

June 27, 1967

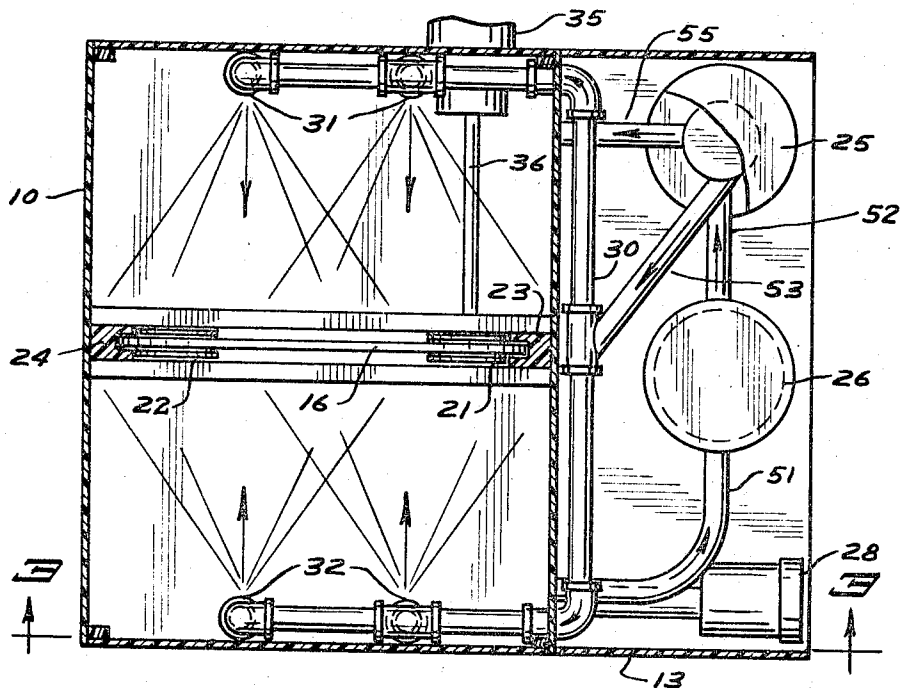
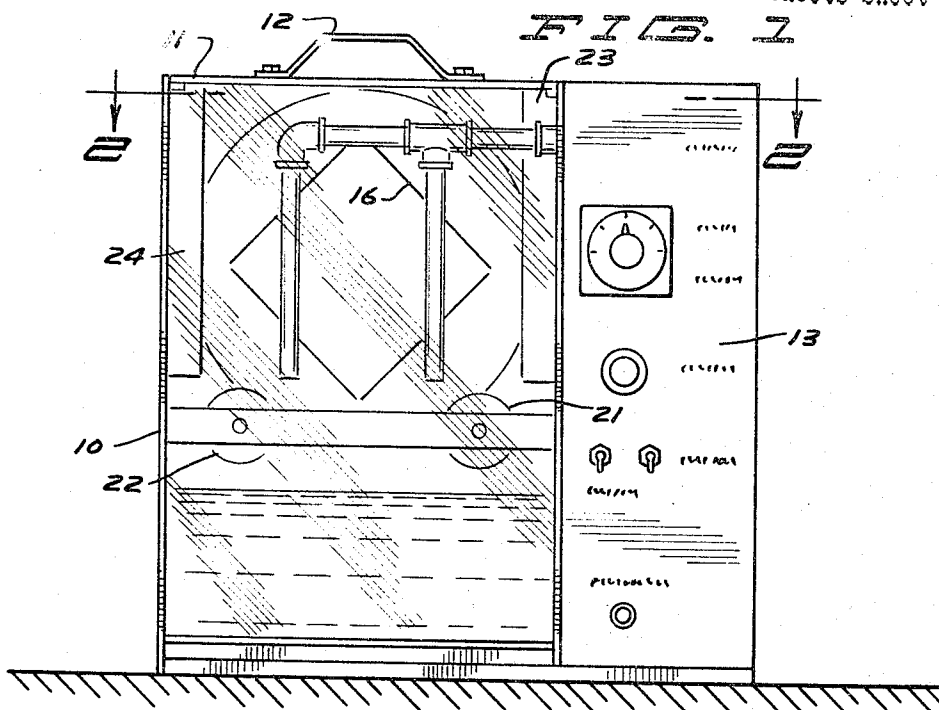
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3,327,721

ETCHING APPARATUS

Filed May 28, 1965

3 Sheets-Sheet 1



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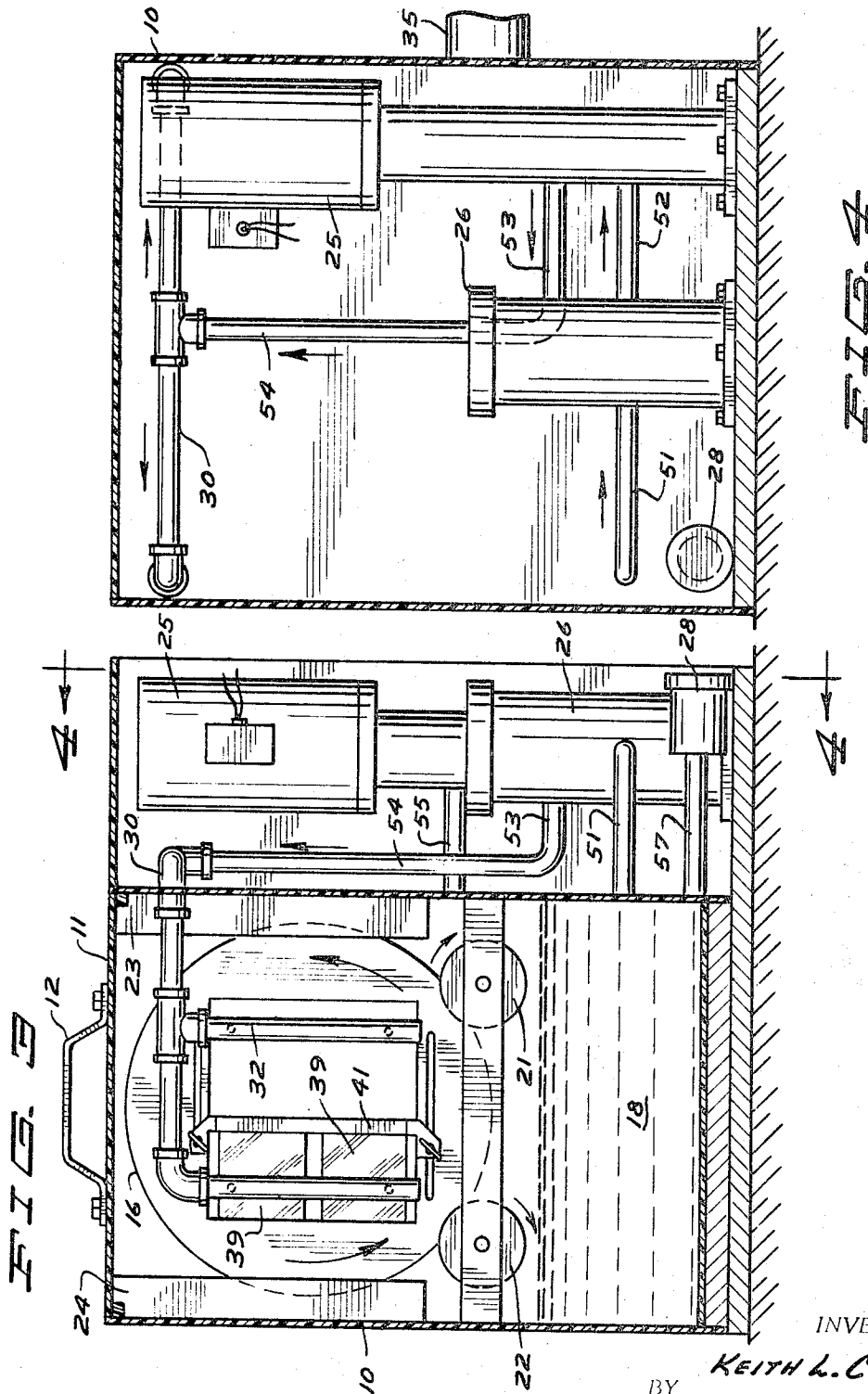
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3 Sheets-Sheet 3

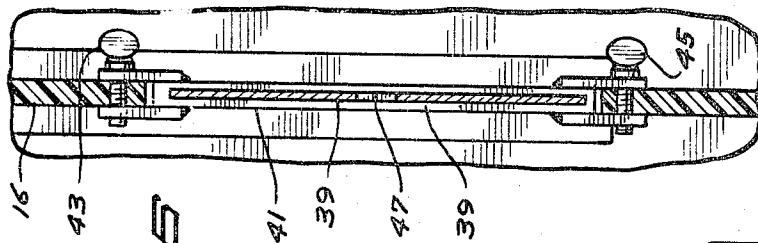


FIG. 6

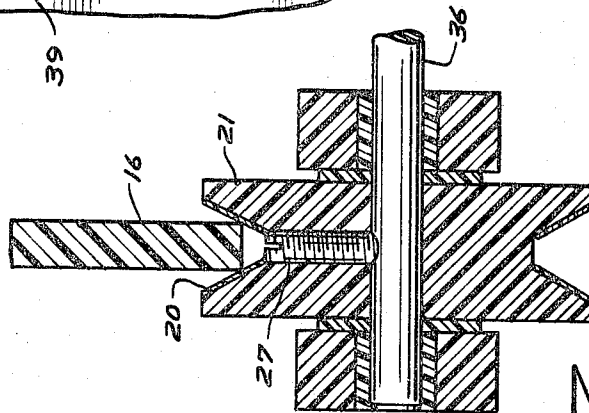


FIG. 7

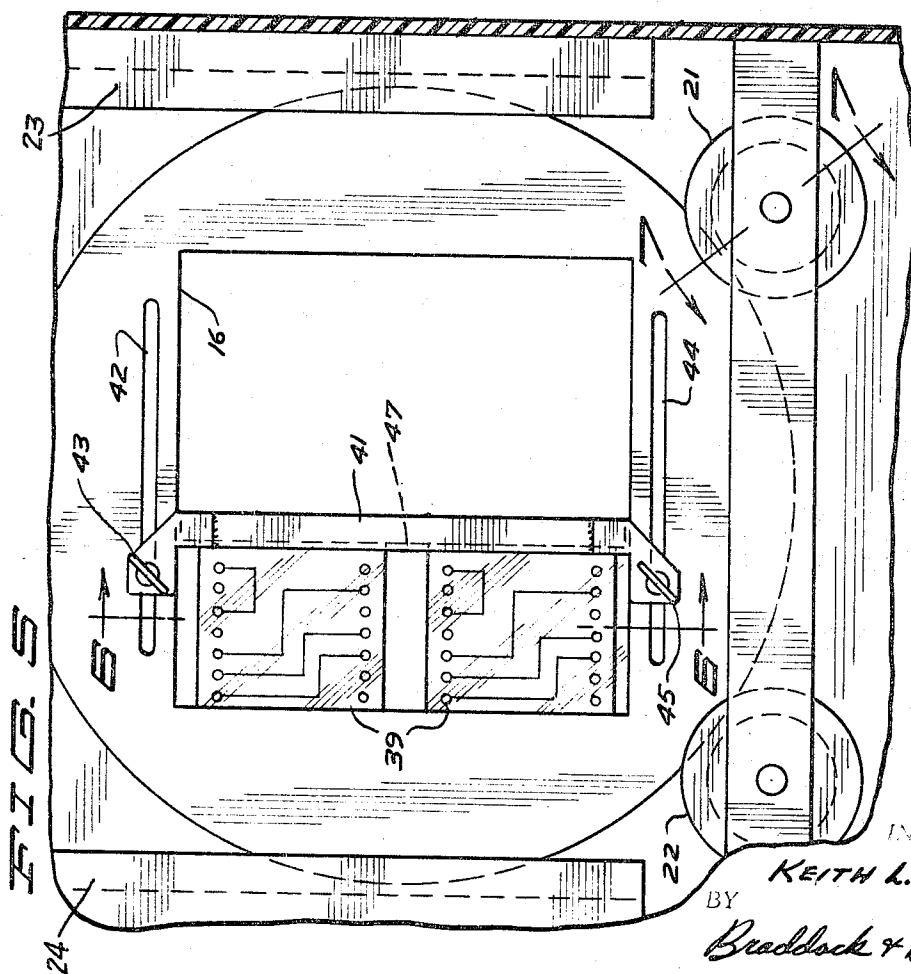


FIG. 8

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ETCHING APPARATUS

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ABSTRACT OF THE DISCLOSURE

Spray etching apparatus in which a circular plate is vertically mounted to rest on a pair of grooved wheels. Rotation of the grooved wheels causes the plate to rotate through a spray pattern set up by an etchant solution, pumped from a tank formed in the lower portion of the housing for the plate, being pumped through sets of spray nozzles. The circular plate forms a central aperture and has selectively adjustable apparatus for holding work pieces within the aperture and off-center with respect to the circular plates.

This invention is concerned with etching apparatus, and more particularly with a vertical rotational spray etching machine.

A wide variety of spray etching machines are presently known in the etching art. Most of these known machines are horizontal spray etching machines. That is, the work pieces to be etched are held in a horizontal plane and sprayed from top or bottom with an etchant solution. Some of the known machines are vertical spray etching machines, which hold the work to be etched in a vertical plane and spray from front or back. The vertical spray etching machines offer some advantages over the horizontal type machines, such as avoiding a pool of etchant solution forming on a horizontally held work piece.

Many of the presently used vertical spray etching machines have the disadvantage of blobbing or masking and patterning of the etched surface of the work pieces. By patterning is meant the uneven or irregular etching of the surface due to an irregularity in a fixed spray pattern impressed on a stationary work piece. By blobbing is meant the irregularities in the etched surface of the work piece due to large amounts of etchant solution falling from the upper vertically held work pieces to the lower work pieces. This blobbing masks the lower work pieces, that is, interferes with the spray trying to reach the surface to be etched, and causes slower and irregular etching of the lower work pieces. To overcome this problem in prior art machines, an operator would have to stop the etching cycle to manually change the relative positions of the upper and lower vertically held work pieces.

The apparatus of this invention overcomes the above mentioned disadvantages by providing a vertically disposed circular carriage or plate including means for holding the work pieces on the plate. Also provided are means for rotating the circular plate, which in the preferred embodiment take the form of a pair of grooved wheels, into the grooves of which the circular plate rests. A motor turns at least one of the grooved wheels to cause the circular plate to rotate. Thus the work pieces will be rotated through a spray pattern which is impressed on the circular plate. Other means for rotating the carriage could be provided, such as a system of gears.

In the preferred embodiment the spray pattern is fixed,

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however, oscillating spray nozzles can be used. To avoid patterning, the work pieces are held off-center with respect to the circular plate. Therefore, as the plate rotates the work pieces pass through various portions of the fixed spray pattern to statistically eliminate the possibility of patterning. The rotation also avoids the problem of blobbing or masking as the rotation of the work pieces causes them to continually change their relative levels to thus even out the flow of etchant solution from the upper work pieces to the lower work pieces. This will decrease the production cycle by obviating the need to stop the cycle to turn the work pieces. In the preferred embodiment, an aperture is formed in the circular carriage, so that the work pieces may be held in the aperture to be sprayed from front and back. This will also decrease the production cycle.

In the drawings:

FIG. 1 is a front plane view of an embodiment of the apparatus of this invention incorporated into a useful embodiment;

FIG. 2 is a top plane view of the embodiment of FIG. 1 taken along the section line 2-2;

FIG. 3 is a sectional view of the embodiment of this invention taken along the section line 3-3 of FIG. 2;

FIG. 4 is another sectional view of the embodiment of this invention taken along the section line 4-4 of FIG. 3;

FIG. 5 is a view disclosing the internal apparatus of the embodiment of this invention shown in the preceding figures;

FIG. 6 is a sectional view of the work piece holding apparatus of this invention taken along the section line 6-6 of FIG. 5; and

FIG. 7 is a sectional view of the rotational drive means of this embodiment of the invention taken along the section line 7-7 of FIG. 5.

In FIG. 1 there is disclosed a tank or case 10, which is provided with a removable top 11. Top 11 is provided with a handle 12 to facilitate removal. Attached to one side of tank 10 is a control panel 13 by which the etching cycle may be manually or automatically controlled. Through a transparent side of tank 10 there can be seen a circular carriage or plate 16 which is vertically mounted in a pair of guides 23 and 24, and which rests on a pair of grooved wheels 21 and 22. Carriage 16 has an aperture formed therein.

In FIG. 2 there is disclosed a motor 35 which is connected by means of shaft 36 to wheel 21. There is also disclosed a pump 25 and a filter 26 which are here shown mounted external to tank 10 and behind panel 13. A tube 51 connects the lower internal portion of tank 10 to filter 26. A tube 52 connects filter 26 to pump 25. A tube 53 provides an output from pump 25 which will eventually flow into a manifold 30. Manifold 30 connects to a back set of spray nozzles 31 and a front set of spray nozzles 32. There is also shown a tube 55 which provides an overflow path from pump 25 into tank 10. A drain valve 28 is shown mounted behind panel 13.

In FIG. 3 there is disclosed a drain tube 57 which connects valve 28 to an etchant solution 18 in the lower portion of tank 10. There is also shown a conduit 54 which connects tube 53 to manifold 30. A clamp 41 mounted on carriage or plate 16 holds work pieces 39 on plate 16. The arrows shown in FIG. 3 indicate the direction of rotation of wheels 21 and 22, and plate 16.

FIG. 4 discloses the mounting positions of pump 25, filter 26, and spray manifold 30, relative to tubes 51, 52

and 53, and conduit 54. Also shown are motor 35 and valve 28.

In FIG. 5 there is disclosed a pair of slots 42 and 44 in plate 16. One end of clamp 41 is releasably held in slot 42 by a bolt 43. Another end of clamp 41 is releasably held in slot 44 by a bolt 45. Work pieces 39 are shown held between clamp 41 and an inner surface of the aperture formed in plate 16. It is also more apparent from FIG. 5 how guides 23 and 24 provide channels to facilitate the vertical disposition of plate 16. Also, it may be more clearly seen how plate 16 rests in the grooves of grooved wheels 21 and 22.

FIG. 6 discloses how work pieces 39 fit into a channel 47 formed in clamp 41. Also shown is the manner in which bolts 43 and 45 extend through plate 16 by means of, respectively, slots 42 and 44, to releasably fasten clamp 41.

FIG. 7 discloses that groove wheel 21 is fastened to shaft 36 by suitable means here shown as a set screw 27. In this preferred embodiment the groove of wheel 21 is lined with a material 20 having a high coefficient of friction, as for example plasticized polyvinyl chloride, for better gripping circular plate 16. Wheel 22 is also lined with material 20.

In a normal production cycle an operator will remove top 11 of tank 10 and pull out circular carriage or plate 16. The operator will then place work pieces to be etched, such as work pieces 39, in channel 47 of clamp 41. It should be noted here that though this preferred embodiment uses a channel such as 47, a channel is not necessary and the face of clamp 41 could be smooth or of varying configuration. The operator, having loosened bolts 43 and 45 to allow clamp 41 to slide in slots 42 and 44, now slides clamp 41 to one side of the aperture formed in plate 16 such that the work pieces 39 are clamped between an inner surface of the aperture and clamp 41. Bolts 43 and 45 are then tightened to hold work pieces 39 in position. It is important to note that the preferred position for work pieces 39 is one that is off-center with respect to the circular plate 16. This is so that when plate 16 is rotated, there is relative rotational movement of all portions of the work pieces with respect to the fixed spray pattern.

Once the operator has properly clamped the work pieces 39 onto plate 16, plate 16 is inserted through guides 23 and 24 to rest in the grooves of wheels 21 and 22. Top 11 is then placed in position of the top of tank 10. The machine is now ready for a production cycle which will commence when the operator turns on power (not shown) at panel 13.

The switching on of power will have two results. First, power will be applied to motor 35, which will rotate shaft 36 causing wheel 21 to turn due to wheel 21 being rigidly attached to shaft 36 by means of set screw 27. As wheel 21 rotates, the friction between material 20 and plate 16 will cause a rotational movement of plate 16. This rotation of plate 16 is facilitated by rotation of wheel 22, which allows a free rotation of plate 16.

Also, when the power is switched on, the pumping action of etchant solution 18 will commence. As power is supplied to pump 25, there will be a flow of etchant solution forced from the lower portion of tank 10 through tube 51, filter 26, and tube 52 to pump 25. From pump 25 the etchant solution is forced through conduit 54 to spray manifold 30. From spray manifold 30 some of the etchant solution will be forced through the back set of spray nozzles 31, while the rest of the etchant solution 18 will be forced through the front set of spray nozzles 32. In the preferred embodiment the set of spray nozzles 31 and 32 will set up an overlapping fixed spray pattern, which will impinge on two surfaces of work pieces 39 inasmuch as they are held in the aperture within plate 16.

Any overflow of etchant solution 18 out of pump 25 will flow through tube 55 back into tank 10, without passing through the spray manifolds.

Thus the work pieces to be etched 39 are rotated on plate 16 through the fixed spray pattern set up by the sets of nozzles 31 and 32 (or through an oscillating spray pattern set up by motion of the sets of nozzles 31 and 32, if desired). When work pieces 39 are located off-center with respect to plate 16, the portion of the spray pattern impinging on the work pieces will continuously be varied, thus statistically decreasing the possibility of patterning. The continuous motion of work pieces 39 through the fixed spray pattern will have a sweeping effect on the surface being etched. Also, the flow of spent etchant solution 18 downward to the lower portion of tank 10 will be constantly varying its path as the work pieces 39 are rotated, to thus eliminate the possibility of masking due to the etchant solution 18 taking only one path down along the work pieces.

It should be noted that though this preferred embodiment shows only two wheels, such as wheels 21 and 22, a larger plurality of wheels could be used if necessary. Further, if necessary, more than one wheel could be driven from motor 35 or from a plurality of motors. Also, a system of gears or other means could be used to rotate carriage 16.

It should be noted that more than one clamp such as clamp 41 could be used within the aperture formed in plate 16 to hold a greater number of work pieces 39.

It is thus apparent that the apparatus of this invention as described above provides a vertical rotational spray etching machine which eliminates the problems of patterning and blobbing or masking present in the prior art. In doing so, this invention provides a means for decreasing an etching production cycle, while improving the quality of etch.

I claim:

1. Vertical rotary spray etching apparatus comprising:
 - a tank including a lower portion for holding an etchant solution;
 - a pair of vertically disposed sets of spray nozzles mounted in said tank for forming an overlapping spray pattern on a substantially vertical plane between said sets of spray nozzles;
 - filter means;
 - pump means for pumping said etchant solution from said lower portion of said tank through said filter means to said spray nozzles;
 - a plurality of grooved wheels vertically mounted in line on a plurality of horizontally disposed axles within said tank;
 - drive means connected to at least one of said wheels for rotating at least one of said wheels;
 - a circular disk having an aperture formed therein and including means for holding work pieces to be etched within said aperture;
 - said means for holding work pieces being selectively adjustable to hold work pieces off-center with respect to said circular disk; and
 - means vertically mounting said disk substantially in said vertical plane formed by said spray pattern, said disk riding in the grooves of said plurality of wheels for rotating said carriage as said drive means rotates at least one of said wheels.
2. The vertical rotary spray etching apparatus of claim 1 in which said means for holding work pieces to be etched within said aperture formed in said circular disk comprises:
 - a pair of elongated slots formed in said circular disk on opposite sides of said aperture and lying between said aperture and the perimeter of said circular disk;
 - an arm for holding an edge of work pieces to be etched; and
 - fastening means connected to the ends of said arm for releasably fastening said arm between said pair of slots, so that the work pieces to be etched are held between said arm and a surface of said circular disk forming said aperture, said arm adapted to hold the

work pieces to be etched off-center with respect to said circular disk to avoid patterning of said work pieces during an etching process.

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