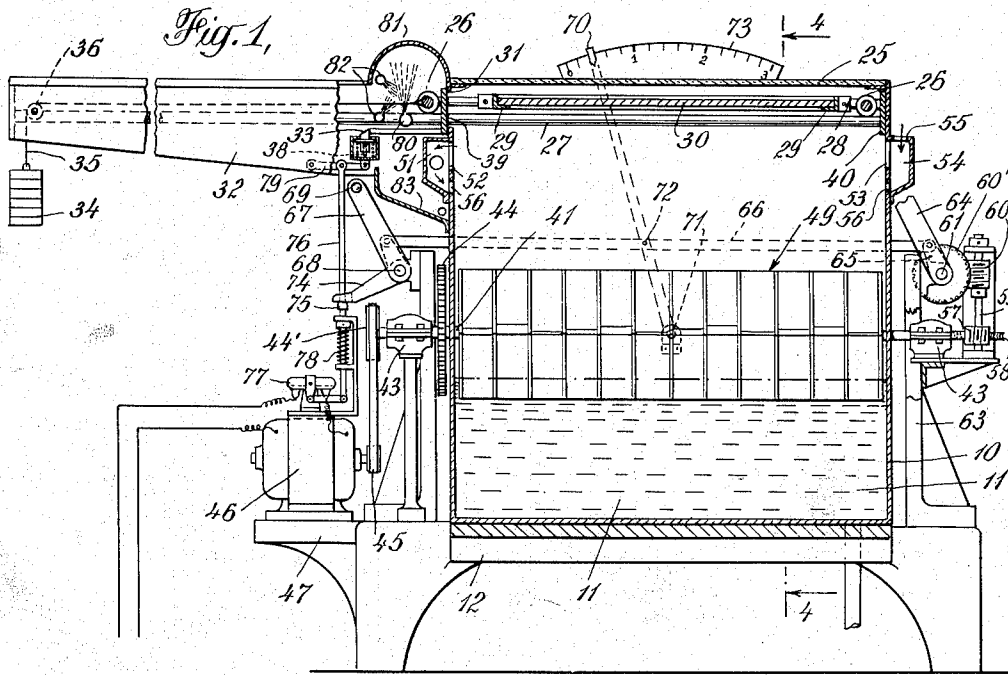
A. H. GAEBEL

2,293,201

ETCHING MACHINE

Filed Jan. 21, 1936

3 Sheets-Sheet 1



INVENTOR

Arthur H. Gaebel

BY

Robert Henry Campbell

ATTORNEY

Aug. 18, 1942.

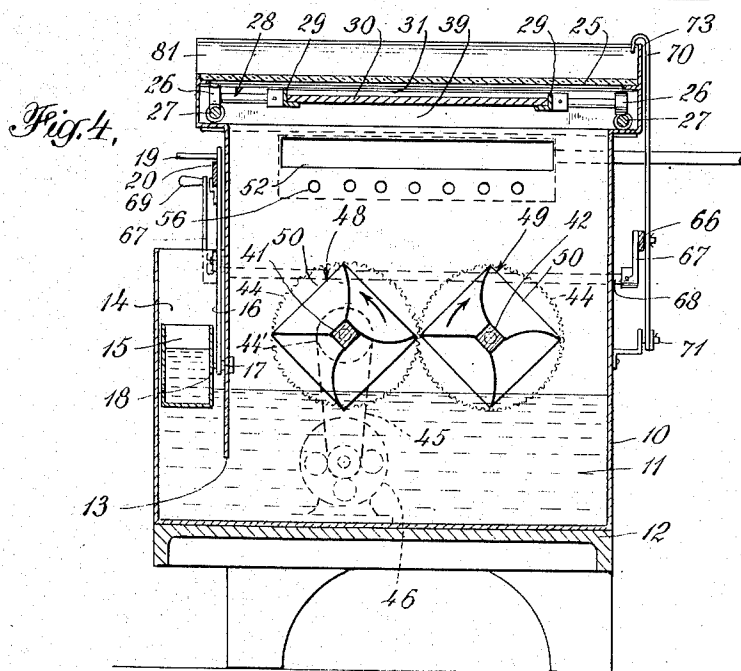
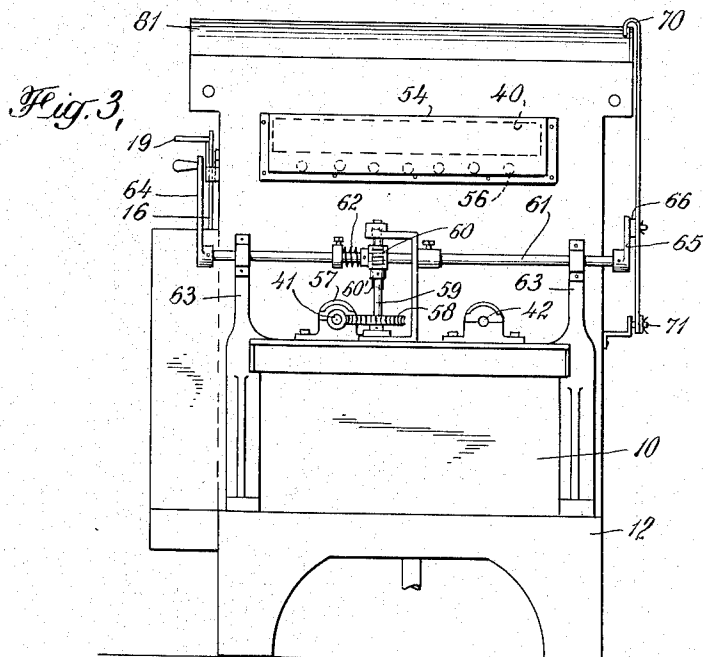
A. H. GAEBEL

2,293,201

ETCHING MACHINE

Filed Jan. 21, 1936

3 Sheets-Sheet 2



INVENTOR
Arthur H. Gaebel
BY
August, Henry & Campbell
ATTORNEYS

Aug. 18, 1942.

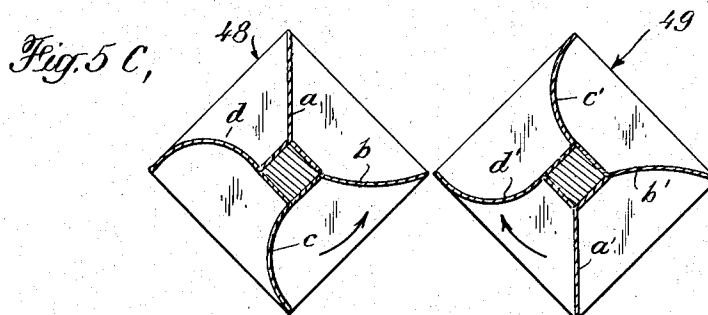
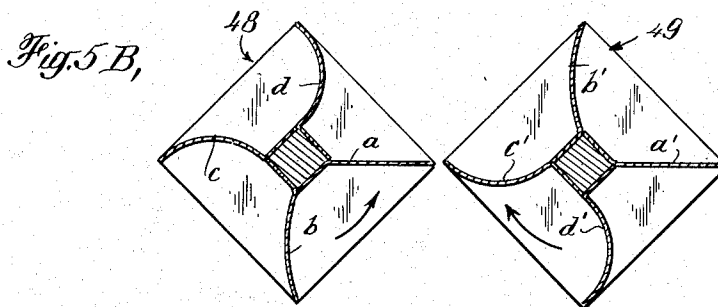
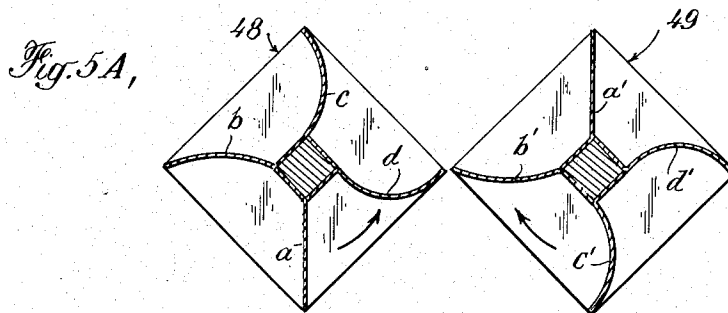
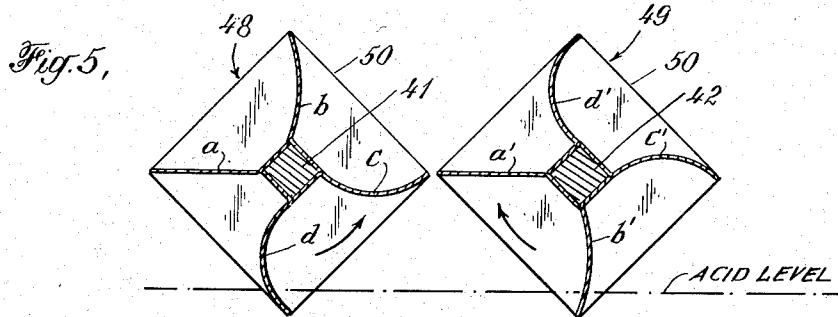
A. H. GAEBEL

2,293,201

ETCHING MACHINE

Filed Jan. 21, 1936

3 Sheets-Sheet 3



INVENTOR

Arthur H. Gaebel
BY
Moquet, Henry & Campbell
ATTORNEYS

UNITED STATES PATENT OFFICE

2,293,201

ETCHING MACHINE

Arthur H. Gaebel, Larchmont, N. Y.

Application January 21, 1936, Serial No. 60,046

11 Claims. (Cl. 41—9)

This invention relates to etching machines and has particular reference to a machine for spraying etching liquor upon a previously prepared plate to etch selected areas thereof for half-tone work or the like.

Etching machines in current use provide no means for adjusting the level of the liquor in the etching tank so that the spray of liquor projected upon the plate by paddle wheels, or the like, cannot be varied in volume and density without reducing or increasing the quantity of liquor in the machine. Various expedients have been provided in an effort to correct this condition, such as raising or lowering the paddle wheels, but this involves mechanical difficulties and increases the cost of the machine. Also, the etching machines in current use must be shut down when it is desired to examine the plate to determine the depth and quantity of the etching, thus increasing the total time necessary to complete the etching operation and requiring greater attention to the machine than is warranted. Moreover, no means is provided for limiting the period of operation of the machine to prevent over-etching.

In accordance with the present invention, an etching machine is provided in which the level of the etching liquor with the machine may be adjusted at will without changing the volume of liquor in the machine or adjusting the paddle wheels, in order to regulate the spray provided by the paddle wheels to suit requirements. Also, in accordance with the invention the spray-producing paddle wheels are constructed to provide a pulsating spray which engages every unit of area of the plate with the same force and density to insure uniform etching. Furthermore, in the machine of the present invention the etching plate may be withdrawn from and replaced in the spray without stopping the machine, and the duration of the operation of the machine may be predetermined by setting a time-controlled stopping mechanism which automatically shuts off the machine at the end of the predetermined etching period.

More particularly, the machine of the present invention, preferably of the upward spray type, comprises a tank for containing the etching liquor, having an auxiliary compartment communicating therewith and containing the liquid displacement device which may be raised and lowered at will in the liquor to lower or raise the level thereof with respect to the spray paddle wheels and thus regulate their spray. The top of the etching tank is closed, preferably by a

plate of glass through which the operation of the machine may be viewed, and the side wall of the tank immediately beneath the glass plate is provided with an opening through which is movable upon horizontal rails a carriage upon which the etching plate is mounted, so that the plate may be moved into and out of the upwardly directed etching spray for inspection, without stopping the machine for that purpose.

The spray-producing paddle wheels are mounted on parallel shafts rotating in opposite directions for directing the spray upwardly. Twelve paddle wheels are preferably provided on each shaft, each wheel comprising four radial paddles of different shapes, like paddles of adjacent wheels being spaced at an angle of 90° around the shaft so that the tips of the like paddles describe a spiral around the shaft. One blade of each paddle wheel is straight, the following blade is somewhat curved in the direction of rotation at its tip, the next following blade is curved to a greater degree in the same direction at its tip, and the fourth blade is curved to a still greater degree in the same direction at its tip. Like blades of adjacent shafts are displaced a half turn from each other, that is to say, the straight blade on one shaft is opposed by the medium curved blade on the opposite shaft, so that as the two shafts rotate in opposite directions the spray produced by one blade on one shaft is not interfered with by the opposite blade on the other shaft, which, because of its shape, retains the liquor which it has picked up for a longer period of time, whereby a uniform density, pulsating spray is obtained at all times, and without sustained cavitation.

Connected by means of a slip clutch to the driving mechanism for the paddle wheels is a pointer which may be adjusted with respect to a dial calibrated in seconds or minutes of operation of the machine. This pointer is connected to the driving mechanism by speed-reducing gearing so as to move slowly over the dial as the machine operates until it reaches the limit of its travel at which point it trips a switch, deenergizing the driving motor so that the rotation of the paddle wheels and consequently the spray ceases.

The mechanism which trips the switch also releases a latch normally holding the plate carriage in etching position, so that a weight automatically draws the carriage out of the etching tank. The latch may be released manually at any time for withdrawing the plate from the tank for inspection. As the plate moves out of

the tank it is flushed of adhering etching liquor by a jet of water and this water is blown from the plate by air jets following the water jets. Guards on the carriage normally close the opening in the tank through which the carriage passes and a stream of air moves transversely of the spray across the upper portion of the etching tank and across the etching surface of the plate, so as to supply necessary air for the etching operation and remove the spent etching liquor fumes from the tank.

It will be seen that with the etching machine of the present invention, plates may be etched uniformly and with a sharp degree of definition for the predetermined proper period of time without requiring constant attention and with the proper degree of spray to secure the best results, these advantages being afforded by the adjustability of the machine and the continuous operation thereof without shut-downs for inspection and the like.

For a more complete understanding of the invention, reference may be had to the accompanying drawings, in which:

Figure 1 is a front elevation of the new etching machine of this invention with the front wall removed to show the interior arrangement thereof;

Fig. 2 is a fragmentary elevation of the machine with a portion of the displacement device tank removed to illustrate its construction;

Fig. 3 is an end elevation of the machine;

Fig. 4 is a vertical section through the machine as seen along the line 4-4 of Fig. 1;

Fig. 5 is an enlarged view of the adjacent cooperating spray-producing wheels;

Figs. 5A, 5B and 5C illustrate successive angular positions of the cooperating spray-producing wheels; and

Fig. 6 is a fragmentary vertical section through a modified form of displacement device.

Referring to the drawings, numeral 10 designates a tank of metal or other material impervious to etching liquor 11, suitably supported on a base 12. Communicating with the lower portion of tank 10 through passage 13 is an auxiliary compartment 14 containing partially immersed in the liquor 11 therein a displacement body 15, which may conveniently comprise a rectangular sheet metal container approximating in plan the shape of compartment 14 and containing water or other weighting material.

A bell crank 16 is pivoted at 17 on the tank wall and is connected by a pin-and-slot combination 18 to the displacement body 15. The upper end of the bell crank 16 is provided with a handle 19 for moving it over a sector 20 secured to the tank 10 and having its center of curvature at pivot 17. Adjustment of the bell crank 16 to the right, as seen in Fig. 2, raises the displacement body 15 and consequently lowers the level of the liquor 11 in tank 10, while adjustment of the bell crank 16 in the other direction effects raising of the liquor level in tank 10.

In the modified form of this displacement body arrangement illustrated in Fig. 6, the auxiliary compartment 14' lies within the confines of tank 10', preferably at the rear thereof, and communicates with the body 11' of liquor therein through passage 13'. The displacement body 15' is raised and lowered by rod 21 having a handle 22 projecting through a vertical slot in the rear wall of the tank 10'. The rod 21 also slides through a sleeve 23 secured to the inner

surface of the tank 10' and having threaded therethrough a locking screw 24, whereby the displacement body 15' is locked in any adjusted position.

The upper end of the tank 10 is closed by a glass plate 25. Supported by wheels 26 on horizontal rails 27 extending across the tank 10 below glass plate 25 is a carriage 28 having adjustable frame members 29 for receiving variously sized plates 30 to be etched. The rails 27 project through an opening 31 in the side wall of the tank 10 and continue into a lateral cantilever extension 32 for the machine, so that the carriage may be moved into and out of the tank 10 from and to the extension 32 for the purpose of removing or replacing the plate 30 or for inspecting it during the etching operation.

A spring latch 33 normally holds the carriage 28 in the tank 10 against the pull of a weight 34 secured to the carriage 28 by means of cable 35 passing over pulley 36. The latch 33 is so shaped as to automatically lock the carriage in position in the tank when it is pushed therein, and may be disengaged by a button 37 connected thereto and extending through a vertical guide slot 38 in the side wall of extension 32, as shown in Fig. 2. The latch 33 is also arranged for automatic release at the end of the etching operation in a manner to be described.

A guard plate 39 carried by carriage 28 is shaped as illustrated in Fig. 1 to normally close opening 31 against escape of fumes and liquor spray during operation of the machine. A similar guard plate 40' on the other end of the carriage 28 closes opening 31 when the carriage is fully withdrawn from the tank 10.

Extending in parallel relation within the tank 10 are a pair of horizontal, square-section shafts 41 and 42 journaled in exterior bearings 43 and geared together by gears 44 to rotate in opposite directions. Shaft 41 is equipped with a pulley 44' connected by belt 45 to an electric motor 46 suitably supported on a bracket 47 secured to base 12. Each shaft 41 and 42 carries a plurality of paddle wheels 48 and 49, respectively, preferably twelve wheels per shaft, each wheel being separated from the next adjacent wheel by a plane disc 50, which is preferably square, as illustrated in Figs. 4 and 5.

Each paddle wheel 48 or 49 comprises four substantially radial blades suitably secured to the corresponding flat surface of the square shaft 48 or 49. One blade, designated *a* on shaft 41, is straight and extends radially. The blade *b*, following *a* in the direction of rotation designated by the arrow in Fig. 5, is curved so as to retain the liquor for a longer period than the straight blade *a*. Similarly, the next or third blade *c* is curved still more, while the fourth blade *d* has the greatest curvature. Inasmuch as shaft 42 rotates in the opposite direction, the blade *a'*, *b'*, *c'* and *d'* corresponding to those on shaft 41, increase in curvature in the opposite direction. Also, the successive paddle wheels 48 and 49 on each respective shaft 41 and 42 are displaced 90° so that the tips of like paddles, such as straight paddles *a* or *a'*, describe a spiral around the shaft.

Also, the like blades of the two shafts 41 and 42 are displaced a half turn from each other, so that the straight blade *a* is opposed to the medium curved blade *c'* (Fig. 5B). With this arrangement one blade retains its liquor longer than the opposing blade, so that their sprays do

not interfere with each other, as is evident upon examination of Figs. 5 to 5C inclusive. Thus, a positive, uniform, pulsating spray is directed upwardly upon the under surface of plate 30, which has been previously prepared. Inasmuch as the blades have different liquor-retaining properties, they release the liquor at different times so that different areas of the plate are treated successively, thus allowing time for the etching action to take place before the same blade again directs spray on the same area. The staggering of the adjacent paddle wheels 48 and 49 on each shaft secures a staggering spray. The density of the spray is varied by adjusting the level of the liquor with respect to the paddle wheels by means of displacement device 15 or 15'.

In order that ample air is furnished for securing rapid etching action of the liquor, a suction duct 51 opening into the upper portion of tank 10 through a narrow horizontal slot 52 draws air across the tank and over the underside of plate 30 through a similar high, horizontal slot 53 of duct 54 in the opposite wall, which is supplied by air openings 55. This air travel is ample to furnish the necessary oxygen and to remove fumes, but it is not sufficiently rapid to impair the spray through which it moves. Thus the air is supplied where it is required. Drain openings 56 are provided in the bottoms of ducts 51 and 54 so that any liquor splashed therein will drain back into the tank 10.

As shown in Figs. 1 and 3, the shaft 41 carries a worm 57 driving worm wheel 58 on short vertical shaft 59 having the worm 60 meshing with a worm wheel 60' journaled on horizontal shaft 61, but having a non-rigid driving connection therewith by means of spring friction clutch 62. Shaft 61 is journaled in brackets 63, is provided at its front end with a handle 64 and at its rear end with a crank 65, which is connected by link 66 to a crank 67 on a transverse shaft 68 having a handle 69. A pointer 70, pivoted at its lower end 71 to the rear wall of the tank 10 and connected at 72 to link 66, moves over a scale 73 at the rear of the machine. Scale 73 is calibrated in units of etching time, such as up to three minutes.

Shaft 68, on handle 69, is provided with a lever 74 adapted to engage an abutment 75 on a slidable vertical rod 76 connected to a normally-closed mercury tube tilt switch 77 in the circuit of motor 46 and held normally closed by spring 78.

When handle 64 or 69 is moved to the right to position pointer 72 opposite the desired etching time on scale 73, clutch 62 slips, permitting shaft 61 to be positioned relatively to its drive gear 60'. The motor 46 accordingly rotates shaft 61, pointer 71, shaft 68, and lever 74 until the latter engages abutment 75 on rod 74 and trips mercury switch 77 to stop the etching operation after the desired interval. Movement of handle 64 or 69 to the right releases the switch 77 to closed position for starting the motor 46.

Rod 76 is also connected to lever 79 pivoted on the side wall of extension 32 and carrying at its free end the latch 33. Thus, as the rod 76 is tripped to stop the etching operation, latch 33 is also released to allow the weight 34 to withdraw the carriage 28 from the tank 10. The spring 78, being considerably stronger than the spring of latch 33, prevents incidental operation of switch 77 by manual operation of latch 33 by handle 37 in the manner described.

As the carriage 28 is withdrawn, a strong spray

of water issues upwardly from pipe 80 extending transversely under hood 81, so as to flush the liquor from the carriage and plate 30 as it is drawn through opening 31. Opposite strong air jets issuing from pipes 82 blow the surplus flushing water from the carriage and plate 30. The water from pipe 80 does not drain into the tank 10, but is collected in a gutter 83.

Operation of the etching machine of this invention will be readily understood from the foregoing description. It is evident that an extremely complete machine is provided for securing rapid, accurate and uniform etching of plates for half-tone or other work, without requiring the constant attention of a skilled etcher.

While a preferred embodiment of the invention is illustrated and described herein, it is to be understood that the invention is not limited thereby, but is susceptible of changes in form and detail within its scope. For example, although a pair of oppositely rotating sets of etching wheels are illustrated, only one spray wheel set of the novel construction shown may be employed with equal facility. Although the shape of the blades, which causes them to continuously scoop up varying quantities of liquor, prevents sustained cavitation and consequent interruption of the spray even with the use of but one spray wheel shaft, a still more uniform spray may be obtained by making the shallower blades larger so as to pick up more liquor, i. e., make the straight blade *a* slightly larger than *b*, *b* slightly larger than *c*, and *c* slightly larger than *d*.

Also, the machine may be made double simply by mounting another extension like 32 on the opposite side of the machine for carrying a second carriage for a second plate to be etched and which can be run into the etching tank and latched in place in the manner described, after the first carriage has been withdrawn. Thus, the output of the machine may be substantially doubled, handles 67, 69 being reset each time a new plate is placed in the tank.

I claim:

1. In an etching machine, the combination of a receptacle for etching liquor, a rotary paddle wheel partially immersed in the liquor for producing a spray thereof, and means for supporting the work to be etched in the spray, said paddle wheel comprising a plurality of paddles each having spray-producing surfaces of different shape for directing the spray in different directions.

2. In an etching machine, the combination of a receptacle for etching liquor, a rotary paddle wheel partially immersed in the liquor for producing a spray thereof, said paddle wheel comprising a plurality of paddles, successive paddles in the direction of rotation having decreasingly curved spray-producing surfaces for directing the spray in different directions.

3. In an etching machine, the combination of a receptacle for etching liquor, a rotary paddle wheel partially immersed in the liquor for producing a spray thereof, said paddle wheel comprising a shaft and a plurality of sets of paddles mounted in radially-staggered relation along said shaft, successive paddles of each set in the direction of rotation having decreased liquor-raising capacities for directing the spray in different directions.

4. In an etching machine, the combination of a receptacle for etching liquor, a rotary paddle wheel partially immersed in the liquor for pro-

ducing a spray thereof, said paddle wheel comprising radially-staggered sets of paddles, the paddles of each set being decreasingly curved in the direction of rotation for directing the spray in different directions.

5. In an etching machine, the combination of a receptacle for etching liquor and a pair of cooperating paddle wheels partially immersed in the liquor and rotating in opposite directions, each paddle wheel comprising paddles of various shapes for directing the spray in different directions.

6. In an etching machine, the combination of a receptacle for etching liquor and a pair of cooperating paddle wheels partially immersed in the liquor and rotating in opposite directions, each paddle wheel comprising paddles of decreasing curvature in the direction of rotation, and said paddle wheels being displaced radially with respect to each other, whereby a paddle of greater curvature on one wheel opposes a paddle of less curvature on the other wheel.

7. In an etching machine, the combination of a receptacle for etching liquor, a rotary paddle wheel therein for spraying the liquor on the work to be etched, said paddle wheel having successive blades of different curvature, and means for changing the level of the liquor with respect to the paddle wheel to vary the spray thereof.

8. In an etching machine, the combination of a receptacle for etching liquor, a rotary paddle wheel therein for spraying the liquor on the work to be etched, said paddle wheel having successive blades of different curvature, a carriage for holding the work to be etched, and guides ex-

tending out of the receptacle at substantially right angles to the direction of the spray along which the work may be moved at will into and out of the spray without stopping the spray.

9. In an etching machine, the combination of an etching chamber, means for supporting a plate to be etched in said chamber, air inlet means in said chamber adjacent one end of said supporting means, and means adjacent an opposite end of said supporting means for withdrawing air from said chamber, said air inlet means and said means for withdrawing air being disposed to direct a current of air across and parallel to the surface of the plate being etched.

10. In an etching machine, the combination of an etching chamber, a frame for holding the plate to be etched, guides supporting said frame for movement into and out of said chamber, means adjacent to said guides for spraying water onto said plate to flush adhering liquor from said plate, and means adjacent to said spraying means for directing a gas under pressure against the plate to substantially remove the water from said plate.

11. In an etching machine, the combination of a receptacle for etching liquor, rotary spray-producing means in said receptacle, a motor for rotating said spray producing means, a switch for starting and stopping said motor, and a timing mechanism actuated by said motor for actuating said switch to stop said motor after a predetermined number of revolutions of said spray-producing means.

ARTHUR H. GAEBEL.