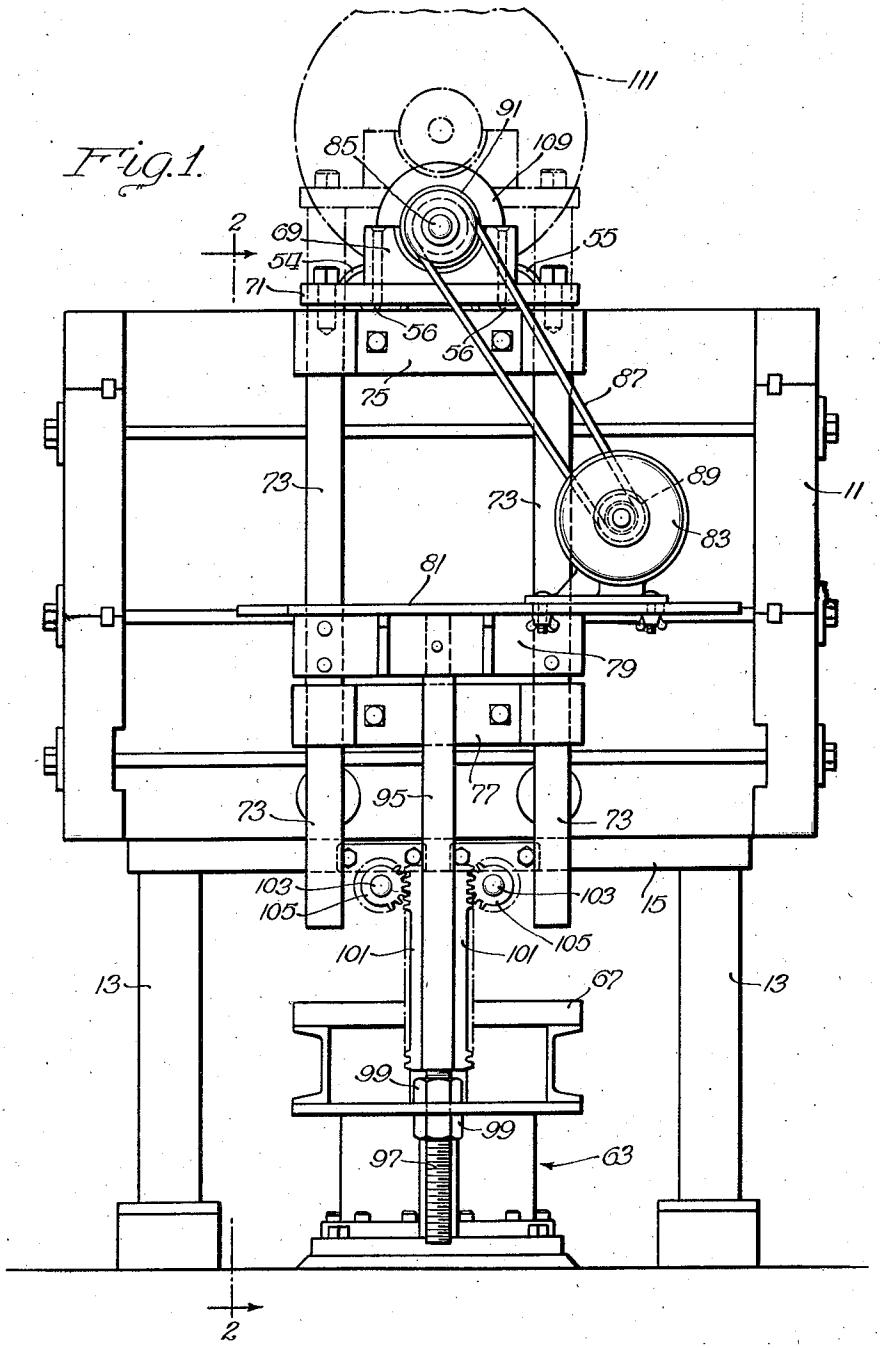
Oct. 17, 1944. C. L. HENDERSON ET AL 2,360,676

CYLINDER ETCHING MACHINE

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Fig. 1.



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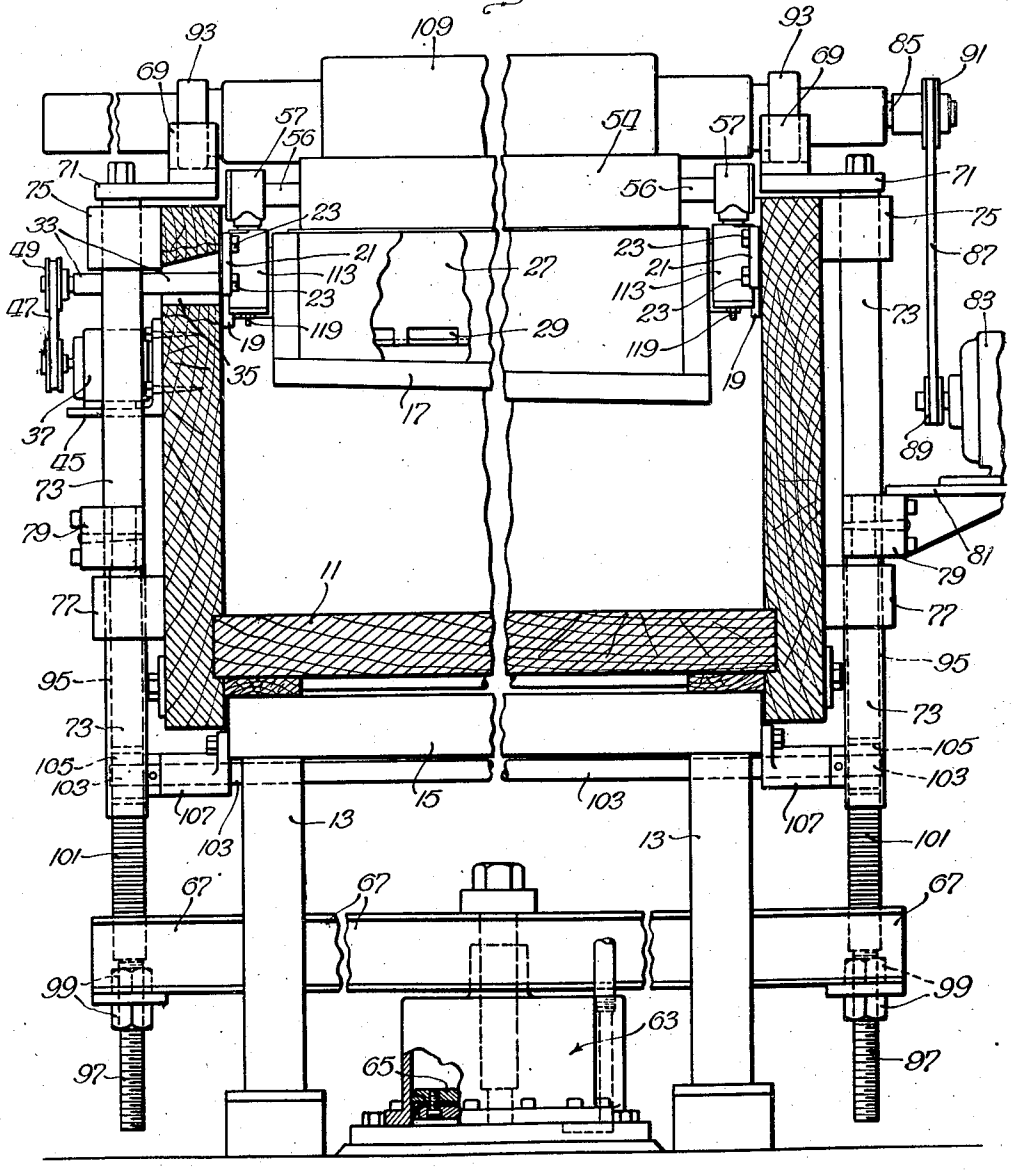
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CYLINDER ETCHING MACHINE

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Fig. 2.



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CYLINDER ETCHING MACHINE

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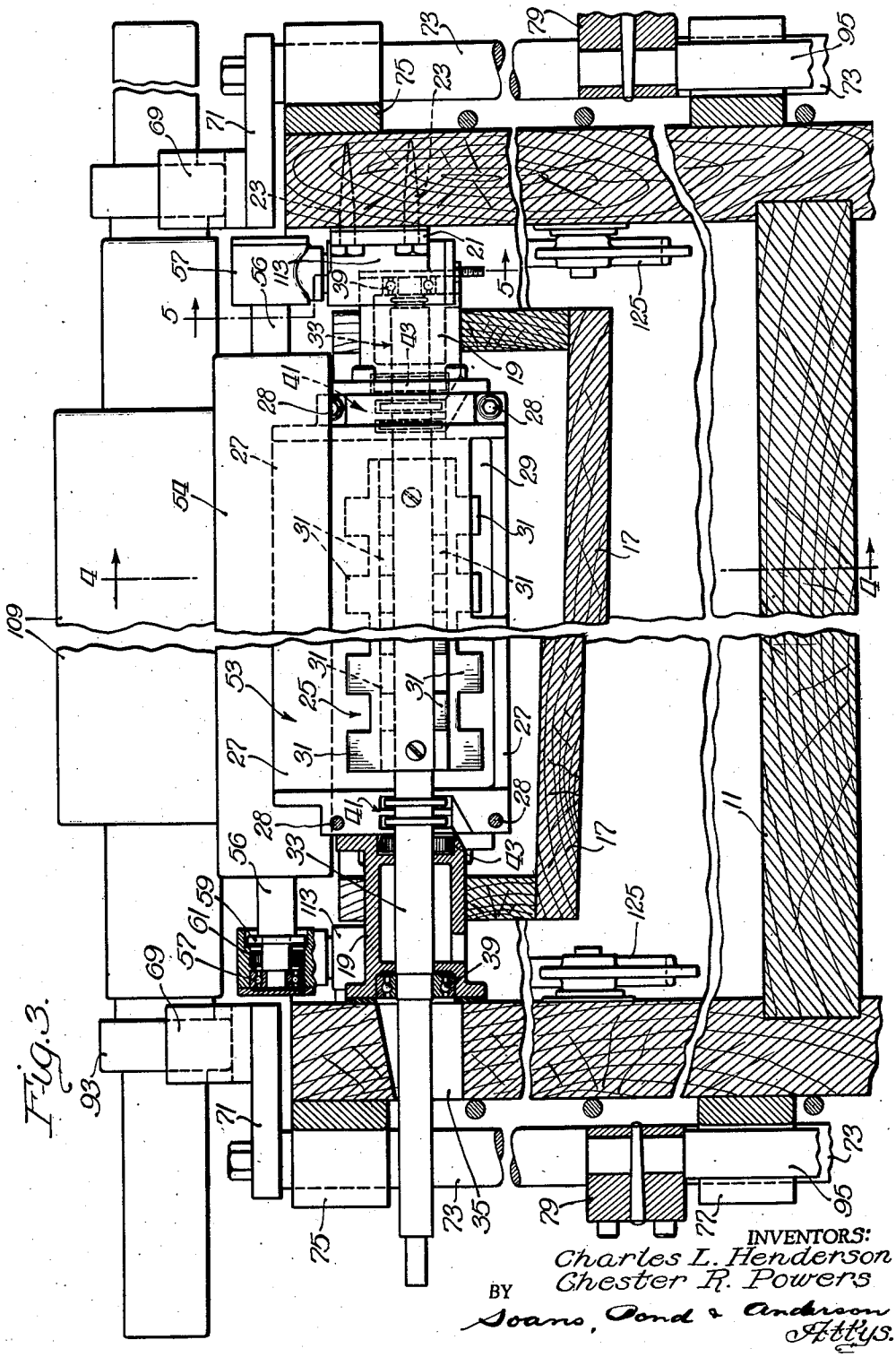


Fig. 3.

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CYLINDER ETCHING MACHINE

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Fig. 4.

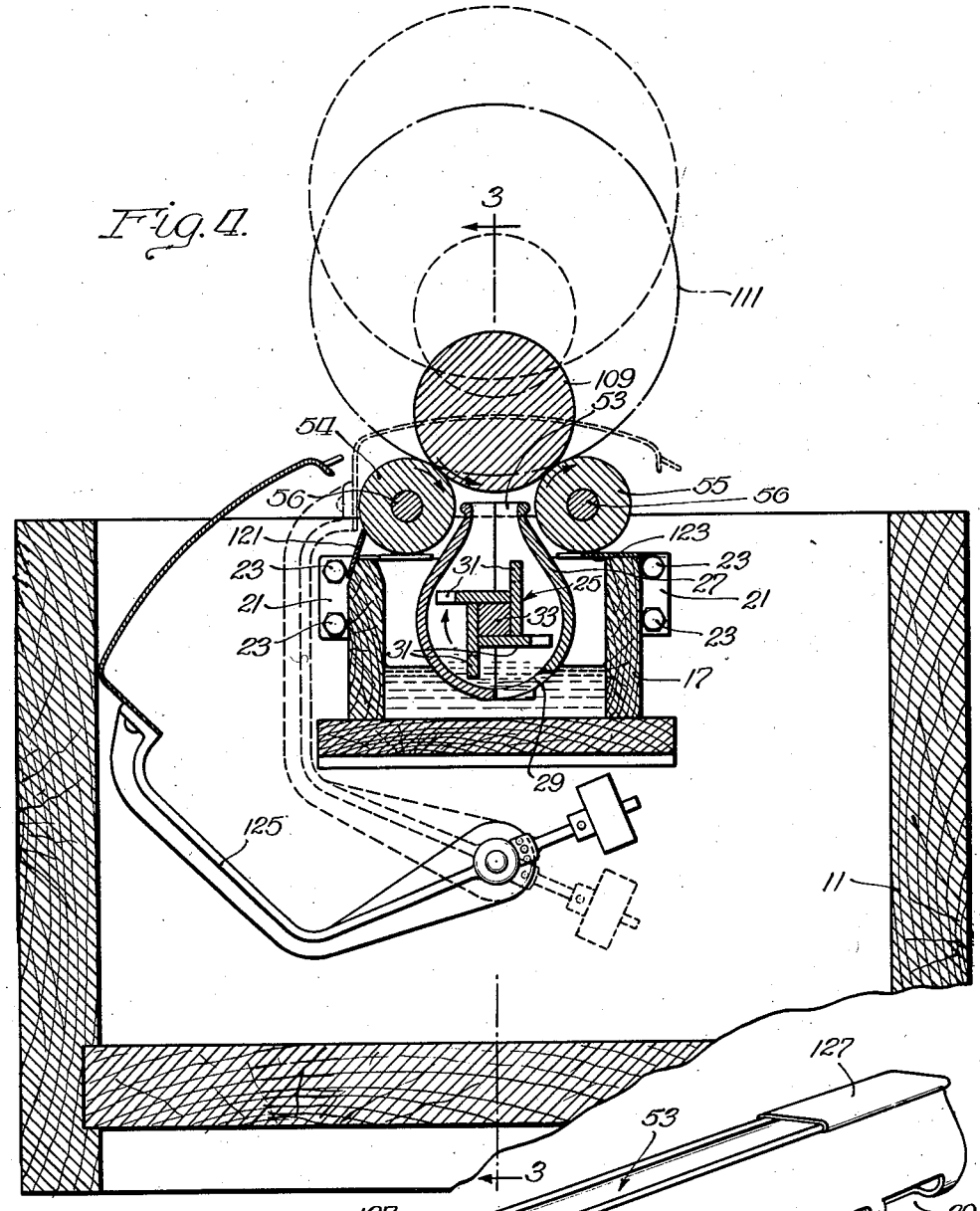
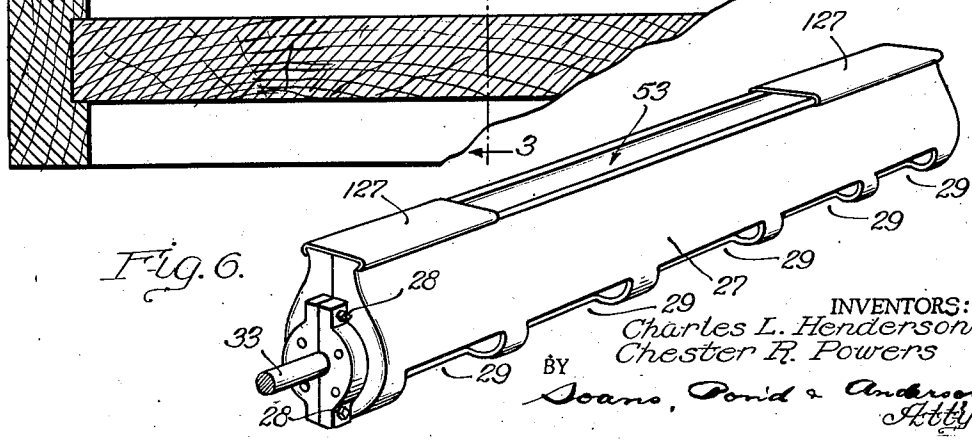


Fig. 6.



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Fig. 7.

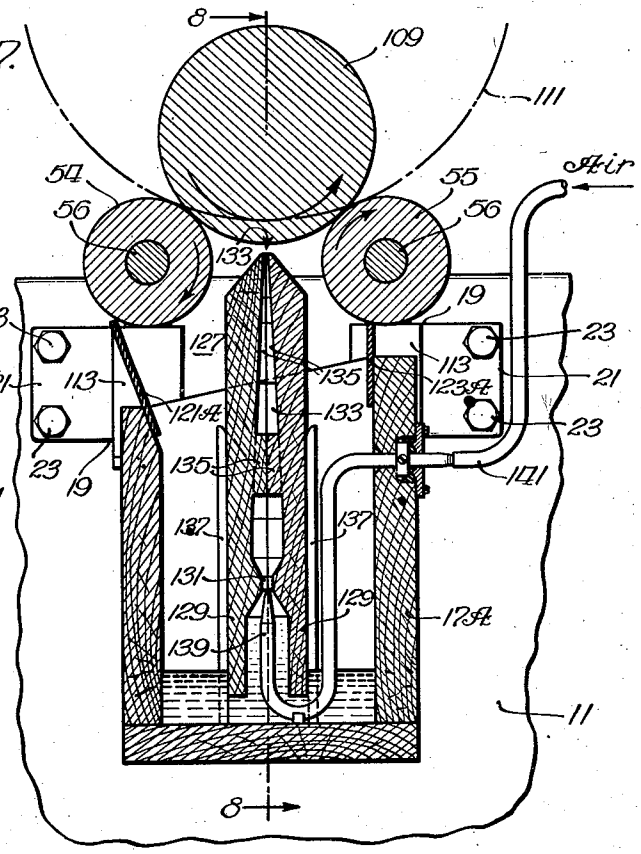


Fig. 5.

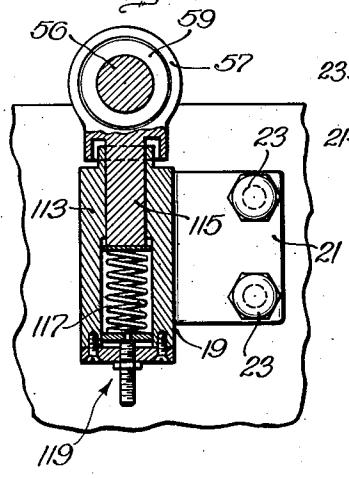
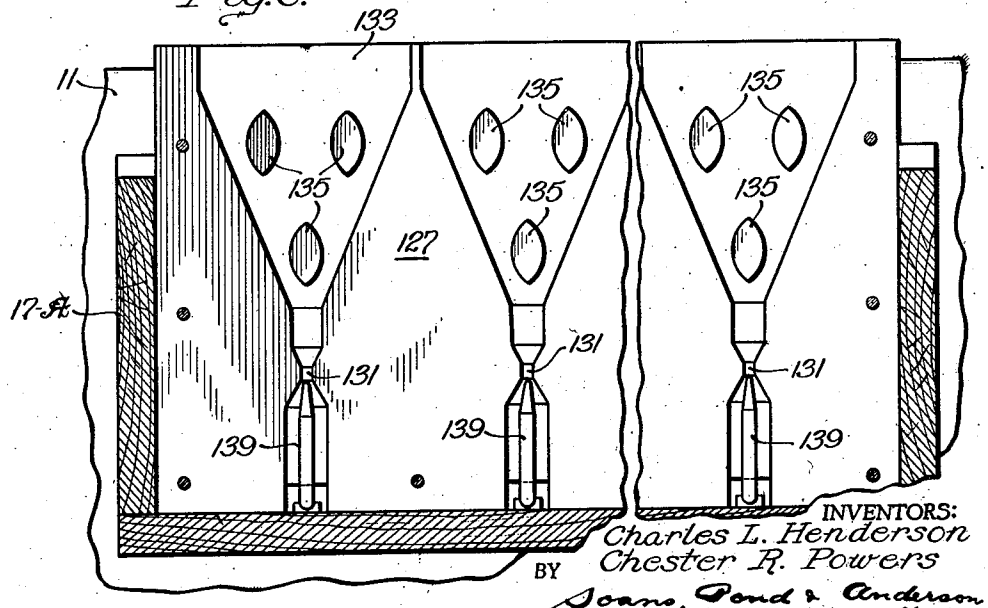


Fig. 8.



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Patented Oct. 17, 1944

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UNITED STATES PATENT OFFICE

2,360,676

CYLINDER ETCHING MACHINE

Charles L. Henderson and Chester R. Powers, Appleton, Wis., assignors to Paper Patents Company, a corporation of Wisconsin

Application July 28, 1941, Serial No. 404,338

12 Claims. (Cl. 41—9)

The present invention relates particularly to apparatus and methods for etching intaglio or relief printing cylinders.

In intaglio printing the printing surface comprises a smooth, metallic surface, usually of copper, having formed therein, by etching or otherwise, symmetrically arranged ink-receiving recesses of very small area. The ink recesses throughout the printing surface are separated by line-like, unetched lands, which serve to support the doctor or scraper blade used for removing excess ink from the printing surface during the actual printing operation.

During the manufacture of intaglio printing cylinders, it is customary to employ a light sensitive film or resist, which as manufactured is soluble in water or other solvent but which becomes insoluble when exposed to light, and to transfer the image or design to be reproduced to the resist photographically. The resist may be formed upon the surface of the metallic plate or cylinder by application thereto in liquid form, or it may be in the form of a sheet, such as carbon tissue, which is wrapped around the printing cylinder or otherwise applied to the surface after the transfer operation, as in the rotogravure process. The image or design which is to be reproduced in the printing surface is broken up into small opaque dots, either before or during the transfer operation. The line-like areas between the opaque dots are exposed to light during the transfer operation, and the resist in those areas is rendered insoluble.

Following the transfer operation, the resist is washed, to either partially or wholly remove the unexposed dot areas, and is hardened. The surface is then etched by immersion in a suitable etching fluid or other procedure. During the etching the light insolubilized, line-like areas of resist intermediate the dot areas protect the underlying portions of the printing surface from the etching fluid, and as a result the etching takes place only in the unexposed dot areas which thereby become ink-receiving recesses in the finished printing plate.

The manufacture of relief cylinders may follow a similar process, as is known in the art.

In the past, difficulty has been experienced in effecting completely satisfactory etching of cylindrical printing surfaces, particularly in the case of intaglio printing surfaces wherein the tone value is controlled by the size of the ink-receiving recesses, although even the etching of rotogravure process surfaces requires great care and highly skilled workmen. The areas in the printing plates which adjoin relatively large areas of white spaces, the areas adjacent light colored type on a tint background, and the areas adjacent full-tone spaces or dark colored type on a tint background, etch so as to produce printing areas which are different in tone from the main body of the etching, the effect being known as shading.

The principal object of the present invention is to overcome this difficulty which is inherent in the prior art etching procedures, and to provide a machine and method whereby uniformly etched surfaces, free from shading, can be produced by a relatively simple etching operation. It is also an object of our invention to provide an improved etching machine, particularly adapted for etching printing cylinders, which can be operated to produce a very uniform etch of excellent printing characteristic. Other objects and the various advantages of the invention will be made apparent by reference to the accompanying drawings and the following description of one preferred embodiment thereof. In the drawings:

Fig. 1 is an end elevation of an etching machine constructed in accordance with the present invention;

Fig. 2 is a sectional view of the machine illustrated in Fig. 1, the view being taken on the line 2—2 of that figure;

Fig. 3 is an enlarged sectional view taken on the line 3—3 of Fig. 4;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary sectional view showing the details of one of the resilient bearing supports for the sealing rolls forming a part of the machine illustrated in the other figures of the drawings;

Fig. 6 is a fragmentary perspective view illustrating one means of adapting the apparatus of the other figures of the drawings for use in connection with short rolls;

Fig. 7 is a sectional view, generally similar to Fig. 4, of a modified form of the apparatus of the present invention; and

Fig. 8 is a sectional view on the line 8—8 of Fig. 7.

Referring particularly to Figs. 1 and 2, the apparatus therein illustrated includes a rectangularly-shaped outer tank 11 of relatively heavy, reinforced, wood construction which is supported upon four uprights 13 and a rigid, metallic frame 15. The outer tank 11 is open at the top and serves to contain the other elements of the apparatus. Because of the possibility that the tank walls may be splashed with acid or other etching fluid, the wood of which the tank 11 is constructed should be impregnated or painted with an acid-resisting compound.

The etching fluid is contained within a box-like container or tank 17, preferably made of wood which has been coated or otherwise treated to render it acid-resisting. The tank 17 is supported adjacent the open top of the main tank

11 by means of suitable hollow support members 19 (Fig. 3), having bracket portions 21 affixed to the two ends of the main tank 11 by suitable lag screws 23, as illustrated. The acid or other etching fluid is applied to the surface which is to be etched by means of a rotatable impeller member 25 and an impeller housing 27 which cooperates therewith. The impeller housing 27 comprises an elongated, open-mouthed, rigid vessel having the general outline illustrated in Figs. 4 and 6. It is bolted to one of the support members 19 at each of its ends, and thereby supported in proper position within the tank 17 for the etching fluid. The impeller housing 27 comprises two complementary half sections of cast iron which are bolted together by suitable bolts 28. The housing 27 is coated with acid-resisting material and is open along its lower edge, as illustrated at 29, to permit free entry of the etching fluid thereinto.

The impeller 25 of the apparatus illustrated in the drawings comprises a series of paddle members 31 made of an acid-resisting plastic, such as that sold under the trade name of Lucite, or of some other acid-resisting material, which are affixed to a suitable rotatable shaft 33. One end of the shaft 33 extends through an opening 35 in the main tank 11, as illustrated in Fig. 3, for connection to a motor 37 (Fig. 2) or other rotating means.

The impeller 25 is supported for free rotation within the impeller housing 27 by suitable bearings 39 (Fig. 3), which in turn are supported in the hollow support members 19. To prevent acid carry-over into the bearings 39 during the operation of the apparatus, a labyrinth seal 41 is provided at each end of the impeller housing 27, and this is backed up at each end of the machine by a gland seal 43. The motor 37 which is used for rotating the impeller 25 is supported upon a bracket 45 affixed to the adjacent end of the main tank 11 and is connected to the impeller shaft 33 by a belt 47 and suitable pulleys 49 and 51. A variable speed motor is preferred.

In order to confine the etching fluid which is discharged through the mouth 53 of the impeller housing 27 by operation of the impeller 25, the machine is provided with two longitudinally-extending sealing rolls 54 and 55 which are supported for free rotatable movement by means of central shafts 56 and spaced bearings 57 which form a part of the support members 19. The sealing rolls 54 and 55 are identical in construction and should be made of fairly soft, acid-resisting rubber or rubber compound. Rolls of sufficient softness to give a plastometer reading of about 140 with a ¼ inch ball have proven particularly satisfactory. To prevent acid from being carried into the supporting bearings 57 for the sealing rolls, the bearing supporting structure includes a liquid deflector 59 and a gland seal 61, as shown in Fig. 3.

Printing cylinders vary considerably in length and in diameter, and a satisfactory etching machine should include means for accommodating cylinders of varying dimensions. In the particular machine illustrated in the drawings, this means includes an adjustable bearing support structure for the cylinder which is to be etched. This structure includes a hydraulic operating mechanism 63 (Figs. 1 and 2) having a movable piston 65 which is mechanically connected to a longitudinally-extending beam 67, a pair of vertically movable supports, one of which is located at either end of the apparatus, and means for mechanically interconnecting the supports so as to assure uniform movement thereof in response to movement of the hydraulic piston 65 and the beam 67. Each of the vertically movable supports includes a yoke 69, which is rigidly affixed to an upper crosshead 71. The upper crosshead 71 is bolted to two spaced, cylindrical guides 73 which are supported for slidable vertical movement in suitable spaced guideways 75 and 77 rigidly affixed to either end of the main tank 11. To limit the downward movement of the vertically movable supports, and for other reasons, a second crosshead member 79 is keyed to the two cylindrical guide members 73, as illustrated in Figs. 1 and 2. The lower crosshead member 79 at the right hand end of the apparatus (Fig. 2) has affixed thereto a platform 81 which serves as the support for a motor 83. This motor 83 may be connected to the shaft 85 of the cylinder being etched by a suitable belt 87 and pulleys 89 and 91 for the purpose of rotating the cylinder during the etching operation. To permit free rotation of the printing cylinder during the etching operation, suitable ball bearings 93 are placed over the ends of the shaft 85 of the cylinder. These bearings 93 rest on the yokes 69, as illustrated.

Each of the lower crossheads 79 is adjustably connected to one end of the longitudinally-extending beam 67 by means of a rod member 95, having a threaded portion 97 at its lower end, and a pair of adjusting nuts 99. To assure equal uniform movement of the two vertically adjustable supports for the printing cylinder, each of the rod members 95 extending between the lower crossheads 79 and the beam 67 is provided with two diametrically spaced rack sections 101, and the pair of rack sections on each side of the machine are interconnected by a transversely-extending shaft 103 and suitable pinion gears 105 keyed thereto. The shafts 103 are rotatably supported on the main frame 15 of the machine by rigid bearings 107 (Fig. 2).

It will be apparent that the above described mechanism provides a convenient vertically adjustable support for the cylinders which are to be etched. Cylinders of relatively small size, such as the cylinder at 109 in the drawings, can be accommodated just as easily as cylinders of the largest sizes, as illustrated by the outline 111 in Figs. 1 and 7.

To assure a liquid-tight seal during each operation of the machine, the bearings 57 for the sealing rolls 54 and 55 are resiliently supported upon the members 21 by means which, as illustrated in Fig. 5, include a rigid guideway 113, a cylindrical bearing support member 115 located in said guideway and movable in a vertical direction relative thereto, a spring 117 which normally biases the bearing support member 115 (and the bearing) in an upward direction, and a tension adjusting means 119 for the spring 117. During the operation of the apparatus, the vertically adjustable supports for the cylinder to be etched will be lowered by the operation of the hydraulic operating mechanism 63 until the cylinder resiliently engages and seals with the sealing rolls. The sealing pressure can be readily controlled by adjusting the tension of the spring 117.

During the actual etching operation it is desirable that the printing cylinder which is to be etched should be rotated at a relatively slow speed, and tests indicate that cylinder speeds within the range of from about 10 to 12 R. P. M. are particularly satisfactory for etching copper

surfaces with perchloride of iron. The impeller **25**, on the other hand, should be rotated at relatively high speed, in order to accomplish good atomization and even distribution of the etching liquid and in order that the etching fluid shall be directed against the surface which is to be etched with substantial force. Impeller speeds upwards of about 700 R. P. M. have been found to be satisfactory for cylinders of the usual dimensions. The level of the etching fluid is preferably maintained just slightly above the opening **29** in the impeller housing.

The sealing rolls **54** and **55** effectively prevent leakage or discharge of the etching fluid from the space between those rolls and the encompassed portion of the cylinder which is being etched. At the same time, the sealing roll **55** acts to doctor off excess etching fluid from the cylinder as it rotates, and prevents any substantial quantity of that fluid from remaining on the cylinder after it passes the sealing roll. To prevent any carry-over of etching fluid on the other sealing roll **54**, the apparatus includes a longitudinally-extending rubber doctor **121** which is supported upon the adjacent edges of the tank **17** for the etching fluid, as illustrated particularly in Fig. 4. The doctor **121** continuously returns any of the etching fluid which may accumulate on the sealing roll **54** to the main body of the etching fluid contained in the tank **17**. A longitudinally extending sealing doctor **123**, also supported on the tank **17**, engages the lower surface of the sealing roll **55** to prevent discharge of the etching fluid along that edge of the tank.

When the etching operation has been completed it is usually desirable to wash off the etching fluid as quickly as possible. To facilitate this operation the apparatus includes a pivotally supported metallic apron or deflector **125** which is of such design that it may be swung into place from the inoperative position illustrated in full in Fig. 4 to the operative position illustrated by the dotted lines of that figure. In its operative position the apron **125** covers the sealing rolls **54** and **55** and the space therebetween which would otherwise open into the etching fluid tank **17**. Before moving the apron **125** into place, it is of course necessary to raise the cylinder to a position above that occupied by the protective apron, and this is accomplished by operation of the hydraulic elevating mechanism **63** for the cylinder supports. The elevated position of small and large cylinders are illustrated by the dotted outlines of Fig. 4. Following the elevation of the cylinder and the movement of the apron to operative position, the cylinder can be washed immediately by a hose or other means without risk of diluting or contaminating the etching fluid. The washing liquid will be collected in the main tank from which it can be conveniently discharged.

When etching relatively short cylinders, it will be found desirable to partially cover both ends of the impeller housing with an acid-resisting, removable cover **127**, as illustrated in Fig. 6. This arrangement confines the discharge of the etching fluid to the length of the cylinder which is to be etched.

The modified form of the apparatus illustrated in Figs. 7 and 8 is essentially similar to the machine which has been described in the foregoing, with this one important exception: In the modified apparatus, the etching fluid is directed against the surface to be etched by means of a liquid jet atomizing structure **127** which is operated by a plurality of spaced air jets. The atomizing structure **127**, as illustrated, includes a pair of complementary, machined plate members **129** which are designed so as to provide a plurality of regularly spaced atomizing jet chambers **131** which open into wedge-shaped throats **133** wherein are disposed deflector members **135** for dividing and directing the atomized stream so as to assure full coverage at the open upper end of the throat. The complementary plate members **129** are bolted together and are held in place within a suitable tank **17**—A for the etching fluid by means of cleats or the like as indicated at **137** in Fig. 7. A jet tube **139** is provided in each of the atomizing chambers **131**, and this tube is connected to a suitable source of pressure air through a conduit **141**. Particularly satisfactory results have been obtained when using a jet tube having an orifice about $\frac{1}{16}$" in diameter and an air pressure of about 15 pounds per square inch gauge. The sealing rolls **54** and **55**, the resilient support means for the sealing rolls, the outer tank and the vertically adjustable support means for the cylinder which is to be etched are exactly the same in this apparatus as in the previously described structure. Doctors **121**—A and **123**—A similar to the doctors **121** and **123** are provided for preventing excess etching material from being carried around on the sealing rolls **54** and **55**.

Tests have shown that the etching apparatus which has been described in the foregoing is capable of producing gravure cylinders which are substantially completely free from shading or other defects. Apparently because the etching fluid is continuously applied to a portion of the rotating cylinder and is continuously doctored off at the edges of such portion, the etching operation takes place very uniformly and is capable of easy and convenient control. This accomplishes the highly desirable function of making it possible to carry out the etching of printing cylinders conveniently and efficiently.

It will be apparent that the apparatus and methods described in the foregoing can be used for etching relief or intaglio cylinders for purposes other than printing.

Various modified arrangements of the apparatus described above may be suggested to those skilled in the art. Accordingly, it is my desire that the accompanying claims shall be accorded a broad interpretation and shall be limited only by the prior art and the express language thereof.

We claim:

1. In combination in apparatus of the class described, a cylinder, a pair of spaced horizontally-extending sealing rolls which contact said cylinder, and spray means operable to provide a spray of etching fluid which is directed onto that portion of the surface of said cylinder which is between said sealing rolls.

2. In combination in apparatus of the class described, a cylinder, a pair of spaced, generally parallel, horizontally-extending sealing members which resiliently contact said cylinder during the operation of said apparatus, spray means operable to provide a spray of etching fluid which is directed onto that portion of the surface of said cylinder which is between said sealing members, and means for moving said surface through said spray during the etching operation.

3. In combination in apparatus of the class described, a cylinder, means for supporting said cylinder for rotation about its longitudinal axis, means for rotating said cylinder during the op-

eration of said apparatus, spray means operable to provide an elongated, relatively narrow spray of etching fluid which is directed onto the surface of said cylinder along the length thereof, and sealing means which contact said cylinder on opposite sides of said spray for restricting the area of said cylinder which is contacted by said spray.

4. In combination in apparatus of the class described, a cylinder, means for supporting said cylinder for rotation about its longitudinal axis, means for rotating said cylinder, spray means operable to provide an elongated, relatively narrow spray of etching fluid which is directed onto the surface of said cylinder along the length thereof, and means including a pair of spaced, generally parallel, longitudinally-extending rolls which contact the surface of said cylinder at either side of said spray for restricting the area of said cylinder which is contacted by said spray and for continuously doctoring off the etching fluid from the cylinder surface as it passes out of said spray.

5. In combination in apparatus of the class described, a printing cylinder, an elongated, box-like tank which has an open top and which contains a quantity of etching fluid, means for supporting said cylinder for rotation adjacent the open top of said etching fluid tank, means for rotating said cylinder, means located within said etching fluid tank which is operable to provide an elongated, relatively narrow spray of etching fluid and to direct said spray onto the adjacent surface of said cylinder along the length thereof, and means for continuously doctoring off the etching fluid from the cylinder surface as it passes out of said spray.

6. In combination in apparatus of the class described, a printing surface, horizontally-extending support means for said surface, and means operable to provide a spray of etching fluid which is directed onto said surface to effect the etching thereof, said last-mentioned means including an elongated, box-like tank which contains a quantity of etching fluid, an elongated impeller housing located within said tank, and a rotating impeller located within said impeller housing, said impeller housing having an elongated, relatively narrow throat through which the etching fluid is directed onto said cylinder.

7. In combination in apparatus of the class described, a printing cylinder, means for supporting said cylinder for rotation about its longitudinal axis, means for rotating said cylinder, and means operable to provide an elongated, relatively narrow, spray of etching fluid which is directed onto the surface of said cylinder along the length thereof, said last-mentioned means including a rotating impeller, and an elongated impeller housing within which said impeller rotates, said impeller housing having an elongated, relatively narrow throat through which the etching fluid is directed onto said cylinder.

8. In combination in apparatus of the class described, a printing surface, a pair of spaced, generally parallel, horizontally-extending sealing rolls upon which said surface rests during the operation of said apparatus, and means operable to provide a spray of etching fluid which is directed onto that portion of said surface which is between said sealing rolls, said last-mentioned means including an elongated, box-like tank which contains a quantity of etching fluid, an elongated impeller housing located within said tank, and a rotating impeller located within said impeller housing, said impeller housing having an elongated, relatively narrow throat through which the etching fluid is directed onto said cylinder.

9. In combination in apparatus of the class described, a printing cylinder, vertically adjustable means for supporting said cylinder for rotation about its longitudinal axis, a pair of spaced, generally parallel, horizontally-extending sealing rolls, each having a resilient outer surface upon which said cylinder rests during the operation of said apparatus, means for rotating said cylinder and thereby also rotating said sealing rolls, and spray means operable to provide a spray of etching fluid which is directed onto that portion of said cylinder which is between said sealing rolls, said sealing rolls continuously doctoring off the etching fluid from the cylinder surface as it passes out of said spray.

10. In combination in apparatus of the class described, a printing cylinder, vertically adjustable means for supporting said cylinder for rotation about its longitudinal axis, a pair of spaced, generally parallel, horizontally-extending sealing rolls, each having a resilient outer surface upon which said cylinder rests during the operation of said apparatus, means for rotating said cylinder and thereby also rotating said sealing rolls, and means operable to provide an elongated, relatively narrow, spray of etching fluid which is directed onto that portion of said cylinder which is between said sealing rolls, said spray providing means including an elongated, box-like tank which contains a quantity of etching fluid, an elongated impeller housing located within said tank, and a rotating impeller located within said impeller housing, said impeller housing having an elongated, relatively narrow throat through which the etching fluid is directed onto said cylinder.

11. In combination in apparatus of the class described, a printing cylinder, a pair of spaced, generally parallel, horizontally-extending sealing rolls upon which said cylinder rests during the operation of said apparatus, means for rotating said cylinder, and means operable to provide an elongated, relatively narrow spray of etching fluid which is directed onto the surface of said cylinder along the length thereof, said last-mentioned means including a plurality of spaced jet type atomizing nozzle mechanisms and a source of pressure air.

12. In combination in apparatus of the class described, means for supporting a cylinder to be etched for rotation about its longitudinal axis, means for rotating said cylinder during the etching operation, spaced, horizontally-extending sealing members which are adapted to engage the surface of said cylinder along elements thereof to provide a restricted longitudinal peripheral area on said cylinder exposed to the acid spray, and spray means operable to provide a spray of etching fluid which is directed onto the surface of said cylinder between said sealing members.

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