

June 4, 1963

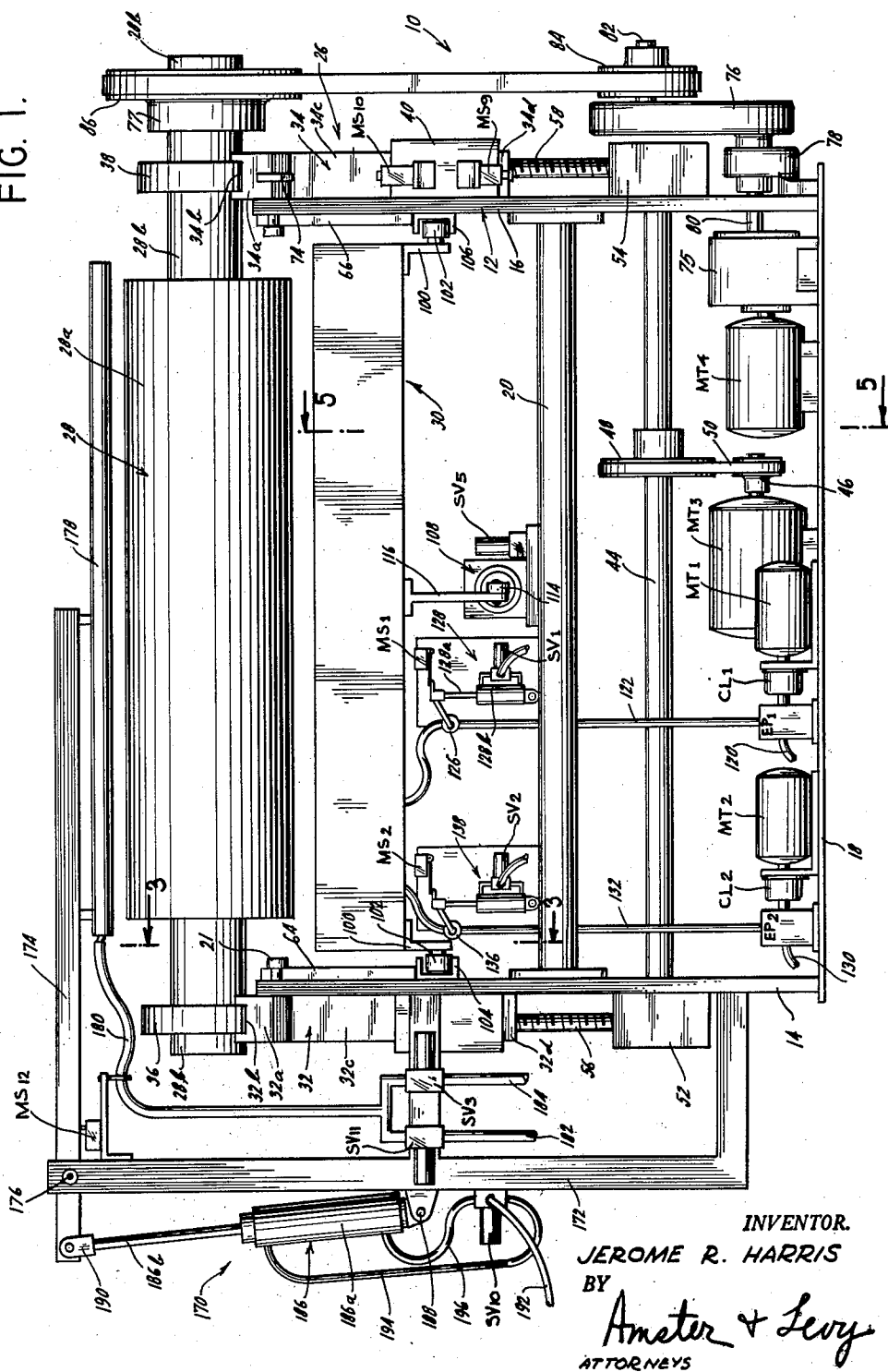
J. R. HARRIS
ETCHING MACHINE

3,092,123

Filed March 19, 1959

6 Sheets-Sheet 1

FIG. 1.



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J. R. HARRIS
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3,092,123

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6 Sheets-Sheet 2

FIG. 2.

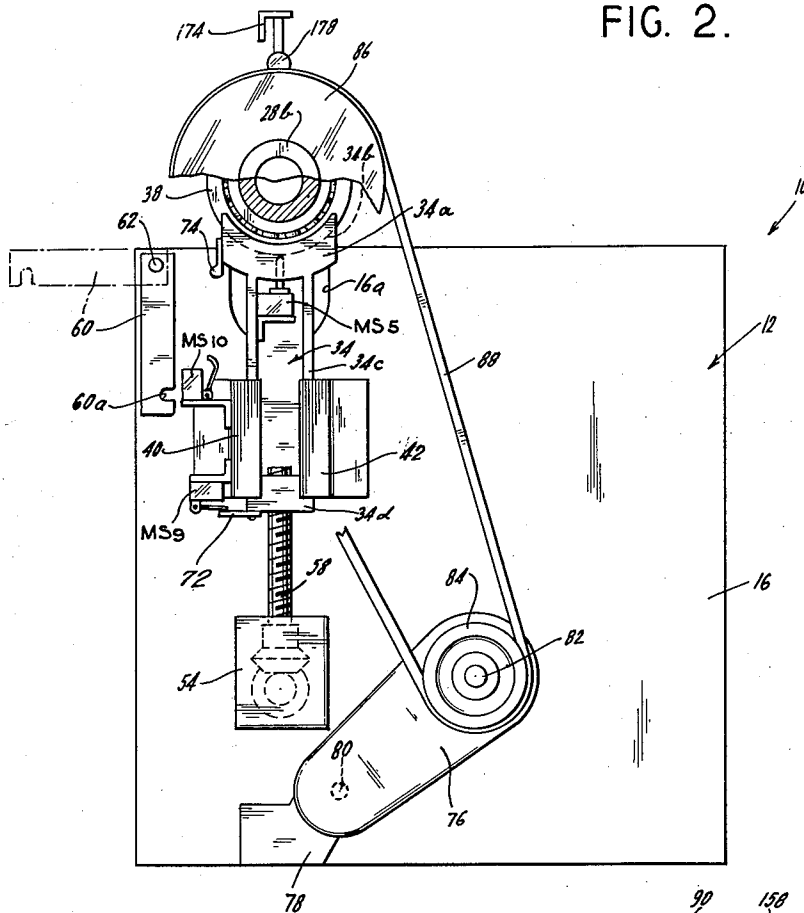


FIG. 3.

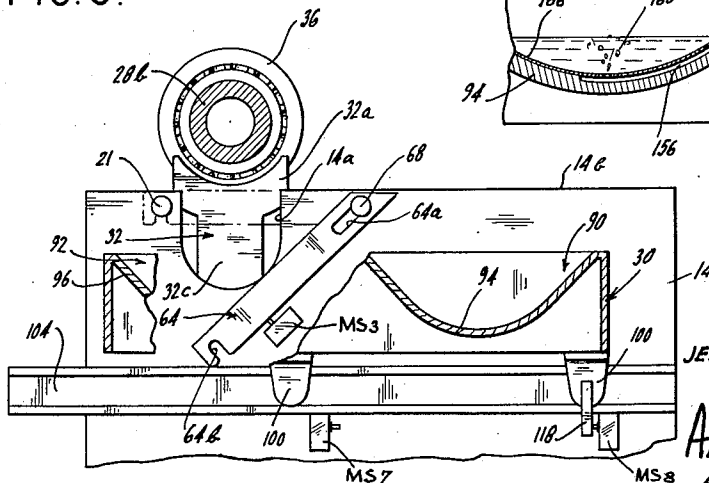
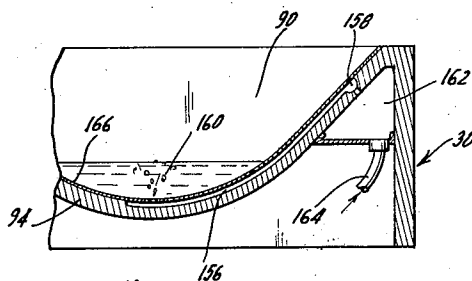


FIG. 4.



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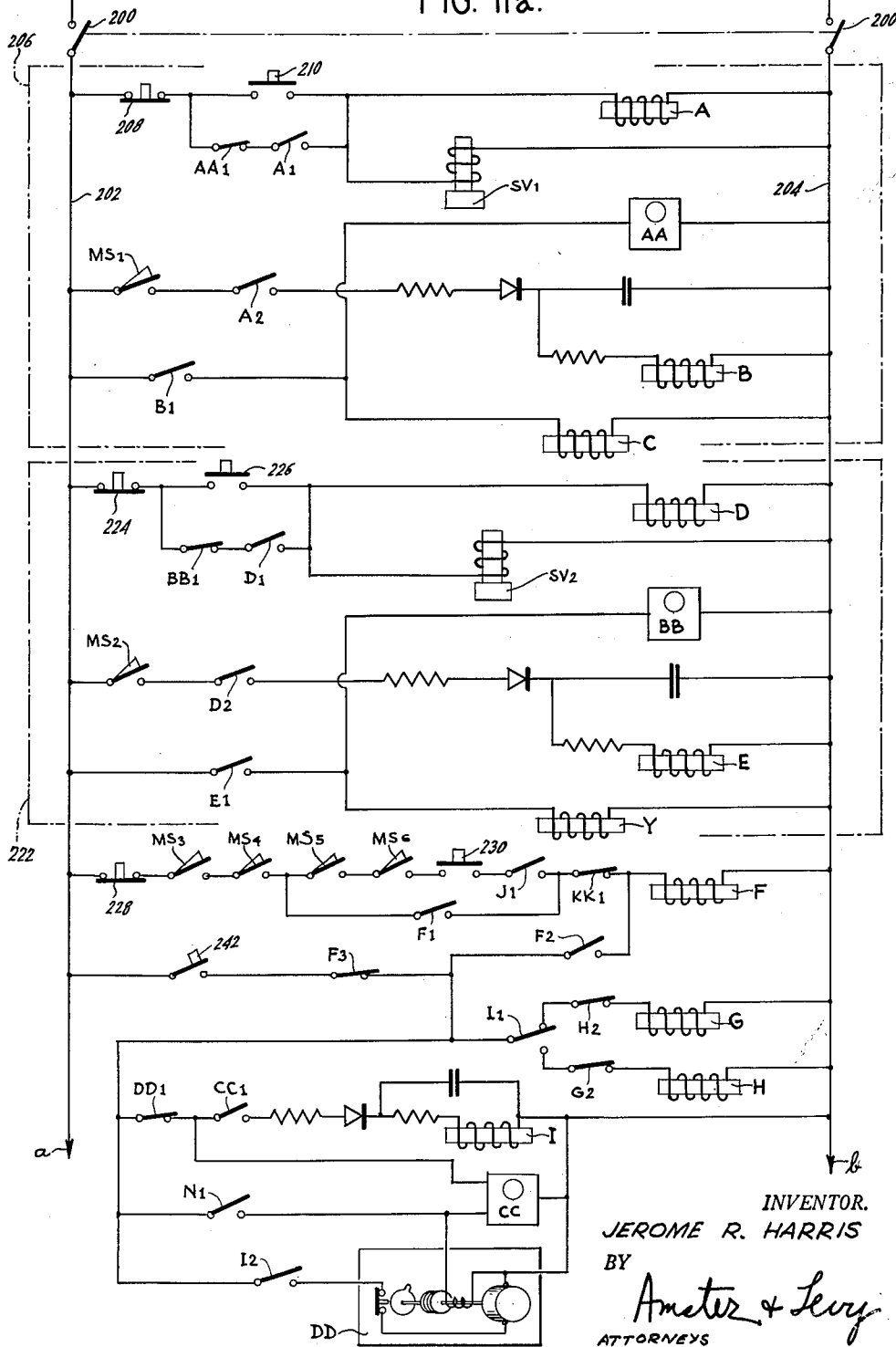
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FIG. 11a.

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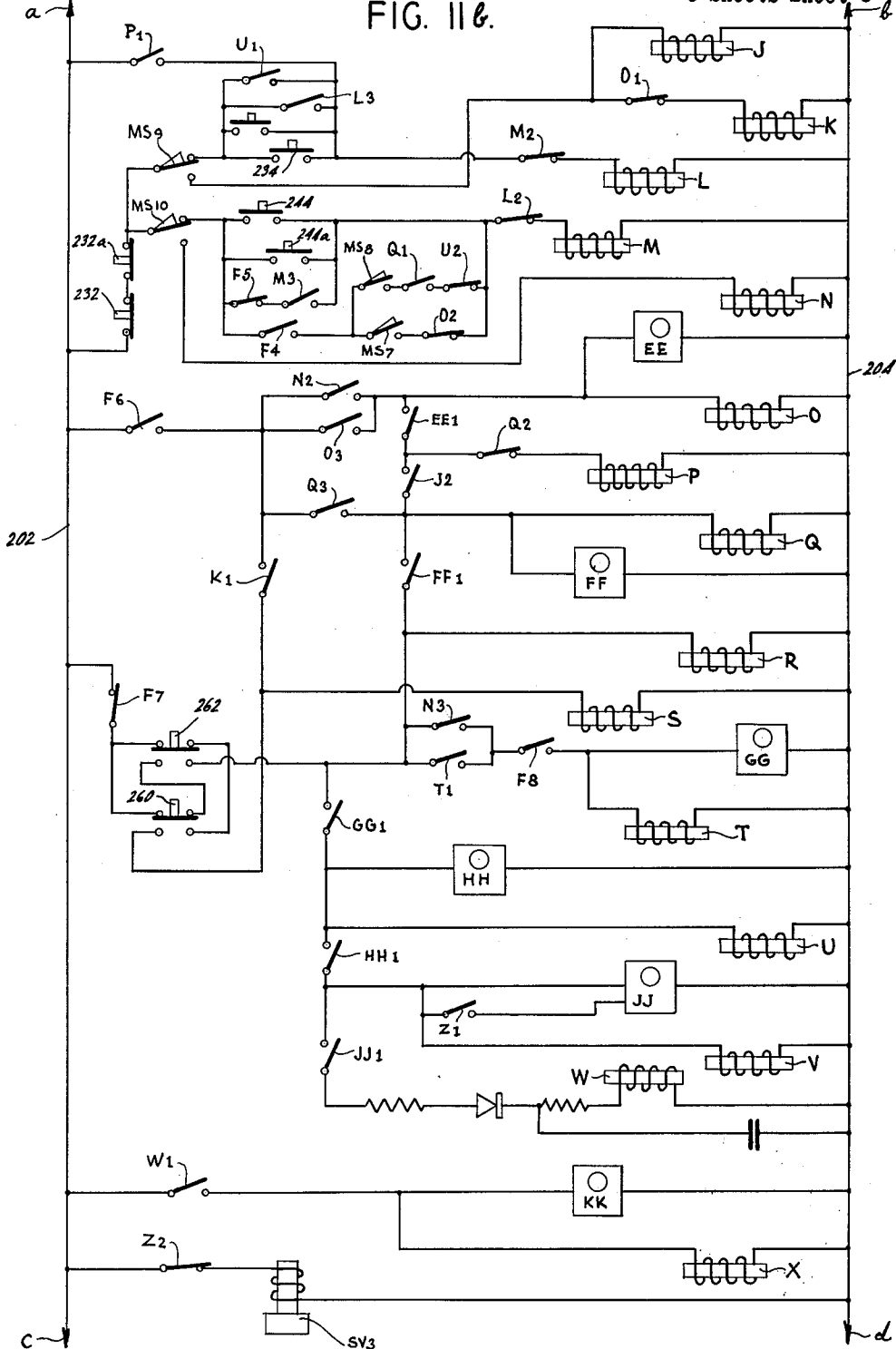
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ETCHING MACHINE

Filed March 19, 1959

FIG. 11b.

6 Sheets-Sheet 5



June 4, 1963

J. R. HARRIS
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3,092,123

Filed March 19, 1959

6 Sheets-Sheet 6

FIG. 11c.

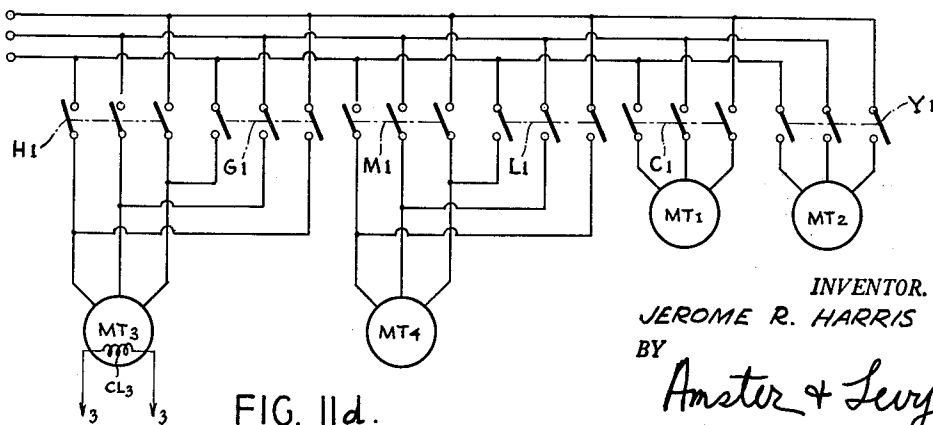
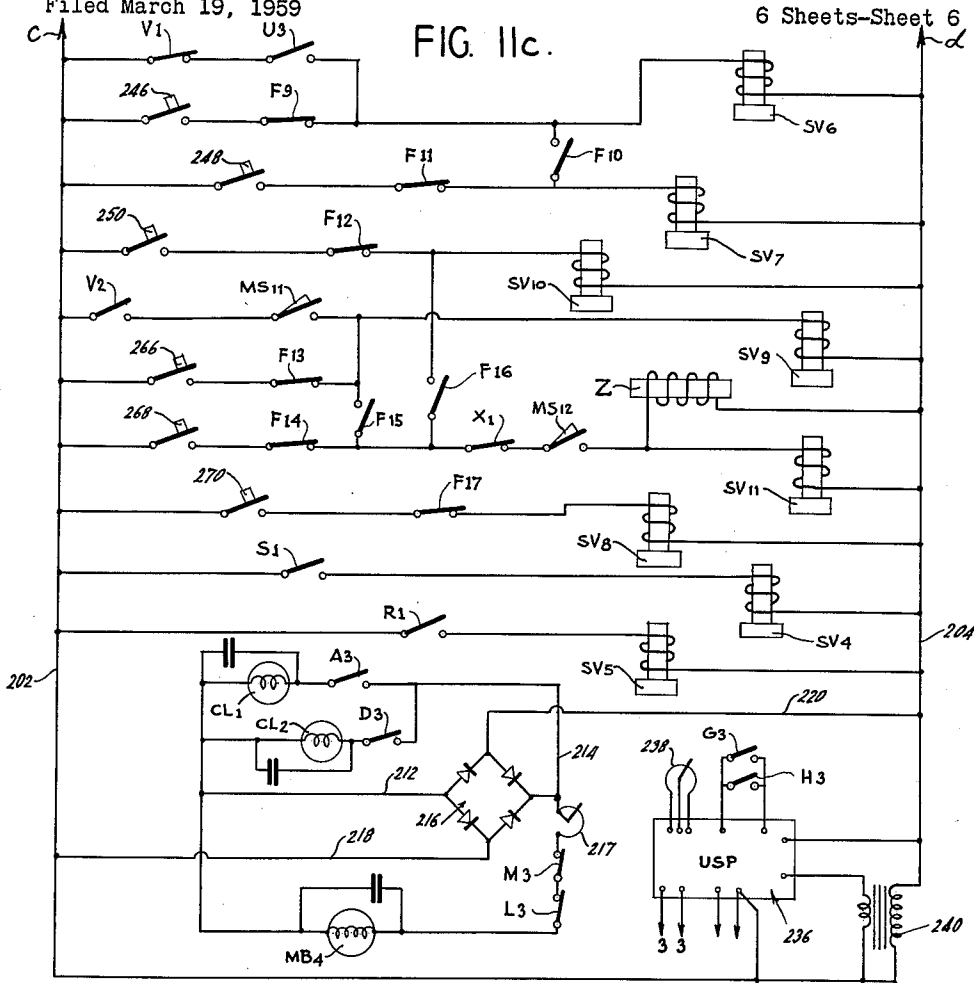


FIG. 11d.

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1

3,092,123

ETCHING MACHINE

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Filed Mar. 19, 1959, Ser. No. 800,439
16 Claims. (Cl. 134—61)

The present invention relates generally to etching apparatus, and in particular to an automatic etching machine suitable for the preparation of rotogravure printing cylinders and the like.

In the preparation of rotogravure printing cylinders, it is the usual practise after placing the resist onto the cylinder surface to rotatably mount the cylinder over an etching stand with provision for turning the cylinder on its axis. An etcher then proceeds with the use of etching acids of various Baumés to etch the cylinder to the degree required to complete the cylinder for printing. The etcher uses the acids of various Baumés in different sequences and in varying amounts and times to obtain the requisite surface properties to enable proper reproduction when the cylinders are used for printing. Such etching procedures, apart from being very time-consuming, requires the use of exceptionally skilled and trained personnel. Even with very highly skilled etchers, there often is substantial variation from cylinder; and it is difficult to reliably reproduce substantially the same quality of printed material although successive printing cylinders may be prepared from the identical copy.

Broadly, it is an object of the present invention to provide an apparatus for etching which obviates one or more of the aforesaid difficulties. Specifically, it is within the contemplation of the present invention to provide improved equipment making possible the substantial automatic etching of printing cylinders with the facility for maintaining and reproducing quality from cylinder to cylinder.

Conventionally, the resist for the printing cylinder used in the gravure process has been prepared with carbon tissues. The use of carbon tissue imposes certain practical limitations in the rotogravure process due to the inherent instability of the materials of the carbon tissues. Using essentially the same process and the same carbon tissue, it is difficult to reliably reproduce printing cylinders time after time, which in conjunction with the highly discretionary etching procedures which have been followed, has made it unfeasible to even attempt to establish a semi-automatic or automatic procedure for etching printing cylinders. However, in recent times, there has been introduced a new type of gravure etching resist which has found widespread application as a substitute for the well known carbon tissue used in the production of printing plates and cylinders for printing presses. Such gravure etching resist includes an emulsion layer of a fine grain presensitized orthochromatic gelatin, a stripping membrane in the form of a thin film which serves as a waterproof protective layer during successive laydowns of resist on the printing cylinders and is removed by a solvent prior to hot-water development, a film base support, and an antihalation backing which serves to counteract curling of the film. Such resist is usually exposed with low wattage incandescent lights and suitable filters to control contrast or density range. It has been found that with the use of such photographic gravure etching resist it is possible to prepare printed and photographic matter with the assurance of excellent reproduction over the entire tone scale. Thus there has been realized as a first step toward standardization of the preparation of rotogravure printing cylinders, the initial preparation of the photographic gravure resist which may then be developed and applied to the printing cylinder. Details of

2

improved equipment for automatic developing such photographic gravure etching resists are found in my co-pending application Serial No. 767,865, filed October 17, 1958, and entitled "Photographic Processing Equipment."

I have found that with appropriate standardization of the initial preparation of the printing cylinder, primarily the application of the photographic gravure resist thereto, it is possible to reliably etch printing cylinders without the need of processing with as many as four and five acids. In particular, with control over ambient conditions and standardization in the preparation of the resist-covered printing cylinder, it is possible to etch printing cylinders using only two acids, with the printing cylinder being exposed in accordance with the method and apparatus aspects of my invention.

In accordance with an illustrative embodiment demonstrating features and advantages of the present invention, there is provided a machine for etching printing cylinders which comprises a frame, carrier means on the frame adapted to engage and support the printing cylinder, an etching trough including first and second side by side wells, lateral guide means engaging and mounting the trough on the frame for side to side movement with the first well normally being disposed below the printing cylinder, means operatively connected to the carrier means for moving the carrier means vertically to lower and raise the printing cylinder relative to the wells such that the printing cylinder may be subjected to the action of the action of the etchants in the first and second wells, and means operatively connected to the trough for moving the trough horizontally to shift the second well to a position below the printing cylinder. Advantageously, my machine includes a control for coordinating the movement of the carrier means and the trough such that the first printing cylinder is lowered into the first well, raised from the first well and after shifting of the trough to position the second well below the printing cylinder, lowered into such second well.

In accordance with further apparatus aspects of the invention provision is made for rotatively supporting the printing cylinder, with a drive operatively connected to the printing cylinder for rotating the printing cylinder on its axis. After a first phase of the etching cycle, the drive is reversed to turn the printing cylinder in the opposite direction with a view to compensating for any irregularities in etchings which might occur incident to continuous rotation of the printing cylinder in one direction throughout the etching cycle.

The above brief description, as well as further objects, features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of presently preferred, but illustrative etching machine demonstrating apparatus of the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a front elevation view of an etching machine demonstrating features and aspects of the present invention;

FIG. 2 is an end elevational view of the machine, taken from the right of FIG. 1;

FIG. 3 is a fragmentary sectional view taken along the line 3—3 of FIG. 1, looking in the direction of the arrows, with part broken away and with the wash boom omitted in the instance of simplicity;

FIG. 4 is an enlarged fragmentary transverse section of a portion of the etching trough showing details of an illustrative air-bubbling system for agitating the etchants in the respective wells of the trough;

FIG. 5 is a sectional view taken substantially along the line 5—5 of FIG. 1, shown with the printing cylinder lowered into the No. 1 etching solution or acid;

FIGS. 6 to 10 inclusive are successive diagrammatic showing of the relationship between the printing cylinder and the etching trough during successive portions of a typical etching cycle wherein;

FIG. 6 shows the printing cylinder in position for movement of a cylinder truck onto run-up rails, with the final loaded position of the printing cylinder being shown by the dot dash lines;

FIG. 7 shows the printing cylinder in its raised position loaded on the carrier member, with the trough laterally shifted to a forward position wherein the No. 1 etching solution is positioned below the printing cylinder for exposure thereto;

FIG. 8 shows the immersion of the printing cylinder in the No. 1 etching solution;

FIG. 9 shows a time later in the cycle after the printing cylinder has been raised out of the No. 1 etching solution and the trough laterally shifted to a position wherein the No. 2 etching solution is beneath the printing cylinder with the printing cylinder being shown lowered into the No. 2 etching solution;

FIG. 10 is a diagrammatic view towards the end of the cycle wherein the printing cylinder is disposed above the No. 2 etching solutions, with the wash boom in place for cleaning off the cylinder to inhibit further etching action; and

FIGS. 11a, 11b, 11c and 11d is a schematic diagram of the overall control circuit for the present automatic etching machine.

Reference will first be made to FIGS. 1 to 5 inclusive of the drawings which show an etching machine, generally designated by the reference numeral 10, demonstrating features of the present invention which comprises a machine frame 12 including spaced opposite end walls 14, 16 carried on a bottom or base wall 18 and interconnected by cross rods 20, 22 having a cross brace 24 welded or otherwise secured thereto.

A cylinder carrier assembly, generally designated by the reference numeral 26, is adapted to support a printing cylinder 28 above a unitary etching stand or trough 30 for exposure of the body section 28a of the printing cylinder to first and second etchants contained in first and second wells of trough 30. The cylinder carrier assembly includes a pair of vertically movable standards 32, 34 mounted outwardly of the respective end walls 14, 16. The standards 32, 34 terminate at their upper end in bearing-seating yokes 32a, 34a, which respectively engage ball bearing mounts 36, 38 on the supporting shaft section 28b of the printing cylinder 28. The ball bearing mounts 36, 38 are assembled on the supporting shaft 28b in a preliminary operation, and when engaged in the respective bearing-seating yokes 32a, 34a on the vertically movable standards 32, 34, provide a means for journaling the printing cylinder 28 for turning movement on its axis, with the body section 28a thereof disposed over the etching stand or trough 30. As seen best in FIG. 1 the seats 32b, 34b formed in the upper arcuate faces of the yokes 32a, 34a are of a width substantially equal to the width of the ball bearing mounts 36, 38 for longitudinally orienting the printing cylinder 28 relative to the etching stand or trough 30, it being understood that ball bearing mounts 36, 38 are initially assembled in the required position to establish such orientation. The standards 32, 34 are mounted for vertical sliding movement on the outer faces of the end walls 14, 16 by identical structures and accordingly it will suffice to describe the vertical guideway for the standard 34. As seen in FIG. 2, the end wall 16 of the frame carries upstanding guide flanges 40, 42 which are spaced apart and cooperate to define a vertical guideway which receives the intermediate mounting section 34c of the standard 34. At its lower end the standard 34 is formed with a cross head 34d serving as the follower nut of a lead screw type raising and lowering mechanism, the standard 32 being

formed with a similar cross head 32d serving as a follower nut.

The lead screw raising and lowering mechanism, which is seen best in FIGS. 1 and 2, may be operated to lower and raise the printing cylinder 28 relative to the etching stand or trough 30 and includes a reversible motor MT3 which is mounted on the bottom wall or base 18 of the frame 12. The motor MT3 is a three phase squirrel cage type of motor with two sets of contacts arranged such that reversing of any two of the three power input leads will change the direction of the rotation of the motor, and as will appear from the description of the control circuit, includes an electric clutch CL3 and brake MB3 which facilitates the instantaneous starting and stopping of the raising and lowering mechanisms. Extending lengthwise of the machine and above the motor MT3 is a drive shaft 44 which is appropriately journaled on the end walls 14, 16 of the frame. Connected between the output shaft of the motor MT3 and the drive shaft 44 is a belt and pulley coupling which includes an output pulley 46 on the output shaft of the motor MT3, a drive pulley 48 on the drive shaft 44 and a belt 50 trained over the aligned pulley 46, 48. The pulley 48 may incorporate a slip clutch of well known construction to facilitate the effective decoupling of the motor MT3 from the drive shaft 44, if required. At its opposite ends the shaft 44 terminates in respective bevel gear housing 52, 54 fixed to the outer faces of the end walls 14, 16. The bevel gearing within the housings, which is illustrated by the dot-dash lines in FIG. 2 in the housing 54, includes one bevel gear fixed to the shaft 44 and a right angle bevel gear fixed to adjacent upstanding one of the lead screws 56, 58 which engage respectively the follower nuts or cross heads 32d, 34d on the standards 32, 34. Accordingly, upon drive of the motor MT3 in one direction, the standards 32, 34 will be simultaneously lowered; and in response to drive of the motor MT3 in the opposite direction, the standards 32, 34 will be simultaneously raised for the purpose of selectively positioning the printing cylinder 28 in relation to the etching stands or troughs 30.

In order to facilitate the loading of the printing cylinder 28 onto the cylinder carrier assembly 26, there is provided at the upper forward corner of each end wall 14, 16 a pivoted run-up rail (such as the rail 60 on the end wall 16) having a pivotal mount 62 such that the rail may be swung from the depending position shown in FIG. 2 by the full lines to the horizontal position shown in FIG. 2 by the broken lines. It is contemplated that the printing cylinder 28 will be moved to a loading position in front of the machine on a cylinder truck 198, as shown diagrammatically in FIG. 6. The cylinder truck carries a pin 198b engageable within the notch 60a formed in the run-up rail 60 such that the rail may be releasably secured in the horizontal position, bridging the gap between the machine frame and the cylinder truck. This enables the cylinder 28 to be rolled on its supporting shaft section 28b to a loading position wherein the respective ball bearing mounts 36, 38 are disposed above the bearing-seating yokes 32a, 34a of the standards 32, 34.

To enable the loading of the printing cylinder 28 onto the carrier assembly 26 and the vertical displacement thereof, the opposite end walls 14, 16 are provided with elongated cutouts 14a, 16a providing clearance for the respective opposite ends of the supporting shaft section 28b of the printing cylinder. The respective elongated cutouts are bridged by loading rails 64, 66 which are pivotally and slidably mounted at the inner side faces of the respective end walls 14, 16. Since the mounting and operation of the loading rails is identical, it will suffice to describe the mounting and operation of the loading rail 64 on the inner side of the end wall 14. As seen best in FIG. 3, the loading rail 64 is formed at one end with an elongated slot 64a engaged on a pivot pin 68 fixed

5

to the side wall 14, with the other end of the loading rail being provided with a notch 64b engageable on a pin 21 fixed to the end wall 14 to releasably secure the loading rail in a position straddling the elongated cut-out 14 and forming a substantial continuation of the upper edge 14b of the end wall along which the printing cylinder 20 is rolled during its unloading from the cylinder truck. The elongated slot 64a enables the loading rail to be retracted relative to the pin 70, such that the notch 64d may be engaged thereover and released therefrom. Obviously during the loading of the printing cylinder 28 onto the standards 32, 34 of the carrier assembly 26, such standards are in their lowered position, as shown diagrammatically in FIG. 6. With the printing cylinder properly in position, the standards 32, 34 are raised such that the yokes 32a, 34a engage the respective ball bearing mounts 36, 38 to lift the printing cylinder 28 to the raised supported position, illustrated in FIGS. 1 to 3 inclusive whereupon the loading rails 64, 66 may be moved to their respective retracted positions (see FIG. 3) wherein the cutouts 14a, 16a are unobstructed and permit the raising and lowering of the printing cylinder during the etching cycle.

As a protective measure, interlock switches are incorporated into the control circuit and associated with the loading rails, the cylinder carrier assembly and the raising and lowering mechanisms. Specifically, a rail position microswitch MS3 is positioned to be closed when the loading rail 64 is in its retracted or clearance position (see FIG. 3) and a similar rail-position microswitch MS4 is associated with the loading rail 66. The respective switches MS3 and MS4 are opened when the loading rails 64, 66 are in their horizontal or operative position and lock out automatic machine operation until such time as the rails are retracted to their respective clearance positions. These microswitches prevent circuit operation in the event that the operator inadvertently leaves either one of the loading rails in their operative horizontal positions and attempts to place the machine into its automatic cycle.

As a further precautionary measure, cylinder-position microswitches MS5 and MS6 are arranged respectively to be closed by the ball bearing mounts 38, 36 when the printing cylinder is properly supported on the standards 34, 32, the location of the microswitch MS5 being shown in FIG. 2. In the event of improper alignment of the printing cylinder and/or improper seating of the bearings 36, 38 on the standards 32, 34, these microswitches will preclude circuit operation until such improper positioning or seating of the printing cylinder 28 is corrected.

Still further, and as seen best in FIG. 2, there is provided a carrier raised-position microswitch MS9 which is closed when the carrier assembly 26 and the supported printing cylinder are in the raised position and a carrier lowered-position microswitch MS10 which is closed when the carrier assembly and the supported printing cylinder are in the lowered position for immersing the printing cylinder into the etching stand or trough 30. The carrier raised-position microswitch MS9 is closed by a switch actuating finger 72 carried by the cross head or follower nut section 34d of the standard 34 and positioned to engage the microswitch MS9. The yoke section 34a of the standard 34 carries a further switch actuating finger 74 which is positioned to engage and close the microswitch MS10 when the standard 34 is lowered. The interconnection of these interlocks as well as the previously described interlocks will be set forth in connection with the detailed description of the control circuit.

Operatively connected to the printing cylinder 28 is a turning mechanism which rotates the cylinder on its axis, first in one direction during a first phase of the etching cycle and then in the opposite direction in a second or final stage of the etching cycle. The turning mechanism, seen best in FIGS. 1 and 2, comprises a cylinder turning motor MT4 which is mounted on the base or bottom

6

wall 18 of the machine frame 12. The motor MT4 is a three-phase squirrel cage motor with two sets of contacts such that the reversing of any two of the three wires of the three phase input will change the direction of rotation of the motor. The output shaft of the motor MT4 is connected via a gear reduction unit 75 through a pair of intermediate belt and pulley couplings to a turning head 77 which is releasably secured to the cylinder supporting shaft 28b outwardly of the ball bearing mount 38. As seen best in FIG. 2, a belt and pulley housing 76 is rockably mounted on a bearing bracket 78 fixed to the machine frame and rocks by its own weight in the counter-clockwise direction about the axis of the output shaft 80 of the gear reduction unit 75 to tension the belt and pulley couplings in the various vertical positions of the printing cylinder and the turning head 77 supported thereon. Specifically, the output shaft 80 of the gear reduction unit 75 carries a pulley (not shown) within the housing 76 which pulley is coupled to a second pulley (not shown) within the housing 76, with the latter pulley being carried on an intermediate pulley shaft 82. The pulley shaft 82 further carries an intermediate pulley 84 which is aligned with a driven pulley 86 secured to or formed integrally with the turning head 77, with a belt 88 being trained over the aligned pulleys 84, 86. Accordingly, in response to drive of the motor MT4 in one direction or the other, the reduced speed output at the shaft 80 will be coupled via the belt and pulley coupling within the housing 76 and the further belt and pulley couplings 84, 86, 88 to the supporting shaft 28b for the printing cylinder 28 such that the printing cylinder will be driven in the appropriate direction. It will be appreciated that this drive can be continued throughout the entire etching cycle even when the printing cylinder is being raised or lowered since the rocking action of the pulley housing 76 about the rocking axis provided by the output shaft 80 of the gear reduction unit 72 enables the automatic tightening of the belt and pulley couplings in the various positions of the carrier assembly.

As seen best in FIGS. 4 and 5, the laterally shiftable etchant stand or trough 30 is seen to include a generally rectangular plastic body formed with two side by side wells 90, 92. Each of the wells includes a concave base wall 94, 96 of a curvature approximating the curvature of the printing cylinder with the opposite end walls of the wells being cutout as indicated at 98 to provide for clearance for the supporting shaft section 28b of the printing cylinder. The well 90 is adapted to receive a prescribed quantity of a first or No. 1 etching solution or acid, while the well 92 is adapted to receive a prescribed quantity of a second or No. 2 etching solution or acid.

Normally the etching stand or trough 30 is disposed within the lateral limits of the machine frame 12 (see FIG. 6) but is shiftable to a laterally offset position (see FIG. 5) wherein the well 90 for the first etchant is positioned for immersion of the printing cylinder 28, with the well 92 spaced forwardly of the machine frame. The trough is mounted for such sidewise shifting movement by a number of depending brackets 100 each of which rotatably journals a roller 102. Several rollers are provided at each end of the etching stand or trough 30, with the rollers being guidingly engaged in horizontally-extending guide flanges or rails 104, 106 fixed to the inner faces of the upstanding end walls, 14, 16.

A lateral shifting mechanism is operatively connected to the etching stand or trough 30 to periodically shift the same to a first etching position wherein the first etching well 90 is beneath the printing cylinder and then to a second etching position wherein the second etching well 92 is beneath the printing cylinder. Normally the second etching well 92 is beneath the cylinder, and as a first step in the automatic operation, the etching stand or trough 30 is shifted laterally from the starting position (see FIG. 6) to the first etching position (see FIG. 5). The lateral shift mechanism includes a double-acting air

piston and cylinder 108 which is mounted transversely of the machine frame 12 on the cross brace 24 beneath the etching stand or trough 20. The cylinder body 110 has appropriate air inlets at its opposite ends, with solenoid controlled valves SV4 and SV5 selectively controlling the admission of air to the cylinder body, as is generally understood. The piston rod 112, which is driven to the left in FIG. 5 upon admission of air via the solenoid controlled valve SV4 and is driven to the right in FIG. 5 upon admission of air via the solenoid controlled valve SV5, is coupled by a connecting head 114 to a depending arm 116 fixed to the trough 30. Accordingly, upon the selected admission of air to the double-acting piston and cylinder 108, the lateral shift of the etching standard trough 30 may be achieved. To this end the solenoid control valves SV4, SV5 are connected in the control circuit and as will be described achieve the lateral shifting as required during the automatic etching cycle.

As seen in FIG. 5, further interlocking microswitches are provided to indicate the respective etching positions of the etching stand or trough 30. Specifically a switch-actuating finger 118 is connected to the trough at one of the rear roller-supporting brackets 108 and first and second etching-position microswitches MS7, MS8 are fixed to the end wall 14 of the machine frame in position to be contacted and closed respectively by the switch-actuating finger 118 in the first and second etching positions.

As seen best in FIG. 1, respective etchant supply systems are provided for the first and second etching wells 90 and 92 of the etching trough or stand 30. Specifically, the first etchant supply includes a first positive displacement etchant pump EP1 which is connected to a pump motor MT1 via an electric clutch CL1. The etchant pump EP1 is connected via an etchant supply pipe 120 to storage or supply tanks (not shown) which is preferably located in the same room as the etching machine. The pump EP1 delivers the No.1 etchant under pressure via the outlet pipe 122 to an inlet head or nozzle 124 (see FIG. 5) which is located in the concave base wall 94 of the well adjacent to the upper end thereof. In the outlet pipe 122 there is provided a normally closed inlet valve 126 which is controlled by an air-operated double-acting piston and cylinder 128. With the piston rod 128a in the position illustrated in FIG. 1, the inlet valve 126 is closed and when the piston rod 128a is driven down downwardly due to the admission of air to the upper end of cylinder body 128b the valve is opened. The double-acting piston and cylinder 128 is selectively actuated by a solenoid-controlled three-way valve SV1 which is connected in the control circuit, as will hereinafter be described. An inlet valve position micro-switch MS1 is arranged to be closed when the piston rod 128a is in the position corresponding to the valve 126 being closed. The micro-switch MS1 opens in response to the opening of the inlet valve 126 and thereby provides an indication of the condition of the etchant inlet valve 126.

A substantially identical second etchant supply system is provided for introducing a prescribed quantity of the No. 2 etchant into the well 92 of the etching stand or trough 30. This system includes a second positive displacement etchant pump EP2 coupled via an electric clutch CL2 to a pump motor MT2, with the pump having an etchant supply pipe 130 connected to storage or supply tanks for the second etchant which deliver the second etchant via the inlet pipe 132 to an inlet nozzle or head 134 positioned adjacent the upper edge of the concave base wall 96 of the second well 92. A normally closed etchant inlet valve 136 is connected in the inlet pipe 132 and is controlled by a double-acting piston and cylinder 138 which is selectively actuated by a three way solenoid controlled valve SV2. An inlet valve-position microswitch MS2 is provided for the second inlet valve 136, with the switch MS2 being closed when the valve 136 is closed.

Drain means are connected respectively to the wells

90, 92 of the etching trough 30 which are arranged to enable the drain of the respective etching solutions to a drain line. Further, provision is made for connecting the respective wells to a catch or recovery tank 140 mounted at the rear of the machine frame (as seen in FIG. 5). Specifically, the drain 142 for the first or No. 2 etchant well 90 includes a drain pipe having a solenoid controlled valve SV6 connected in one leg or branch thereof for connecting the drain via a drain hose 144 to the catch or recovery tank 140 and a solenoid controlled valve SV8 in a second leg or branch thereof for connecting the drain via a further drain hose 146 to a drain line in the event that the solution or acid is not to be recovered. In a similar fashion, the drain 148 for the second or No. 2 etchant well 92 has one branch which is connected via a normally closed valve 154 to a drain hose 150 connected to the recovery or catch tank 140 and a second branch or leg which is connected via a solenoid controlled valve SV9 to a drain hose 150 connected to the main drain line. As seen in FIG. 5, a solenoid controlled valve SV7 is effected via a double acting piston and cylinder 152 to open the normally closed drain valve 154 connected in the branch from the drain 148 to the drain pipe 150, with the microswitch MS11 being closed when the valve 154 is closed. This system for the controlled connection of the drain of the No. 2 etchant well to the recovery tank 140 will be recognized as being identical to the inlet valves 126, 136 and their respective controls and position-indicating microswitches MS1, MS2. As will be explained in connection with the control circuit, it is important to provide an interlock for connection of the drain 148 to the catch tank 140 to preclude the inadvertent introduction of water into the catch tank, as might occur if the valve 154 were opened during the washing phase of the etching cycle.

Provision is made in each of the etching wells or tanks 90, 92 for the admission of air under pressure therein to bubble or agitate the respective etchants during the etching cycle. Identical arrangements are provided for the admission of air to the respective wells and accordingly it will suffice to describe in detail only the arrangement for the well 90, as shown best in FIG. 4. The well 90 along its length is formed with a number of side by side slit-like air passages 156 which communicate with each other along their upper ends via a common duct or passageway 158 formed longitudinally of the concave base wall 94 of the well 90. At their lower ends, each of the air passages 156 is provided with an outlet opening 160 such that air introduced into the upper ends of the passages may bubble into the etchant through the openings 160. A manifold 162 is provided in communication with the common duct or passageway 158, with an air inlet hose 164 being connected to the manifold for the introduction of air under pressure thereto. By the appropriate disposition of the slit-like passages 156 along the length of the well and the sizing of their respective outlet openings, it is possible to maintain the etchant in a bubbly condition which promotes the continuous replenishment of the etchant at the successive exposed surfaces of the printing cylinder 28 and also tends to remove the etching residue. The well base wall 94 is appropriately covered with a lining 166 of fibre glass or similar material which is laminated thereto to present a continuous well surface which is substantially impervious to attack by the etchant, with the laminated lining closing off and completing the respective passages 156. It will be appreciated that other arrangements are suitable for the introduction of air under pressure into the respective wells 90, 92.

Referring again to FIG. 1, there is shown a cylinder wash assembly, generally designated by the reference number 170, which includes a boom carrier bracket 172 secured to and projecting outwardly from the end wall 14 of the machine frame 12. Mounted at the upper end of the boom carrier bracket 172 is a boom arm 174

which has a pivotal mount 176 contiguous to its outer end, the boom arm extending lengthwise of the machine in its operative or horizontal position. Extending below the boom arm 174 is the water boom 178 which is of a length to be substantially coextensive with the printing cylinder 28 and is formed on its underside with a number of spray openings. Provision is made for introducing water into one end of the water boom 178 via a flexible supply pipe 180 which includes a first branch 182 adapted to be connected to a source of water and a second branch 184 adapted to be connected to a back drain. A solenoid controlled two-way water inlet valve SV11 is provided in the branch 182 to control the admission of water from the branch or line 182 to the supply pipe 180, while a solenoid controlled water drain valve SV3 is connected in the branch 184 to enable back draining of the water boom 178. The water boom 178 is movable from a substantially upright inoperative position (not shown) outwardly of the end wall 14 of the machine frame through a clockwise swing to a substantially horizontal operative position (FIG. 1) wherein the boom 178 is coextensive with and overlies the printing cylinder 28. The boom is moved from its substantially vertical inoperative position to its horizontal operative position by a boom actuating mechanism which includes a double-acting piston and cylinder 186 having a cylinder body 186a and a piston rod 186b. The cylinder body 186a has a pivotal mount 188 on the boom bracket 172, while the piston rod 186b has a pivotal coupling 190 to the extension of the boom arm outwardly of the pivotal mount 176. Air is selectively introduced into the double-acting piston and cylinder 186 via an air inlet hose 192 which is selectively connected through a four-way solenoid controlled valve SV10 with one branch 194 to the upper end of the cylinder body 186a and with another branch 196 to the lower end thereof. Accordingly, upon admission of air under pressure via the air inlet hose 192 and the branch hose 196 to the lower end of the double-acting piston and cylinder, the boom assembly is swung to the operative position shown in FIG. 1; and upon admission of air under pressure to the upper end of the cylinder body 186a via the branch hose 194, the boom assembly is moved to the retracted or inoperative position.

Preliminary to reference to the schematic control diagram of FIGS. 11a to 11d inclusive, reference will be made to FIGS. 6 to 10 inclusive for a brief description of the sequence of operations performed by the etching machine illustrated in FIGS. 1 to 5.

At the start of operations, the printing cylinder 28 is brought to a position in front of the machine frame 12 by the cylinder truck or cart 198. The upper supporting edges 198a of the truck or cart supports the respective oppositely directed shaft sections 28b of the printing cylinder 28, such that the printing cylinder may be rolled from the cart onto the upper supporting edges 14b, 16b of the end walls of the machine frame, with the run-up rails 60 and the loading rails 64, 66 facilitating the positioning of the printing cylinder 28, as shown by the dotted line in FIG. 6, to be engaged and lifted by the respective vertically movable standards 32, 34. It will of course be appreciated that this manner of loading is merely illustrative and in some instances overhead cranes will be used to transport the printing cylinders to a position for engagement and support in the etching machine. The operator then places the carrier assembly 26 into operation to lift the printing cylinder 28 to the elevated clearance position, as shown in FIG. 7, wherein the loading rails 64, 66 may be dropped to clear the machine for operation, the cart or 198 being likewise moved away. When the machine is placed into operation, as may be appreciated by progressively inspecting FIGS. 6 and 7, the trough 30 shifts laterally in a forward direction to bring the well 90 for the No. 1 etchant beneath the supported printing cylinder. Thereupon the printing cylinder is lowered into the well 90, as may be appreciated

by progressively inspecting FIGS. 7 and 8. After a prescribed time interval in the No. 1 etchant, the carrier assembly lifts the printing cylinder to the clearance position (e.g. the FIG. 7 position) whereupon the trough 30 shifts laterally rearwardly to bring the No. 2 etchant well 90 beneath the printing cylinder. When the trough is repositioned, the carrier assembly 26 lowers the printing cylinder into the second etchant, as is seen in FIG. 9, it being understood that the printing cylinder moves to the FIG. 7 position intermediate the positions illustrated respectively in FIGS. 8 and 9. After a prescribed time in the second etchant, the carrier assembly lifts the printing cylinder to its elevated position whereupon the wash boom 178 is brought to its horizontal position coextensive and over the printing cylinder for a wash interval, as shown diagrammatically in FIG. 10.

Referring now specifically to FIGS. 11a, 11b and 11c there is shown the overall schematic diagram for my improved automatic printing cylinder etching machine, the motor energization circuitry being shown in FIG. 11d. The control circuit is energized from an appropriate source of alternating current over a double pole single-throw main control switch 200 to the A.C. control lines 202, 204. Connected across the lines 202, 204 is a No. 1 etchant supply control generally designated by the reference numeral 206, which may be placed into operation prior to the automatic machine cycle to introduce a prescribed quantity of the No. 1 etchant into the well or tank 90. The control 206 includes a normally closed stop push button 208 connected in series with a normally open start push button 210 and the energization coil of a relay A. The relay A includes a holding circuit shunting the start-push button 210, which holding circuit includes the relay contact A1 in series with the normally closed contact AA1 of the first etchant supply timer AA. Simultaneous with the energization of the relay A, the solenoid controlled valve SV1 is activated which via the double-acting piston and cylinder 128 opens the normally closed etchant supply inlet valve 126 for introduction of the etching solution into the No. 1 tank. In response to opening of the valve 126, the valve-position microswitch MS1 is closed to complete the energization circuit for the slow release relay B, this circuit having been previously conditioned by energization of the relay A and the closing of the contact A2 in series with the microswitch MS1. When the relay B is energized, the contact B1 closes to connect the relay C across the line which via its contact C1 (see FIG. 11d) energizes the pump motor MT1 for the first etchant supply system. As seen in FIG. 11c the coil for the clutch CL1, which couples the motor MT1 to the fixed displacement pump EP1, is energized from a full wave rectifier 216 which has its output leads 212, 214 connected across the clutch CL1 which is in series with a normally open relay contact A3, the latter being closed to condition the circuit in response to closing of the relay A. The full wave rectifier 216 is connected across the lines via the leads 218, 220. Since the fixed displacement pump will pump a prescribed quantity of the first etchant in accordance with the setting of the timer AA an accurate means is provided for controlling the admission of the No. 1 etchant to the well 90. After the timer AA times out, the normally closed contact AA1 in the holding circuit for the relay A opens and via contact A2 deenergizes the relay B after the time delay of relay B. When relay B is deenergized, contact B1 reopens and recycles the timer AA and deenergizes the pump motor MT1 for the No. 1 etchant pump EP1 via the contact B1. The provision for slow release in the relay B assures that relay A will drop out by opening of the contact AA1 before the timer AA is reset for the next cycle whereupon the contact AA1 is closed.

A No. 2 etchant supply control, generally designated by the reference numeral 222, is provided for introducing a prescribed quantity of the No. 2 etchant into the

well or tank 92. This control is identical to the control 206 and includes a normally closed stop push-button 224, a normally open start push-button 226 in the energization circuit for the relay C. The relay C includes a holding circuit shunting the start-push button 226 which holding circuit includes the relay contact D1 in series with the normally closed contact DB1 of the second etchant supply timer BB. Simultaneous with energization of the relay B in response to the depression of the start push-button the solenoid controlled valve SV2 is activated which via the double acting piston and cylinder 138 opens the normally closed etchant supply inlet valve 136 for introducing the etching solution into the No. 2 tank. In response to opening of the valve 136, the valve position microswitch MS2 is closed to complete the energization circuit for the slow release relay E, this circuit having been previously conditioned by energization of the relay D and closing of the contact D2 in series with the microswitch MS2. When the relay E is energized, the contact E1 closes to connect the relay Y across the line which via its contacts Y1 (see FIG. 11d) energizes the pump motor MT2 for the second etchant supply system. As seen in FIG. 11c, the coil for the clutch CL2, which couples the pump motor MT2 to the fixed displacement pump EP2 is energized previously in response to closing of the contact D3 of the relay D. In response to the closing of the contact D1 the timer BB which establishes the interval during which the fixed displacement pump EP2 is effective to supply the No. 2 etchant to the tank 92 begins its timing function. When the timer BB times out the circuit is reset as previously described in connection with the control 206.

Reference will now be made to the automatic cycle control which is seen to include a stop push-button 228 and a start push-button 230 in series with a relay F and the interlock microswitches MS3, MS4, MS5, and MS6, as well as the normally open contact J1 of the relay J. The microswitches MS3 to MS6 inclusive are closed when the loading rails are in their respective retracted positions and the cylinder is properly cradled in the carrier assembly. The contact J1 closes to complete the energization circuit for the relay F when relay J (see FIG. 11b) is energized. Relay J is connected across the lines via a stop push-button 232 (its remote counterpart 232a) and the microswitch MS9 when transferred. Microswitch MS9 transfers when the carrier assembly is in the raised position to complete the energization circuit for the relay J and in the event that the relay J is not so energized the operator depresses the raise-carrier push-button 234 in series with the microswitch MS9 in its untransferred position to elevate the carrier assembly and the printing cylinder preliminary to the automatic cycle. With the relay J energized, the contact J1 completes the energization circuit for the relay F which immediately places into operation the automatic turn mechanism for the printing cylinder. The automatic turn mechanism includes a relay G which connects the turn motor MT3 across the lines via the contact G1 to turn the motor in one direction and a relay H having contacts H1 for connecting the motor MT3 across the line to turn in the opposite direction. The motor is connected to a conventional variable speed drive 236 having a speed control potentiometer 238, with the variable speed drive being connected across the lines via the power transformer 240. The clutch CL3 for the motor MT3 is energized in response to closing of either of the contacts G3, H3. The relays G and H are energized in alternation over the transferable contact I1 over the closed conditioning contact F2 of the relay F, with the relays G and H having respective lockout contacts G2, H2 in their associated circuits.

Contact I1 is transferred under the control of two conventional timers CC and DD each of which timers includes an internal clock motor which after a prescribed time interval achieves an external control function. When

the lockout contact F2 closes the timer CC starts its timing interval, receiving its power via the normally closed contact DD1 of the timer DD. When the timer CC times out it closes its normally opened contact CC1 to complete an energization circuit for a slow release relay I which immediately transfers its contact I1 to de-energize the relay G and stop the motor MT3 through its contact G1, with the variable speed clutch coupling being deenergized via the contact G3. Relay H is then energized over the transferred contact I1, starting the motor MT3 in the reverse direction through contact H1, with the reenergization of the variable speed clutch through the contact H3. Further, relay I via contact I2 starts the timer DD which after it times out opens the relay DD1 to reset the timer CC, resetting of the timer CC opens the contact CC1 which in turn disrupts the energization circuit for the slow release relay I, with the relay I allowing for the timer CC to be reset before relay I drops out. When relay I finally drops out, contact I2 opens, resetting the timer DD which in turn closes the contact DD1 and again repeats the timing cycle via the timer CC. As will be described hereinafter, the normally opened contact end N1 serves as a lockout for precluding reversal of the turn direction of the printing cylinder at such times during the operating cycle when the printing cylinder is in the raised position above the etching stand or trough 30, since during the periods of transfer it is important that the cylinder continue to rotate in the same direction to maintain on the surface thereof a substantially fixed quantity of the No. 1 etching solution.

Returning now to the automatic cycle, simultaneous with the energization of the relay J (FIG. 11b), the relay K is energized over the transferred microswitch MS9 which remains in the requisite position to complete the energization circuits for the relays J, K when the carrier assembly is in the elevated position. Upon energization of relay K, the contact K1 closes in order to condition the circuit for energization of the relay S which is effective to shift the etching stand or trough 30 into the No. 1 etching position for exposure of the printing cylinder to the No. 1 etchant in the well 90. As will subsequently be described, relay K and contact K1 are opened at a prescribed time in the cycle upon energization of the relay O and opening of the contact O1 to serve as a lockout.

Energization of the relay F opens a number of relay contacts associated respectively with the push button controls to preclude manual operation of the machine and also closes a number of other contacts for the purpose of conditioning certain circuits for operations. Specifically, contact F6 (FIG. 11b) is closed which completes an energization circuit via closed contact K1 of the relay K for the relay S. The relay S includes a contact S1 (FIG. 11c) which connects the solenoid-controlled valve SV4 across the lines 202, 204. As seen in FIG. 5, energization of the valve SV4 introduces air under pressure to the right end of the double-acting piston and cylinder 108 which is effective to shift the etchant trough 30 laterally to the No. 1 etching position illustrated in FIG. 5 wherein the well 90 for the No. 1 etchant is positioned to receive the printing cylinder 28. When the etching stand or trough 30 arrives at the laterally-shifted position shown in FIGS. 5 and 7, the first etching-position microswitch MS7 is closed to indicate the positioning of the etching stand for the first immersion of the printing cylinder 28. As seen in FIG. 11b, the first etching-position microswitch MS7 is connected in a series energization circuit for the relay M which energization circuit includes the normally closed stop push button 232, and its remote counterpart 232a, the untransferred carrier-lowered position microswitch MS10, the closed conditioning contact F4 of the relay F, the now closed microswitch MS7, the lockout contact O2 and the lockout contact L2. Upon energization of the relay M, the

motor MT4 (see FIG. 11d) of the carrier raising and lowering mechanism is connected across the three phase line via the stator contacts M1 for rotation of the motor in a direction appropriate to lower the carrier assembly 26 for immersing the printing cylinder into the No. 1 etchant in the first well or tank 90. It will be appreciated that provision is made for the manual lowering of the carrier assembly by a secondary energization circuit for the relay M via the untransferred carrier-lowered position microswitch MS10, the normally open carrier-lowering push button 244 (and its remote counterpart 244a) and the normally closed lockout contact L2. Relay M locks across the line via conditioning contact F5 and holding contact M3 shunting the push button 244. The lockout contact L2 precludes energization of the relay M when the relay L for the carrier-raising mechanism is energized and conversely the lockout contact M2 precludes energization of the relay L. When the carrier-lowering push button 244 is depressed and the relay M is energized, the contact M3 which is connected in series with the normally closed contact F5 is closed which completes the holding circuit for the relay M, which holding circuit is disrupted when the microswitch MS10 transfers to indicate that the carrier assembly has reached the lowermost limit of its travel as established by the positioning of the microswitch MS10. It will of course be appreciated that the provision for manual lowering of the carrier assembly via depression of the normally open push button 244 is effectively locked out by the opening of the normally closed contact F5 of the relay F which is energized during the automatic etching cycle. Further and in order to accurately establish the raised and lowered positions of the cylinder carrier assembly 26, the motor MT4 of the raising and lowering mechanism is provided with a direct current electric brake MB4 (FIG. 11c) which is connected in the output leads 212, 214 of the full wave rectifier bridge 216. The brake MB4 is connected in a series circuit including the contacts M3, L3 and a brake-setting potentiometer 217. Contacts M3, L3 are normally closed and accordingly a braking force, determined by the setting of the potentiometer 217, is applied to the motor MT4. When the motor is placed in operation for either the raising or lowering motion, depending upon the energization of the relays L and M respectively, the associated contact L3, M3 is opened to remove the braking force.

Returning now to the automatic sequencing, the closing of the first etching position microswitch MS7 causes the relay M to energize which connects the motor MT4 to the line via the contacts M1 in a direction appropriate to lower the carrier assembly 26 and the printing cylinder 28 into the No. 1 etchant. When the carrier assembly reaches its lowered position, the carrier-lowered microswitch MS10 transfers to complete an energization circuit for the relay N and simultaneously deenergizes the relay M which stops the carrier raising and lowering motor MT4, and applies the brake MB4. Energization of the relay N closes the contact N2, which via the closed conditioning contact F6, connects the first etching timer EE across the lines for initiating the timing of the immersion of the printing cylinder 28 in the first or No. 1 etching solution. Closing of the contact N2 also completes an energization circuit for the relay O which as previously indicated includes a normally closed lockout contact O1 in the energization circuit for the relay K. At this time the lockout contact O1 is opened to preclude energization of the relay K until such time as the entire machine cycle is completed. Further the relay O includes the normally closed contact O2 in the energization circuit for the relay M which also precludes energization of the relay M over the circuit including the first etching-position microswitch MS7. Still further, the relay O includes a normally open contact O3 shunting the contact N2 of the relay N which provides a holding circuit for the timer EE since such timers are

connected in cascade and the circuit is arranged such that the timers should not drop out or be reset incident to the raising and lowering of the printing cylinder between immersions in the first and second etching solutions.

After timing out of the first immersion timer EE, which may be of the order of 12 to 15 minutes, its contact EE1 closes to complete an energization circuit for the relay P over the lockout contact Q2. Relay P includes a normally-open contact P1 which via the lockout contact M2 connects the relay L across the line. Energization of the relay L connects the motor MT4 across the three phase line via the stator contacts L1 which is effective to cause the carrier assembly 26 to move from the lowered position toward the raised position. When the carrier assembly 26 arrives at the raised position, the carrier raised-position microswitch MS9 transferred to energize the relay J which will initiate the next phase of the automatic operation which is recalled to be the transfer of the etching stand or trough to the second or No. 2 etching position wherein the well 92 containing the No. 2 etching solution is beneath the printing cylinder. During this phase of the operation, relay K is not energized since the lockout contact O1 of relay O is opened and precludes energization of the relay K over the circuit provided by the transferred microswitch MS9. However, energization of the relay J has closed the normally opened contact J2 which open closing of contact EE1 energizes the relay Q and the first drain interval timer FF. Energization of the relay Q closes the contact Q3 to lock the relay Q across the line, opens the lockout contact Q2, in the circuit of relay P and closes the contact Q1 to condition the energization circuit for relay M containing the closed conditioning contact F4, the opened second etching-position microswitch MS8, and the lockout contacts Q2, L2. Accordingly, upon transfer of the etching stand or trough to the No. 2 etching position, as shown diagrammatically in FIG. 9 and as indicated by the closing of the second etching-position microswitch MS8, as will subsequently be described circuits will be conditioned for lowering of the carrier assembly to immerse the printing cylinder into the second or No. 2 etchant in the well 92. After the drain interval timer FF times out, the contact FF1 closes to connect the relay R across the line. Energization of the relay R closes its contact R1 (see FIG. 11c) which completes the energization circuit for the solenoid controlled valve SV5 which admits air under pressure to the left end of the cylinder body 110 of the double-acting piston and cylinder 108 (see FIG. 5) which drives the etching stand or trough laterally to the right in FIG. 5 to bring the well 92 containing the No. 2 etchant beneath the printing cylinder. When the etching trough 30 reaches the second etching position the microswitch MS8 will be closed when contacted by the actuating finger 118 which completes the energization circuit for the relay M as aforesaid and activates the motor MT4 via its stator contacts M1 to lower the cylinder carrier assembly to immerse the printing cylinder into the No. 2 etching solution. When the carrier assembly reaches its lowered position, the actuating finger 74 on the standard 34 will contact and transfer the carrier lowered-position microswitch MS10 which interrupts drive to the motor MT4, with the carrier assembly in the lowered position. Transfer of the carrier-lowered position microswitch MS10 completes an energization circuit for the relay N which closes relay contact N3 in the energization circuit for the second etchant immersion interval timer GG. The timer GG is connected across the line via the closed contact FF1 of the drain interval timer FF, the contact N3, and the conditioning contact F8 of the energized relay F. Further, relay T is energized which closes its contact T1 and connects the timer GG across the line until such time as the control circuit is reset. After the prescribed immersion time in the second etching solution, which may be of the order of 12 to 15 minutes, the timer GG times out and closes its contact GG1 to connect the second

drain interval timer HH across the line to establish the requisite drain period over the second etching well or trough 92. It will of course be appreciated that in certain cases it may not be necessary to provide for one or both of the drain interval timers FF and HH and these may be eliminated by merely eliminating the timers and their respective normally-open contacts FF1 and HH1. Simultaneous with the energization of the second drain interval timer HH, the relay U is energized which via the contact U1 completes an energization circuit for the relay N over the untransferred carrier raised position micro-switch MS9, the contact U1 which shunts the carrier raising push button 234 and its holding contact L3, and the lockout contact M2. Energization of the relay L connects the motor MT4 of the carrier raising and lowering mechanism across the line via the stator contact L1 to raise the cylinder carrier assembly 26 to the elevated position above the second etching well 92, as shown diagrammatically in FIG. 10, for the second drain time interval.

Further, energization of the relay U closes the contact U3 (FIG. 11c) which connects the solenoid controlled valves SV6 and SV7 across the line for their respective control function. Specifically, the solenoid controlled valve SV6 directly connects the drain 142 from the well 90 for the No. 1 etching solution to the catch tank via the drain hose 144. The solenoid controlled valve SV7 operates the double-acting piston and cylinder 152 which opens the drain valve 154 for connecting the drain 148 for the well 92 for the No. 2 etching solution to the catch tank 140 via the drain hose 152. With respect to the drain controls, it is noted that the contact F10 is closed during the automatic cycle such that closing of the contact U3 is effective to open and operate the respective drain systems for the first and second wells 90, 92. Provision is made for connecting the No. 1 etchant well 90 to the catch tank 44 manually by a switch 246 which is connected via a lockout contact F9 to the coil of the valve SV6. Similarly switch 248 is connected in a series energization circuit for the coil of the valve SV7, with the energization circuit including the lockout contact F11. Accordingly, at any time other than during the automatic cycle when the respective lockout contacts F9, F11 are opened, the operator may close either of the switches 246, 248 to connect the associated well to the catch tank 144 for draining the contents thereof.

Returning to the automatic operation, after the second drain time interval timer HH times out, contact HH1 closes to initiate operation of the timer JJ which is identical in construction to the timers CC, DD employed in the control for the turning mechanism of the printing cylinder. Simultaneous with the energization of the timer JJ, the relay V is likewise energized which opens the contact V1 (see FIG. 11c) in series with contact U3 in the energization circuit for the solenoid controlled valves SV6, SV7 which closes the drain connection from the respective wells 90, 92 to the catch tank. The closing of the drain valve 154 for the well 92 of the No. 2 etchant is signalled by the closing of the drain valve-position micro-switch MS11 which is connected in a series circuit with the contact V2 of the relay V and the solenoid controlled valve SV9 for connecting well 92 to the drain pipe 150. Only upon energization of the relay V and signalling via the closing of the microswitch MS11 that the drain connection to the catch tank is closed, will the circuit be completed for connecting the well 92 to the drain. This avoids the possibility of inadvertently draining the contents of the well 92 (which receives water during the washing phase of the automatic cycle) into the catch tank.

Closing of the microswitch MS11 also completes an energization circuit for the solenoid controlled valve SV10 of the double-acting piston and cylinder 186 of the boom lowering and raising control for the cylinder wash assembly 170. The energization circuit for the valve SV10 is completed via the closed contact V2, the closed micro-

switch MS11 and the closed lockout contacts F15, F16. provision is likewise made for the manual operation of the boom lowering and raising control by a switch 250 which is connected via the lockout contact F12 of the relay F to the solenoid coil of the valve SV10. Accordingly, when not in the automatic cycle, closing of the switch 250 will enable the operator to lower the boom into the operative or horizontal position illustrated in FIG. 1.

Returning again to the automatic operation, the lowering of the boom to the horizontal or operative position shown in FIG. 1 will close the boom-position microswitch MS12. As seen in FIG. 11c, the boom-position micro-switch MS12 completes an energization circuit for the solenoid controlled water inlet valve SV11, the energization circuit including the closed contact V2, the closed microswitch MS11, the lockout contact F15, the normally closed contact X1 of the relay X, and the closed boom-position microswitch MS12. Simultaneous with the energization of the water inlet valve SV11 the relay Z is energized which via the contact V2 (FIG. 11b) closes the normally energized and opened back drain valve SV3. The solenoid controlled back drain valve SV3 is normally connected across the line via the normally closed contact Z2, such that the drain valve SV3 remains opened for so long as the boom is in the upright or retracted position. Only when water is admitted to the water inlet pipe 180 via the water inlet valve SV11 (and when the boom is down as signalled by the closing of the microswitch MS12), is the back drain valve SV3 allowed to close.

Further energization of the relay Z via the contact Z1 (FIG. 11b) initiates the operation of the wash or spray interval timer JJ which is set to establish a prescribed wash time interval for the boom over the second etching well 92, with the drain water from the printing cylinder being caught in the well and passed to the main drain via the opened drain valve SV9. When the wash and spray timer JJ times out, its contact JJ1 closed to complete an energization circuit for the slow release relay W. Energization of the relay W, closes the contact W1 which connects a water drain interval timer KK across the line. The timer KK includes a normally closed contact KK1 in the energization circuit for the relay F (see FIG. 11a). Simultaneous with the energization of the timer KK and in response to the closing of the contact W1, the relay X is energized. Energization of this relay X opens the contact X1 (see FIG. 11c) which disrupts the energization circuit for the water inlet valve SV11 which shuts off the water supply to the boom and also deenergized relay Z which again opens the back drain valve SV3 by closing contact Z2. Finally, when the timer KK times out, the contact KK1 opens and the energization circuit for the relay F is disrupted which deenergizes the relay F and recycles the control for the next automatic sequence of operations.

As shown in FIG. 11b, a manual push button control is provided for selectively positioning the etching trough or stand 30 in the first or second etching positions. Specifically, a normally open push button 260 is connected via lockout contact F7 to the line 202 and via a further lockout contact provided by the push button 262 to the relay S which relay is effective to laterally move the etching stand 30 into the first or No. 1 etching position. In the event that someone accidentally depresses the push button 262 while also depressing the push button 260, the energization circuit will not be completed for the relay S. In a similar fashion, the push button 262 when depressed provides an energization circuit over the push button 260 and the lockout contact F7 for the relay R which is effective to laterally displace the etching stand to the second or No. 2 etching position.

As seen in FIG. 11c, provision is made for manually opening the drain valve SV9 for the well 92 for draining the second etchant. This is achieved by a drain valve switch 266 connected in a series circuit with the lockout

17

contact F13 for connecting the solenoid control valve SV9 across the line. During the automatic cycle of operation the switch 266 is locked out by opening of the contact F13.

Still further provision is made for the manual washing of printing cylinder by a circuit (FIG. 11c) including a water spray switch 268 connected over the lockout contact F14, the normally closed relay contact 1, and the boom-position microswitch MS12 to the water inlet boom control valve SV11. This manual control is locked out until such time as the boom is in the horizontal or operative position by the microswitch MS12 and is completely locked out of the circuit during the automatic operation by opening of the lockout contact F14.

Still further, provision is made for opening the drain valve SV8 of the well 90 for the first etching solution. As seen in FIG. 11c, the drain opening switch 270 is connected in series with a lockout contact F17 to the solenoid control valve SV8. Whenever the operator desires, the switch 270 may be closed to drain the well 90, it of course being understood that the lockout F17 precludes such drain during the automatic cycle.

What I claim is:

1. A machine for etching printing cylinders comprising a frame, a unitary trough member mounted on said frame and having side by side wells adapted to contain quantities of first and second etchants respectively, a carrier member adapted to support a printing cylinder above said trough member, means for turning said printing cylinder on its axis, means operatively engaging and mounting one of said members for vertical movement relative to the other of said members such that said printing cylinder may be subjected to the action of said etchants, raising and lowering mechanisms operatively connected to the vertically movable member for effecting vertical movement thereof relative to the other member, means operatively engaging and mounting said other member for lateral movement relative to said vertically movable member such that said printing cylinder may be subjected in succession to the action of said first and second etchants, shifting mechanisms operatively connected to the laterally movable member for effecting lateral movement thereof relative to the vertically movable member, and means for coordinating said raising and lowering mechanisms and said shifting mechanisms.

2. A machine for etching printing cylinders comprising a frame, a unitary trough member mounted on said frame and having side by side wells adapted to contain quantities of first and second etchants respectively, a carrier member adapted to support a printing cylinder above said trough member, means operatively engaging and mounting said carrier member for vertical movement relative to said trough member such that said printing cylinder may be subjected to the action of said etchants, raising and lowering mechanisms operatively connected to said carrier member for effecting vertical movement thereof relative to said trough member, means operatively engaging and mounting said trough member for lateral movement relative to said carrier member such that said printing cylinder may be subjected in succession to the action of said first and second etchants, shifting mechanisms operatively connected to said trough member for effecting lateral movement thereof relative to said carrier member, and means for coordinating said raising and lowering mechanisms and said shifting mechanisms.

3. A machine for etching printing cylinders comprising a frame, a pair of standards, vertical guide means operatively engaging and mounting said standards on said frame for vertical movement, means on the upper ends of said standards adapted to engage and support said printing cylinder for rotation on its axis, an etching trough including first and second side by side wells, lateral guide means operatively engaging and mounting said trough intermediate said standards for side to side

18

horizontal movement with said first well normally disposed below said printing cylinder, means operatively connected to said standards for moving said standards vertically to lower and raise said printing cylinder relative to said wells such that said printing cylinder may be subjected to the action of the etchants in said first and second wells, means operatively connected to said trough for moving said trough horizontally to shift said second well below said printing cylinder, and control means for coordinating the movements of said standards and said trough such that said printing cylinder may be lowered into said first well, raised from said first well, and after shifting of said trough, lowered into said second well.

4. A machine for etching printing cylinders comprising a frame, a pair of standards, vertical guide means operatively engaging and mounting said standards on said frame for vertical movement, means on the upper ends of said standards adapted to engage and journal said printing cylinder for rotation on its axis, turning means adapted to operatively engage said printing cylinder for rotating said printing cylinder on its axis, an etching trough including first and second side by side wells, lateral guide means operatively engaging and mounting said trough intermediate said standards for side to side horizontal movement with said first well normally disposed below said printing cylinder, means operatively connected to said standards for moving said standards vertically to lower and raise said printing cylinder relative to said wells such that said printing cylinder may be subjected to the action of the etchants in said first and second wells, means operatively connected to said trough for moving said trough horizontally to shift said second well below said printing cylinder, and control means for coordinating the movements of said standards and said trough such that said printing cylinder may be lowered into said first well, raised from said first well, and after shifting of said trough, lowered into said second well.

5. A machine for etching printing cylinders comprising a frame, carrier means on said frame adapted to support said printing cylinder, an etching trough including at least one well mounted on said frame with said well disposed below said printing cylinder, raising and lowering means operatively connected to said carrier means for moving said carrier means to lower said printing cylinder relative to said well such that said printing cylinder may be subjected to the action of an etchant in said well and raised to interrupt such action, a washing boom, means operatively connected to and mounting said boom for movement from a clearance position to an operative position overlying and substantially coextensive with said printing cylinder, actuating means operatively connected to said boom for moving said boom from said clearance position to said operative position, and coordinating means controlled by said raising and lowering means and controlling said actuating means for moving said boom into said operative position after raising of said printing cylinder relative to said well.

6. A machine for etching printing cylinders comprising a frame, a pair of standards, means operatively engaging and mounting said standards on said frame for vertical movement, means on the upper ends of said standards adapted to engage and journal said printing cylinder for rotation on its axis, turning means adapted to operatively engage said printing cylinder for rotating said printing cylinder on its axis, an etching trough including at least one well mounted on said frame intermediate said standards with said well disposed below said printing cylinder, raising and lowering means operatively connected to said standards vertically to lower said printing cylinder relative to said well such that said printing cylinder may be subjected to the action of an etchant in said well and raised to interrupt such action, a washing boom, means operatively connected to and mounting said boom for move-

ment from a clearance position to an operative position overlying and substantially coextensive with said printing cylinder, actuating means operatively connected to said boom for moving said boom from said clearance position to said operative position, and coordinating means controlled by said raising and lowering means and controlling said actuating means for moving said boom into said operative position after raising of said printing cylinder relative to said well.

7. A machine for etching printing cylinders comprising a frame, a pair of standards, vertical guide means operatively engaging and mounting said standards on said frame for vertical movement, means on the upper ends of said standards adapted to engage and journal said printing cylinder for rotation on its axis, an etching trough including first and second side by side wells, lateral guide means operatively engaging and mounting said trough intermediate said standards for side to side horizontal movement, a raising and lowering mechanism operatively connected to said standards for moving said standards vertically to lower and raise said printing cylinder relative to said etching trough such that said printing cylinder may be subjected to the action of the etchants in said first and second wells, a lateral shift mechanism operatively connected to said trough for moving said trough horizontally to shift said etching trough relative to said printing cylinder, means including a first pump for feeding a prescribed volume of a first etchant to said first well, means including a second pump for feeding a prescribed volume of a second etchant to said second well, and a control for coordinating the vertical movement of said standards, the horizontal movement of said etching trough and the delivery of said first and second etchants to said first and second wells.

8. A machine according to claim 7 including first and second agitating means in operative relation to said first and second wells for agitating said first and second etchants during the exposure of said printing cylinder to the action of said first and second etchants.

9. A machine for etching printing cylinders comprising a frame, a pair of standards, vertical guide means operatively engaging and mounting said standards on said frame for vertical movement, means on the upper ends of said standards adapted to engage and journal said printing cylinder for rotation on its axis, turning means adapted to operatively engage said printing cylinder for rotating said printing cylinder on its axis, an etching trough including first and second side by side wells, lateral guide means operatively engaging and mounting said trough intermediate said standards for side to side horizontal movement, a raising and lowering mechanism operatively connected to said standards for moving said standards vertically to lower and raise said printing cylinder relative to said etching trough such that said printing cylinder may be subjected to the action of the etchants in said first and second wells, a lateral shift mechanism operatively connected to said trough for moving said trough horizontally to shift said etching trough relative to said printing cylinder, means including a first pump for feeding a prescribed volume of a first etchant to said first well, means including a second pump for feeding a prescribed volume of a second etchant to said second well, and a control for coordinating the vertical movement of said standards, the horizontal movement of said etching trough and the delivery of said first and second etchants to said first and second wells.

10. A machine according to claim 9 including means operatively connected to said turning means for reversing the direction of turning of said printing cylinder during exposure to said first and second etchants.

11. A machine for etching printing cylinders comprising a frame, a pair of standards, vertical guide means operatively engaging and mounting said standards on said frame for vertical movement, means on the upper ends of said standards adapted to engage and journal said printing cylinder for rotation on its axis, turning means adapted

to operatively engage said printing cylinder for rotating said printing cylinder on its axis, an etching trough including first and second side by side wells, lateral guide means operatively engaging and mounting said trough intermediate said standards for side to side horizontal movement, a raising and lowering mechanism operatively connected to said standards for moving said standards vertically to lower and raise said printing cylinder relative to said etching trough such that said printing cylinder may be subjected to the action of the etchants in said first and second wells, a lateral shift mechanism operatively connected to said trough for moving said trough horizontally to shift said etching trough relative to said printing cylinder, means including a first pump for feeding a prescribed volume of a first etchant to said first well, means including a second pump for feeding a prescribed volume of a second etchant to said second well, a control for coordinating the vertical movement of said standards, the horizontal movement of said etching trough and the delivery of said first and second etchants to said first and second wells, a washing boom mounted for movement into an operative position overlying and substantially coextensive with said printing cylinder, and an actuating mechanism controlled by said raising and lowering mechanism for moving said boom into said operative position in timed relation to the raising of said printing cylinder.

12. A machine for etching printing cylinders comprising a frame, carrier means on said frame adapted to support said printing cylinder, an etching trough including two wells mounted on said frame with said wells disposed below said printing cylinder, means for moving said trough transversely to its length for selective movement between a first position wherein said printing cylinder is in vertical alignment with a first well, and a second position wherein said printing cylinder is in vertical alignment with a second well, raising and lowering means operatively connected to said carrier means for moving said carrier means to lower said printing cylinder relative to said trough such that said printing cylinder may be subjected to the action of an etchant in one of said wells and raised to interrupt said action, supply means for an etchant, pump means for the delivery of a selected amount of an etchant to one of said wells, a washing boom, means operatively connected to and mounting said boom for movement from a clearance position to an operative position overlying and substantially co-extensive with said printing cylinder, actuating means operatively connected to said boom for moving said boom from said clearance position to said operative position, and coordinating means controlled by said raising and lowering means and controlling said actuation means for moving said boom into said operative position after raising of said printing cylinder relative to said well and for coordinating the movement of said raising and lowering means with the transverse movement means and with the pump means for selectively cycling said printing cylinder through an etching operation with selective amount of etching being accomplished in said first well and in said second well.

13. A machine for etching printing cylinders comprising a frame, carrier means on said frame adapted to support said printing cylinder, an etching trough including two wells mounted on said frame with said wells disposed below said printing cylinder, means for moving said trough transversely to its length for selective movement between a first position wherein said printing cylinder is in vertical alignment with a first well, and a second position wherein said printing cylinder is in vertical alignment with a second well, raising and lowering means operatively connected to said carrier means for moving said carrier means to lower said printing cylinder relative to said trough such that said printing cylinder may be subjected to the action of an etchant in one of said wells and raised to interrupt said action, supply means for an etchant, pump means for the delivery of a selected amount

21

of an etchant to one of said wells, and coordinating means for coordinating the movement of said raising and lowering means with said transverse movement means and with said pump means for selectively cycling said printing cylinder through an etching operation with selective amounts of etching being accomplished in said first well and in said second well.

14. A machine for etching printing cylinders comprising a frame, a unitary trough member mounted on said frame and having side by side wells adapted to contain quantities of first and second etchants respectively, a carrier member adapted to support a printing cylinder above said trough member, means operatively engaging and mounting said carrier member for vertical movement relative to said trough member such that said printing cylinder may be subjected to the action of said etchants, raising and lowering mechanisms operatively connected to said carrier member for effecting vertical movement thereof relative to said trough member, means operatively engaging and mounting said trough member for lateral movement relative to said carrier member such that said printing cylinder may be subjected in succession to the action of said first and second etchants, shifting mechanisms operatively connected to said trough member for effecting lateral movement thereof relative to said carrier member, a wash boom movable into an operative position over said trough member, boom-moving mechanisms operatively connected to said wash boom for moving the same into said operative position, and means for coordinating said raising and lowering mechanisms, said shifting mechanisms and said boom-moving mechanisms.

15. A machine for etching printing cylinders comprising a frame, a unitary trough member mounted on said frame and having side by side walls adapted to contain quantities of first and second etchants respectively, a carrier member adapted to support a printing cylinder above said trough member, means operatively engaging and mounting said carrier member for vertical movement relative to said trough member such that said printing cylinder may be subjected to the action of said etchants, raising and lowering mechanisms operatively connected to said carrier member for effecting vertical movement thereof relative to said trough member, means operatively engaging and mounting said trough member for lateral movement relative to said carrier member such that said printing cylinder may be subjected in succession to the action of said first and second etchants, shifting mechanism operatively connected to said trough member for effecting lateral movement thereof relative to said carrier member, means for coordinating said raising and lower-

22

ing mechanisms and said shifting mechanisms, and first and second agitating means in operative relation to said first and second wells for agitating said first and second etchants during the exposure of said printing cylinder to the action of said first and second etchants.

16. A machine for etching printing cylinders comprising a frame, a unitary trough member mounted on said frame and having side by side wells adapted to contain quantities of first and second etchants respectively, a carrier member adapted to support a printing cylinder above said trough member, turning means adapted to operatively engage said printing cylinder for rotating said printing cylinder on its axis, means operatively connected to said turning means for periodically reversing the direction of turning of said printing cylinder, means operatively engaging and mounting said carrier member for vertical movement relative to said trough member such that said printing cylinder may be subjected to the action of said etchants, raising and lowering mechanisms operatively connected to said carrier member for effecting vertical movement thereof relative to said trough member, means operatively engaging and mounting said trough member for lateral movement relative to said carrier member such that said printing cylinder may be subjected in succession to the action of said first and second etchants, shifting mechanisms operatively connected to said trough member for effecting lateral movement thereof relative to said carrier member, and means for coordinating said raising and lowering mechanisms and said shifting mechanisms.

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