May 9, 1933. F. T. POWERS 1,908,487

CONTINUOUS ETCHING MACHINE

Filed Jan. 11, 1928

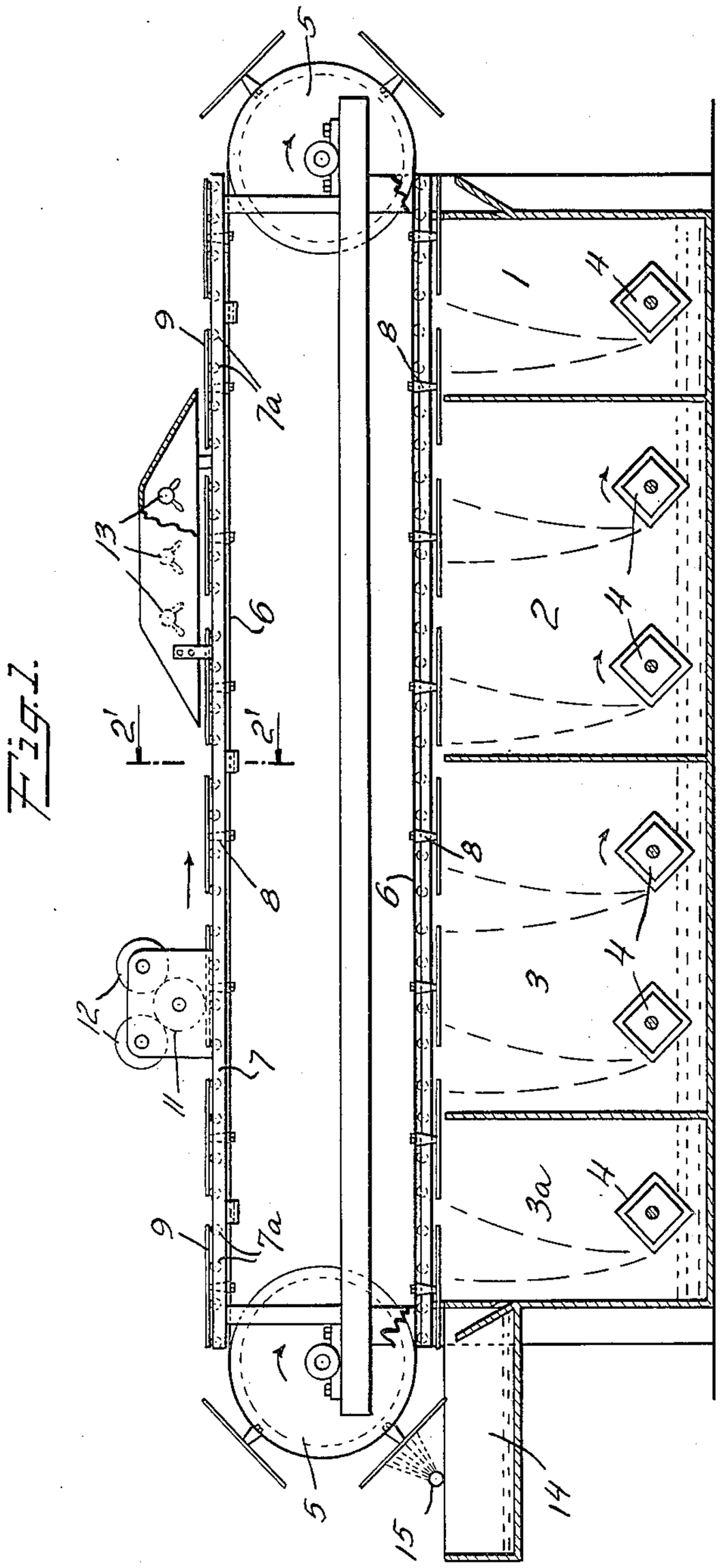

FIG. 1.

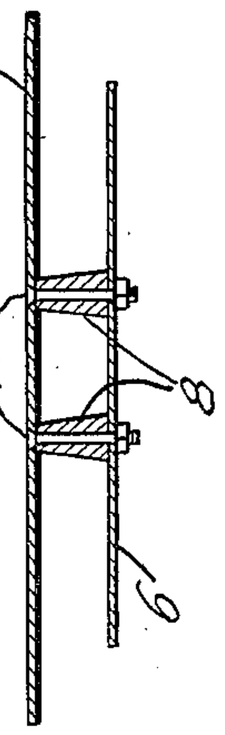

FIG. 3.

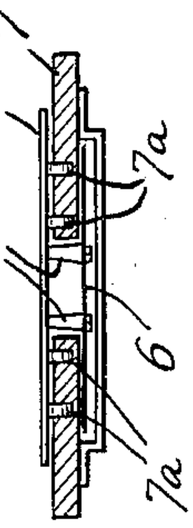

FIG. 2.

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UNITED STATES PATENT OFFICE

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CONTINUOUS ETCHING MACHINE

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My invention relates to a process and apparatus for the continuous etching of plates for use in printing and for etching other articles for various purposes such as the etching of decorative designs on the surface of objects or etching name plates or metal markers for various uses.

The object of my invention is to increase the speed with which such etching may be accomplished and to reduce the amount of skilled labor and attention required to etch objects of the character described, thereby reducing the cost of etching.

Heretofore it has been necessary, in the production of etched objects, and particularly etched plates for use in printing and the like, to accomplish the etching in a number of stages or "bites," each of which required that the plate be removed from the etching machine and prepared by the application to its surface of a "resist," such for example as "dragon's blood" or an acid-resisting ink. By the use of my invention the processes necessary to the completion of the etching are performed without the necessity of removing the object from the machine and once the prepared plate or other object is placed in the machine and the machine put into operation, all of the steps necessary to the completion of the etching process may be performed within the machine and a completely etched plate turned out at the conclusion of its operation.

Moreover a large number of plates or other objects may be etched simultaneously, so that the output of the machine is many times the output which is possible with an equal number of skilled etchers using etching machines and processes heretofore in common use.

Heretofore the process of etching objects of the character described, as, for example, a "line etching" or "half tone plate" for printing, has been about as follows. An image, reversed, of the design to be etched is produced by photographic means on the surface of the plate to be etched. To this image is applied, by means of a roller, an acid-resisting coating and the plate is exposed for a short interval of time to the action of an etching fluid in an etching machine. This comprises the first "bite." The plate is then removed from the etching machine, washed, dried, powdered "four ways" with "dragon's blood," which necessitates four applications of powdered "dragon's blood" by means of a brush and the heating and cooling of the plate after each of the four applications. The plate is then again placed in the etching machine and subjected for a longer period to the action of the etching fluid. This comprises the second "bite."

Again the plate is removed from the etching machine, washed, dried, powdered "four ways" with "dragon's blood" and heated and cooled and again returned to the etching machine for the third "bite." In all, four "bites" are usually given the plate. The etching time of each succeeding "bite" is roughly twice as long as that of the preceding "bite." Thus, if the first "bite" is ten seconds, the second "bite" will be about twenty seconds and the third "bite" about forty seconds and the fourth "bite" about one minute and twenty seconds, making a total etching time of about two and a half minutes. In the etching machines most commonly used the plate remains in a stationary position while each bite is etched. The commonly used paddle wheel type of spraying device does not throw a uniform spray over the entire area of the plate. It follows, therefore, that a plate remaining stationary in such a spray will be subjected to unequal etching in different portions of its surface. With my new apparatus and process, the plate may be passed through all portions of the spray and while so passing all portions of the plate pass through all portions of the spray, with the result that the plate is evenly etched over its entire area.

It is not alone the actual etching time which slows up the process but the numerous washings, dryings, brushings with powder, heating and cooling, necessary to complete the process. It requires rapid work on the part of an expert etcher to complete the etching of one plate in forty minutes.

By the use of my process and apparatus, one such expert etcher can place fifteen to twenty or even more such plates in my ma-

chine and in twenty minutes or less the entire batch of plates will be completely etched. Another benefit resulting from the use of my invention is the more even and uniform etching of large plates throughout their entire area, by reason of the fact that the plates travel through the spray of etching fluid thrown against them, while in the etching tank, instead of remaining stationary and being subjected to a more violent spraying action in some portions of their area than they are in other portions.

Having described the main objects of my invention and the deficiencies of the present methods of etching which are overcome by its use, I will describe the machine and its operation, and show in what manner my process differs from the above described process now in common use.

In the accompanying drawing like characters denote same or similar parts, and arrows indicate direction of motion, rotation, or view.

Fig. 1 is a side elevation with one side of the lower portion removed to afford a view of interior mechanism.

Fig. 2 is a section through that portion of the machine indicated by the figures 2′, 2′, looking in the direction indicated by the adjacent arrows.

Fig. 3 is an enlarged section of a portion of Fig. 2 and shows the manner of attaching the plate or other object to be etched to the conveying member.

In Fig. 1, three tanks constructed of material resistant to the action of the etching fluid are represented by 1, 2 and 3. In each of these tanks are one or more rotatable spray-producing elements, 4, 4. In tank 1 there is one such element 4 shown, while in each of tanks 2 and 3, two such elements are shown. The number of tanks and the number of spray-producing elements may be varied as desired. Each of the spray-producing elements 4 is provided with means, not shown in the drawing, for rotating it at suitable speed in the direction indicated by the arrows. Above and on either end of the row of tanks are two rotatable drums 5, 5, or equivalent, over which extends a belt 6. The drums 5 are so positioned with respect to the tanks 1, 2 and 3 that the lower strand of the belt 6 passes through the upper portion of said tanks, while the upper strand of the belt 6 passes under a table 7. The drums 5 are rotated at suitable speed by means not shown in the drawing but which may be any suitable source of power which will rotate the drums in the direction shown by the arrows. The belt 6 is provided with pairs of hollow studs 8, 8 spaced apart at intervals and adapted to receive the plates, 9, 9 to be etched. These studs 8 may or may not be permanently or even rigidly attached to the belt 6. In the drawing this belt is represented as being thin and sufficiently flexible to pass around the drums, but, if desired, this belt may be of the chain or link-belt type with attachments on certain of the links for the reception of the object to be etched. When a belt of the chain type is used the drums 5 are replaced by sprocket wheels. The plates 9, 9 to be etched are attached to the studs by any convenient means such as bolts 10, 10 passing through the plates and the studs, whereby the plates are held firmly to the belt without interfering with the bending of the belt as it passes over the drums 5, 5. This detail of the manner of attaching the plates to the belt is more clearly shown in Fig. 3. Over the table 7, at a height which permits the plates 9, 9 to pass beneath but in contact with it, is a roller 11, by means of which a "resist" such, for example, as acid resisting ink, is applied to the surface of each plate as it passes under the roller. Operating in conjunction with the roller 11 there may be distributing rollers, 12, 12, which serve to keep the "resist" more evenly distributed on the surface of the roller 11. Various devices are in common use on printing machinery for maintaining an even distribution of ink on an inking roller which will suitably serve this purpose in my machine. In the top of the table 7 I have shown a plurality of small wheels or rollers, 7*a*, whose upper portions project slightly above the level of the top of the table 7 and upon which the plates 9 may ride as they pass under the roller 11. Also above the table 7, and at a suitable height which will permit the plates 9, 9 to pass beneath, are a plurality of heating elements 13, 13, which in the drawing are shown as gas pipes with flame jets on their lower portion, but which may be of the electric resistance type or other form of heating element.

For some classes of work it is desirable to wet the surface of the plate with certain solutions before applying the "resist" to the surface. For applying these solutions I have provided a spraying element 15 and below it a tray 14 to catch the surplus solution.

Reduced to its simplest form, the process of etching designs on the surface of objects consists in applying a "resist" to that portion of the surface which is not to be acted upon by the etching medium and then applying an etching medium to act upon that portion of the surface of the object which is not to be covered by the "resist." Under some less exacting conditions, particularly when it is not desired to etch the surface deeply, this simple process may be followed and my process and apparatus is admirably adapted to carry out this simplest form of etching. In such a case the pattern to be etched may be formed on the "resist" roller 11 so that the pattern is imprinted upon the surface of the object 9 to be etched by the passage

of the roller over the surface. In such simple processes of etching the heating means, 13, may be eliminated and for some classes of work only one tank for the etching medium is required. Such a single tank machine might have one or several of the spraying elements, 4, within it. For such simple classes of etching any machine would consist essentially of (*a*) etching tank 1 with one or more spray-producing elements therein 4, with means for rotating them, (*b*) inking roller, 11, with means for inking it, (*c*) supporting and conveying means 6 for the objects to be etched, with means for mechanically operating the movable parts of the mechanism.

In other classes of work it is desirable to heat the resist after it has been applied to the object and for this class of work the heating elements, 13, are incorporated in the machine. In still other classes of work it is desirable to apply to the surface of the object a coating to prevent the resist from adhering to portions of the surface of the object which it is desired to etch and at the same time insure its adhering to those portions of the surface which it is desired to protect from the action of the etching medium. For this class of work the element designated as a spraying element 15 is incorporated in the machine. Thus it is apparent that my machine may vary considerably from a comparatively simple combination of parts capable of performing few operations to a more complicated combination of parts capable of performing a variety of operations or steps in the process of etching but the underlying principle in each form which the machine may take is that of continuously or intermittently passing the object to be etched while attached to a conveying or transporting element through a series of operations any desired number of times or repetitions.

My new process and my new apparatus enables plates to be etched by using a large number of small bites economically and expeditiously whereas it would be extremely slow and very expensive to etch a plate in, say, ten bites by present methods, using apparatus now available. It also results in a more uniform etching of the entire area of large plates by reason of the movement of the plates through the spray of etching fluid, whereby all parts of the plate pass through the strongest as well as the weakest portions of the spray. This permits of a deep etch and practically eliminates the necessity for routing the plates after etching. The advantages of more perfect etching, smoother shoulders on the sides of the raised portions of the etched figures, less undercutting and better printing qualities are attained by the use of my process and apparatus without any increase of cost or in time required in completing the etched object. In fact, both the cost and the time are greatly decreased and in the making of etched printing plates for newspaper use the time element is extremely important.

Having described the construction of a machine embodying my invention, I will now describe my new process of etching objects and the operation of the machine.

Before starting the process of etching the tanks 1, 2, 3 are filled to the proper depth with suitable etching fluid. The depth of the etching fluid in the tanks is such that the spray elements 4, 4 will, as they revolve, dip into the etching fluid, pick it up and project it upward. Water is placed in the tank 3*a* to such a depth that the spray element 4, in tank 3*a*, will pick up the water and project it upward.

The objects to be etched, suitably prepared, which in this description are assumed to be flat metal plates, are attached to the belt 6, by means of pairs of hollow studs 8, 8 using countersunk head bolts. Plates are attached to the belt with successive pairs of studs until all or a portion of the carrier belt 6 is occupied.

During the operation of loading the belt with plates, the belt is moved along its line of travel to bring successive pairs of the studs 8 into a convenient position for attaching plates. Such convenient positions are at the ends of the table 7, or near the middle of table 7 between the inking device and the heater. Power is applied to the drums 5, 5 to rotate them in the direction indicated by the arrows thereon and at the same time power is applied to one or more of the spray elements 4, 4. As the drums 5, 5 rotate, the carrier belt with its attached plates moves in the direction indicated by the arrows, to bring each plate successively into and through the upper portion of the series of tanks 1, 2, 3, etc., wherein the spray-producing elements project a spray of etching fluid against the surface of the objects being etched and so effect an etching away of those portions of the surface of the article as are not protected by the "resist." Having passed over the etching tanks the plates are then carried through the wash tank 3*a*, wherein a spray of water produced by the rotation of the spray-producing element 4 washes off the remnant of etching fluid remaining on the plates. The plate next passes through the spray 15 and is coated with a solution of a chemical which has the effect of causing ink to adhere to the figure portion of the plate while it prevents the ink from adhering to the remaining portions of the surface of the plate. The chemical used varies with different metals, for example, a solution of oxalic acid may be used when zinc plates are being etched and a solution of common salt, sodium chloride, may be used when copper

plates are being etched. Continuing in the path of the belt the plate or other object is carried over the drum and over to the table 7, above which is located the resist roller 11. As each plate or other object passes under the roller a fresh application of "resist" is made to its surface. The "resist" is next heated to render it fluid in order that it will flow down the sides of the figure produced on the surface of the object by the action of the etching fluid. This heating and melting of the "resist" is accomplished as the object passes slowly under the heating elements 13 as the belt carrier advances in the direction indicated by the arrow. The object has at this stage of the process had one "bite," of the etching fluid, been washed, coated with "resist," and the resist melted, and it is in readiness to continue the etching process as the belt carrier moves over the drums and brings the object again into the etching tanks. This second bite may be longer and more severe than the first bite and therefore more of the spray-producing elements 4 may be put in motion by the operator. Each additional spray-producing element which is put in motion increases the action of the etching fluid and in this way the depth of each successive bite is regulated. As each complete circuit of the carrier belt is completed the object is successively etched, washed, chemically treated, coated with resist, and heated, and this process may be repeated and continued until any desired depth of etching has been attained. At the conclusion of the operation all of the objects have been completely etched and are removed from the carrier belt.

I am aware that processes for etching plates are in use which involve the individual, successive steps described in the early part of this description but they involve the making of a few bites, usually three or four, each of which bites are approximately twice the duration of exposure to the etching medium as the last previous bite. The methods ordinarily used produce shoulders on the sides of the etched figure and what is known as "undercutting" is common. The three or four bites given to the plate in the present well-known processes are each successively more severe than the previous bite and figures having ragged sides and outlines result. With my new process, used in conjunction with my new etching machine, many more small bites are taken instead of one small bite, one medium small bite, one medium large bite and one very large bite, as is practiced at the present time. As many as eight or ten or even more bites are taken by my process, each of which is a relatively small bite. The result is a plate having superior printing qualities, gradual gradation from high lights to half tones and from half tones to shadows. This desirable result is brought about by the multiplicity of small bites and the numerous applications of the resist.

Having described my new process for etching and the construction of a preferred form of my machine, and having described its method of operation so that one skilled in the art may make and use the same, I will now state what I claim as novel and for which I pray for letters patent.

I claim:

1. The process for etching photo-mechanical printing plates, which consists in simultaneously subjecting a plurality of the plates being etched successively and repeatedly to the operations of applying a resist to portions of the surface of the plates, heating the surface of the plates to which the resist has been applied, spraying the surface of the plates with an etching fluid, removing the residual etching fluid from the surface of the plates.

2. The process for etching photo-mechanical printing plates, which consists in simultaneously subjecting a plurality of the plates being etched successively and repeatedly to the operations of applying a resist to portions of the surface of the plates, heating the surface of the plates to which the resist has been applied, spraying the surface of the plates with an etching fluid, removing the residual etching fluid from the surface of the plates, while said plates are simultaneously carried consecutively and successively through said operations.

3. An apparatus for etching photo-mechanical printing plates, comprising an etching chamber, means for conveying plates successively and repeatedly through said etching chamber, means for projecting an etching fluid against the surface of said plates, means for washing the etching fluid from the said plates, means for applying a resist to the surface of the plates, and means for heating said resist on the surface of said plates.

4. An apparatus for etching photo-mechanical printing plates, comprising in combination, an etching chamber, means within said chamber for spraying an etching fluid against a plate, means for washing the etching fluid from a plate, means for applying a resist to the surface of a plate, means for heating said resist on the surface of said plate, and means for conveying plates successively and repeatedly through said etching chamber, and bringing said plates into operative relation with each of said means.

5. An apparatus for etching photo-mechanical printing plates, comprising an endless carrier for supporting the plates to be etched, receptacle for an etching fluid, means for bringing the etching fluid into contact with the surface of the plates to be etched, means for removing the residual etching fluid from the surface of said plates, means for

applying a resist to the surface of said plates, and means for heating the surface of said plates to melt the resist thereon, the said endless carrier operating to convey the said plates successively and repeatedly into operative relationship with each of said means.

6. An apparatus for etching photo-mechanical printing plates, comprising an endless carrier for supporting the plates to be etched, an etching chamber, means for projecting an etching fluid against the surface of a plate, means for removing the residual etching fluid from the surface of a plate, means for applying a coating to prevent the adhesion of a resist to the etched portions of a plate, means for applying a resist to the surface of a plate, and means for heating the surface of a plate to melt the resist thereon, the said endless carrier operating to convey plates successively and repeatedly through said etching chamber and into operative relationship with each of said means.

7. An apparatus for etching photo-mechanical printing plates, comprising an etching chamber, an etching-fluid-spraying means within said chamber, means for washing etching fluid from a plate and means for conveying plates successively and repeatedly through said etching chamber and into operative relationship with said washing means.

8. An apparatus for etching photo-mechanical printing plates, comprising an etching chamber, means within said chamber for projecting an etching fluid against a plate, means for washing an etching fluid from a plate, means for applying a resist to a plate, and means for supporting and conveying plates successively and repeatedly through said etching chamber and consecutively into operative relationship with each of said means.

9. An etching machine for photo-mechanical printing plates comprising in combination a receptacle for the etching fluid, means for projecting the etching fluid against the surface of the said plates, means for removing the residual etching fluid from the surface of the plates, means for drying the surface of the plates, and means for conveying a plurality of plates consecutively into operative relation with each of said means.

10. An etching machine for photo-mechanical printing plates, comprising in combination a receptacle for etching fluid, means for bringing the etching fluid into contact with the surface of the plates, means for removing the residual etching fluid from the surface of the plates, and means for conveying a plurality of plates consecutively into operative relation with each of said means.

11. An etching machine for photo-mechanical printing plates, comprising in combination a receptacle for etching fluid, means for applying the etching fluid to the surface of the plates, and conveying means whereby a plurality of plates are consecutively brought into operative relation with said means and into position for inspection, in similar recurring cycles.

12. The process for etching photo-mechanical printing plates, which consists in simultaneously subjecting a plurality of the plates successively and repeatedly to the operations of applying an etching fluid to the surface of the plates, removing the residual etching fluid from the surface of the plates and drying the plates while said plates are simultaneously carried consecutively and successively through said operations.

13. The process for etching photo-mechanical printing plates, which consists in subjecting a plurality of the plates successively and repeatedly to the operations of applying an etching fluid to the surface of the plates, removing the residual etching fluid from the surface of the plates, and heating the plates while said plates are carried consecutively and successively through said operations.

14. An apparatus for etching photo-mechanical printing plates, which is characterized by means for applying an etching fluid to the surface of said plates, and conveying means, whereby a plurality of plates is carried consecutively into and out of operative relationship with said means for applying an etching fluid to the surface of the plates.

15. An apparatus for etching photo-mechanical printing plates, which is characterized by conveying means whereby a plurality of plates is individually carried consecutively into and out of operative relationship with means for performing operations on the said plates, means for applying an etching fluid to the surface of the plates.

16. A machine for etching photo-mechanical printing plates, which is characterized by means for conveying at a uniform speed a plurality of plates consecutively and repeatedly through the position for etching and position for examining alternately, and means for controlling the rate of travel of said plates at said uniform speed through said positions.

Signed at Douglaston in the county of Queens, and State of New York this 8th day of January, A. D. 1927.

FRANK T. POWERS.