

Feb. 23, 1954

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2,669,810

METHOD AND APPARATUS FOR GRAINING LITHOGRAPHIC PLATES

Filed Jan. 28, 1950

5 Sheets-Sheet 1

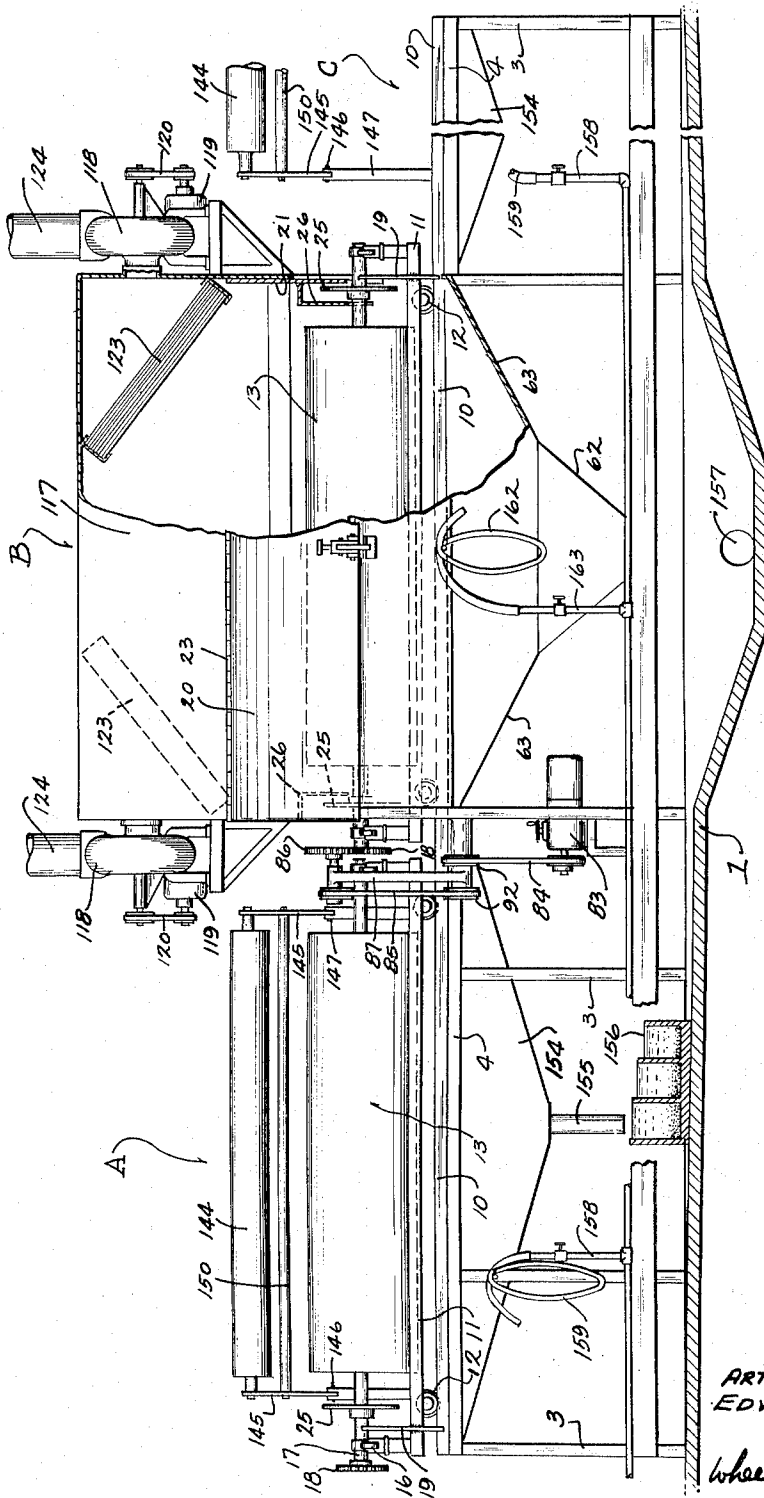


Fig. 1

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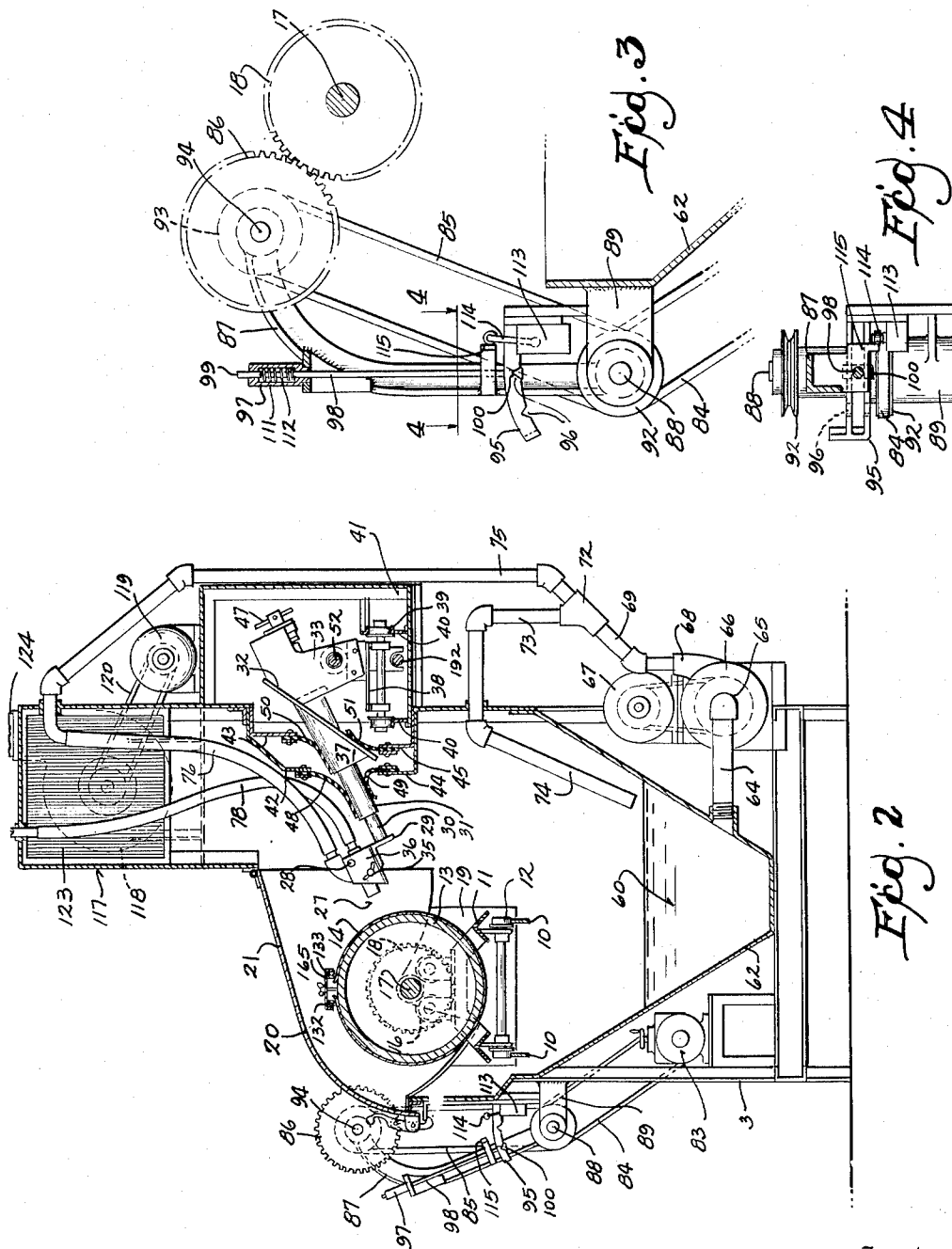
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5 Sheets-Sheet 2



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5 Sheets-Sheet 3

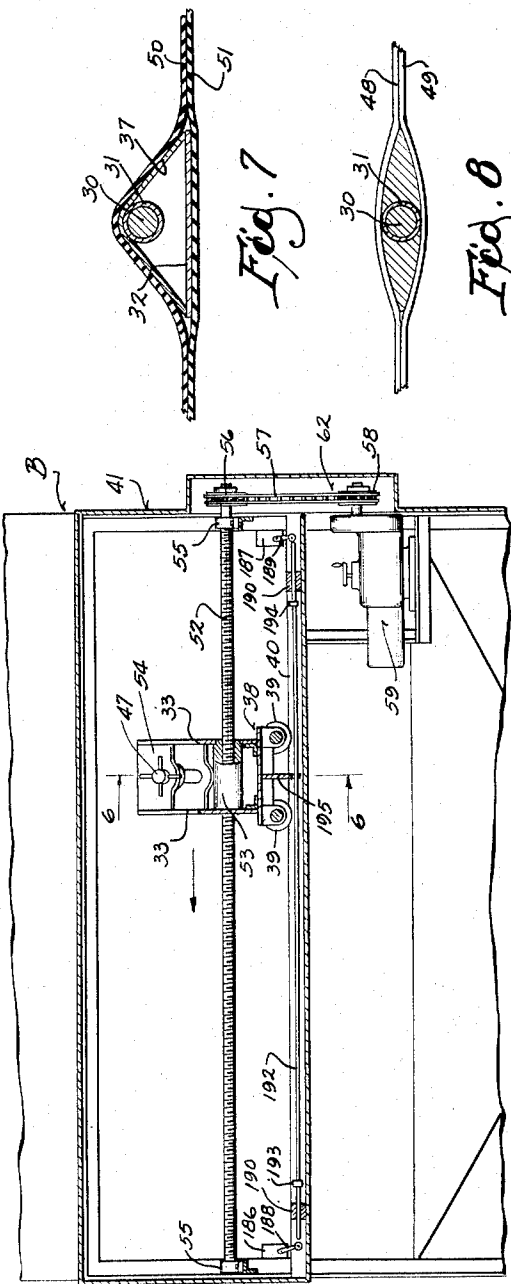


Fig. 5

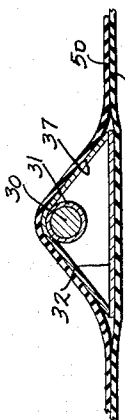


Fig. 7

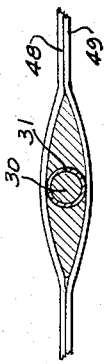


Fig. 8

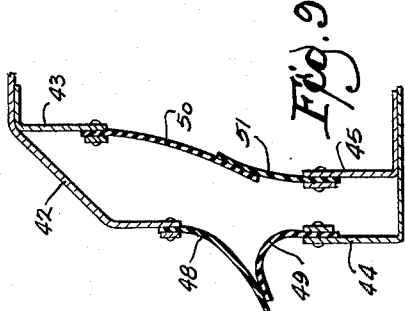


Fig. 9

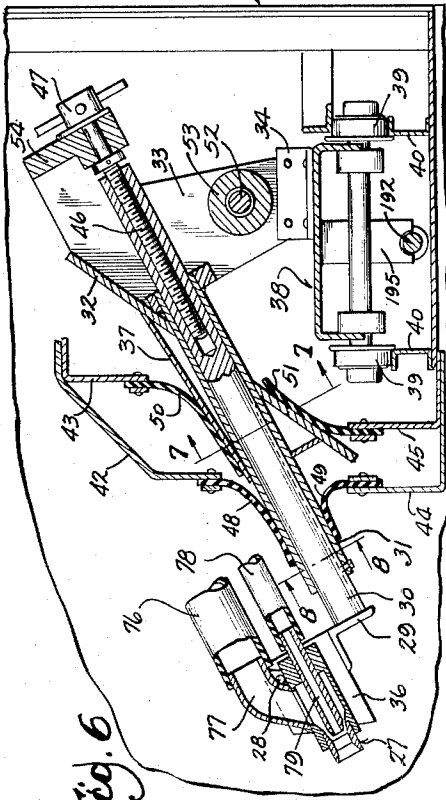


Fig. 6

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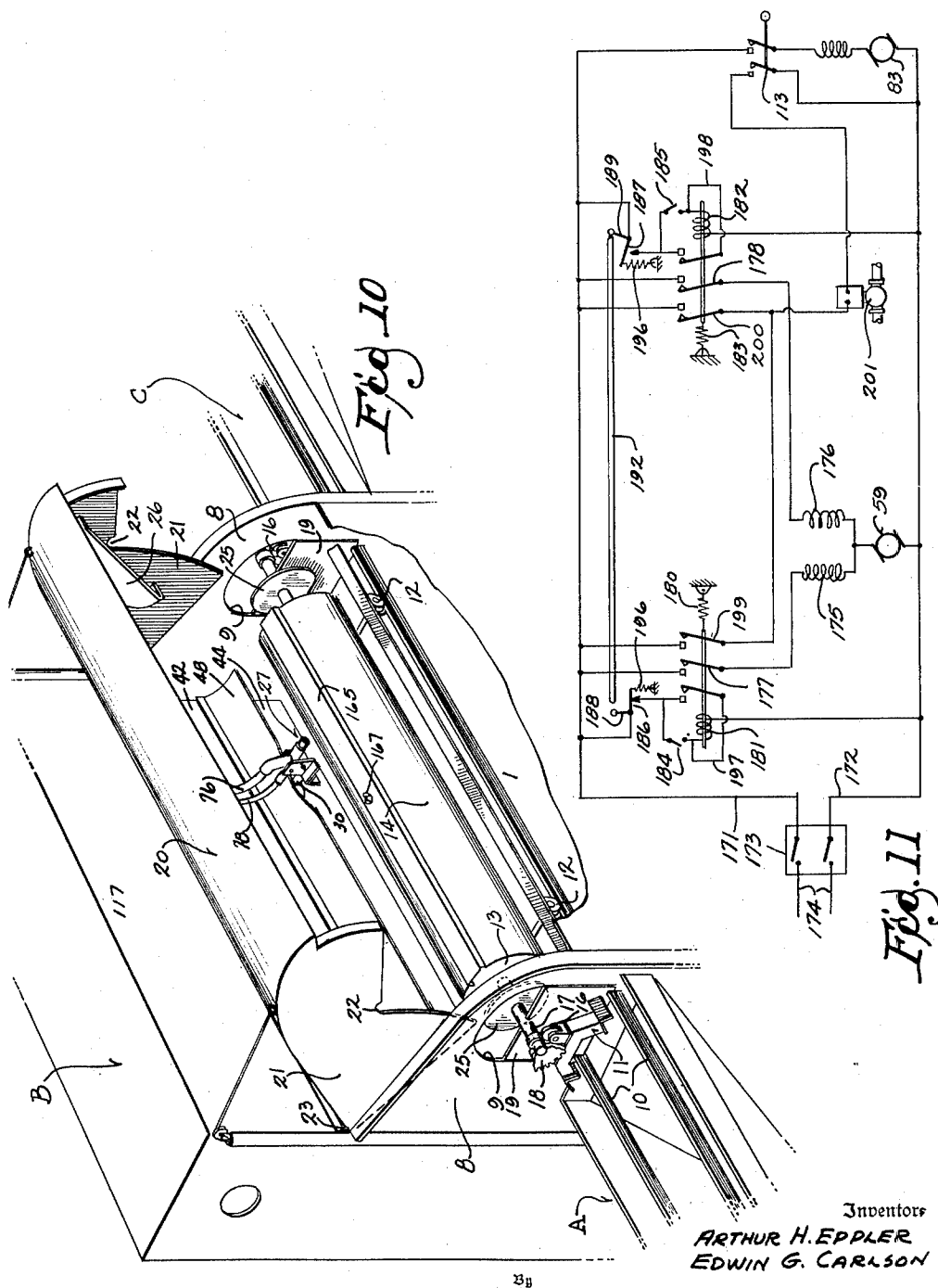
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METHOD AND APPARATUS FOR GRAINING LITHOGRAPHIC PLATES

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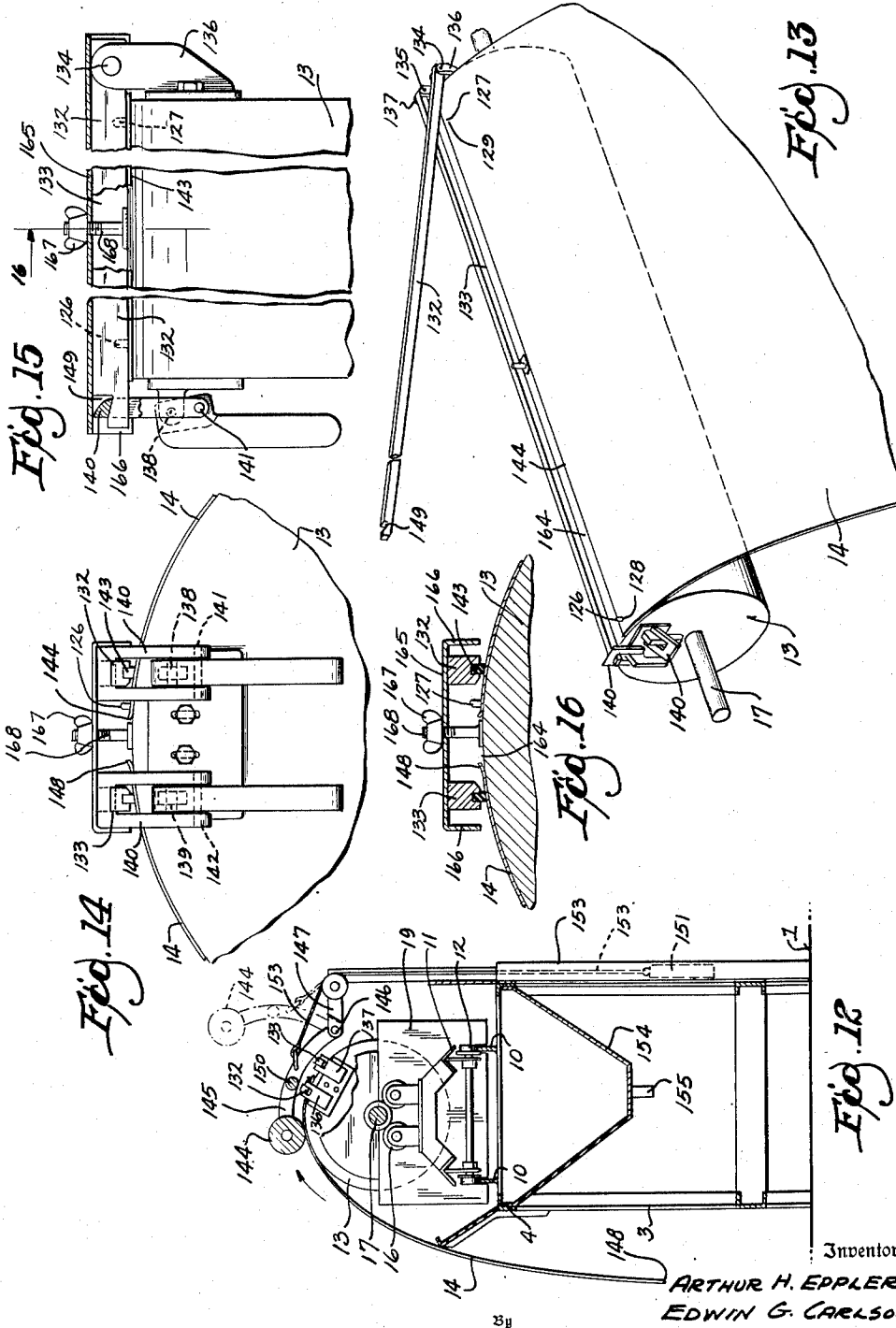
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Filed Jan. 28, 1950

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,669,810

METHOD AND APPARATUS FOR GRAINING
LITHOGRAPHIC PLATESEdwin G. Carlson, Caledonia, and Arthur H.
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Application January 28, 1950, Serial No. 141,040

21 Claims. (Cl. 51-15)

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This invention relates to a method and apparatus for abrading sheet surfaces and more particularly to a method and apparatus for graining lithographic plates.

Lithographic plates are surface grained to provide an ink and water retaining surface. The grained surface is etched in accordance with the reproduction desired. The quality of the reproduction and the minute details thereof is dependent largely on the quality and uniformity of the plate grain.

Lithographing plates have been heretofore grained on shaking tables using marbles or the like to abrade the plate surfaces. Sand and mud blasting techniques have also been employed. It is the principal object of this invention to adopt the liquid-borne abrasive polishing method and apparatus described in the United States patent to Arthur H. Eppler, No. 2,462,480, issued February 22, 1949, to the graining of lithographic and other sheets or plates.

In this connection it is an object of the invention to produce a uniform grain, both in depth and in breadth, with even peaks and no undercuts. The invention has application to both deep etched and alumin processed plates. The grain produced by practice of this invention is desirably uniform between remote portions of the same plate and between plates successively grained. Grain produced by this method and apparatus is characterized as deep and close permitting good moisture control while improving the ability of the plates to hold minute detail. Lithographic work done with a plate grained by this method and apparatus is of higher quality than heretofore attainable.

A further object of the invention is to control the amount of metal cut from the plate so that no more of the plate is removed than is necessary to produce a uniformly grained surface. In this manner the life of the plate is considerably extended.

Other general objects of the invention are to speed the process of graining plates, to reduce the labor required to perform graining operations, and to reduce the space required to house the graining apparatus.

An important object of the invention is to provide a method for uniformly graining a plate which includes projecting a fluid-borne abrasive against the plate in a repeatedly overlapping pattern. It is an object of the invention to provide for such an overlapping grain pattern by disposing the plate on a cylindrical path, rotating the plate on its cylindrical path at relatively high speed and axially traversing the rotating

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plate at a relatively slower speed with a stream of fluid-borne abrasive. In this manner, for any selected abrasive stream width, the graining pattern will repeatedly overlap and all portions of the plate will be treated with comparable amounts of abrasive. By properly relating plate rotating speed to stream traversing speed the desired grain may be produced in one or two passes of the stream, while at the same time providing multiple overlapping of the grain pattern to insure uniformity and speed the graining process.

More specifically the invention contemplates that the plate to be grained be wrapped about a drum which is then rotated at high speed in the path of a stream of liquid-borne abrasive projected from a nozzle against the plate surface. The nozzle stream is moved at uniform speed in a direction axially of the drum in order to treat all portions of the plate surface with uniformity.

A further particular object of the invention is to provide novel apparatus for the performance of the plate graining method. It is an object to provide apparatus including exposed and housed stations having drum conveying apparatus providing communication therebetween. In this manner the operator may manipulate the drum while it is in an exposed and accessible position, and thereafter shift the drum to a housed position where the graining takes place. By the use of exposed stations at either side of the housed station one plate may be undergoing graining while another plate is being prepared for the graining operations.

Another object of the invention is to provide a novel method and apparatus for wrapping a normally flat plate about a cylindrical drum so as to facilitate and reduce the labor required to position the plate and to insure a close fit of the plate to the drum periphery. In this connection it is an object of the invention to provide novel clamping bars and a roller cooperative therewith to roll the plate upon the drum.

Another object of the invention is to provide a novel drum housing having a side opening and a cover having a side flange which cooperates with a shield on the drum carriage to effectively close the opening with the drum drive connections exposed.

Another objection of the invention is to provide a novel drum drive mechanism wherein all of the driving parts are disposed exteriorly of the housing enclosing the drum.

Another object of the invention is to provide the drum housing with a nozzle and a supply to the nozzle of liquid-borne abrasive, the nozzle being provided with a drive to cause the nozzle

to traverse the drum and to jet abrasive against a plate wrapped about the drum. In this connection it is an object of the invention to provide the nozzle with a drive mechanism having control means which automatically stops nozzle traverse at each end of the drum and likewise stops abrasive jetting. The entire driving means is substantially isolated by flexible curtains from the portion of the drum housing containing the drum and the nozzle.

A further object of the invention is to provide the nozzle with a mounting including means for advancing and retracting the nozzle respecting the drum, and with means for tilting the nozzle on the mounting to change the angle of stream projection respecting the drum.

A still further object of the invention is to provide the relatively movable elements of the machine with an interlock control system which assures uniform graining of the plate by making drum rotation and nozzle traverse movement a required condition for abrasive jetting. Consequently, in the event the drum stops rotating or the nozzle stops traversing the drum, the jet is likewise stopped to prevent any portion of the drum from receiving any more of the abrasive than any other drum portion.

Other objects will be more apparent to those skilled in the art upon an examination of the following disclosure.

In the drawings:

Fig. 1 is a front elevational view of a machine embodying the invention, said machine having one housed station and two exposed stations, one of which is shown only fragmentarily.

Fig. 2 is a transverse cross section taken through the housed station to show the positional relationship of the various parts.

Fig. 3 is an enlarged side elevational detail view of the drum drive mechanism partly in cross section.

Fig. 4 is a cross section taken along the line 4—4 of Fig. 3.

Fig. 5 is a rear elevation of the nozzle drive mechanism and mounting, the rear panel of the drum drive housing being removed to expose the drive elements and nozzle mount.

Fig. 6 is an enlarged cross sectional view taken along the line 6—6 of Fig. 5.

Fig. 7 is a cross sectional view taken along the line 7—7 of Fig. 6.

Fig. 8 is a cross sectional view taken along the line 8—8 of Fig. 6.

Fig. 9 is a detail view taken at a portion remote from the nozzle of the overlapping curtains which separate the drum treating chamber from the nozzle drive mechanism chamber.

Fig. 10 is a perspective view of the drum and carriage in housed position, portions being broken away to show the positional relationship of parts.

Fig. 11 is a circuit diagram of the interlocked control system.

Fig. 12 is an end elevation, partly in cross section, of an exposed station showing the plate partly wrapped about the drum.

Fig. 13 is a perspective view of the drum and plate showing the manner of applying the plate to the drum and the clamping apparatus thereof.

Fig. 14 is an enlarged end elevation of the drum showing the details of the trunk latch mechanism which clamps the plate to the drum.

Fig. 15 is an enlarged but fore-shortened side elevation of the drum showing details of the

clamp bars and trunk latch mechanism which releasably holds the plate to the drum.

Fig. 16 is a cross sectional view taken along the line 16—16 of Fig. 15.

The general organization of the preferred apparatus is best shown in Figs. 1, 2 and 10. The floor upon which the apparatus is supported is indicated as 1. Resting upon the floor 1 is an extensive framework including upright members 3 and horizontal members 4, which provide a bed for the track 10 which in turn supports the movable drum 13.

In the preferred embodiment the apparatus includes a housed or drum treating station B flanked by substantially identical exposed loading stations A and C. In Fig. 1 station C is shown only fragmentarily. A completely operative structure having a housed station and a single exposed station would be satisfactory; however, from the standpoint of convenience and efficiency two exposed loading and washing stations are preferred. In this manner operations in the housed station may be concurrent with those at an exposed station.

As best shown in Fig. 10 the side 3 of the housed station is provided with a large opening 9 to provide access from adjacent exposed station A to the treating chamber within the housed station B. Where three stations are used a similar opening in the other side of the housing is provided.

In order to provide for bodily shifting the drum 13 between the exposed and housed stations, parallel tracks 10 extend therebetween and pass through the housing opening 9. The drum 13 is supported by a carriage 11 having wheels 12 which ride on the tracks 10. As the tracks 10 extend completely through the housed station a single carriage 11 may be provided to move through the housing to either of the oppositely disposed exposed stations. However, it is contemplated that two carriages be utilized, each to be moved between the housed station and one of the exposed stations. In this manner one or the other of two drums each on its own carriage, will be available for plate loading or unloading concurrent with the graining of a plate on the other of said drums.

The carriage 11 is provided with upwardly exposed saddle bearings indicated generally as 16 for the rotatable support of the drum 13 upon its axle 17. The axle 17 carries a gear 18 at an extreme end, the gear acting as a driven part in the drum drive mechanism to be hereinafter described. A lithographic or other plate 14 may be loaded with facility at the exposed station by wrapping it about the drum 13 in a manner to be hereinafter described more in detail. The carriage with drum and plate may then be bodily transported over the track 10 from the exposed station into the housing.

The openings 9 in the housing accommodate the carriage movement between stations. Furthermore the gear 18 must remain exposed to effect drum driving connections externally of the housing. In order to effect a closure of the side opening under these conditions the carriage 11 carries an end shield 19 which partially closes the side opening 9 when the drum is properly positioned (Fig. 10). The opening is completely closed by lowering the novel housing cover 20 which is pivoted to the housing on the continuous piano-type hinge 23, and is provided with downturned flange portions 21 having a relieved semi-circular portion 22 which fits the drum axle 17.

The carriage shield 19 and cover flange 21 overlap (see Fig. 1) to isolate the treating chamber from the gear 18 and from the room environment. Drum axle 17 is further provided with a disk 25 which spans the center portions of the overlapped flange 21 and shield 19 to centrifugally throw off material striking it and thereby to prevent escape of liquid splash or the like from the treating chamber. The inner surface of flange 21 is desirably provided with a baffle plate 26 which partially caps the disk 25 to further prevent escape of the liquid-borne abrasive from the chamber.

Within the housed station B an abrasive gun or nozzle 27 is positioned on carriage 38 to traverse the drum 13. As best shown in Figs. 2 and 6 the nozzle mounting includes a transverse pintle 28 about which the nozzle oscillates as set by clamp 35. The pintle and clamp are supported on side brackets 36 which extend upwardly from angle bracket 29 which is fixed to the tubular stem 30. Stem 30 is reciprocal for adjustment purposes in sleeve 31, which is unitary with a carriage mount including sloping plate 32 and brackets 33 secured for support to the angle brackets 34 bolted to the carriage frame 38. An arched shield 37 mounted on plate 32 houses the sleeve over a portion of its length.

Carriage frame 38 is provided with wheels 39 which ride on spaced tracks 40 which parallel the drum axis. The tracks 40 are mounted in a nozzle drive chamber 41 which hangs from the rear of the housing B as best shown in Figs. 2, 5 and 6. The chamber 41 is isolated from the treating chamber by its inner complementary wall portions 42, 44 and 43, 45. The nozzle stem and sleeve extends transversely between the facing edges of these walls and through the spread curtains 48, 49 and 50, 51.

The curtains 48, 49 and 50, 51 are made of flexible self-supporting material such as rubber and overlap to close about the sleeve 31 and arched shield 37 as is best shown in Figs. 7 and 9. As illustrated in Fig. 8 the sleeve 31, at the portion of its length mutually embraced by the overlapping curtains, is provided with a laterally tapered or streamlined portion having its edges tapering to zero thickness in the plane of nozzle traverse. In this manner the respective curtains 48 and 49 are shaped to conform themselves smoothly about the sleeve, thus effectively isolating the treating chamber from the drive mechanism of the nozzle.

The curtains 50, 51 are similarly conformed about the arched shield 37 and undersurface of plate 32 as illustrated in Fig. 7. In this manner the nozzle and nozzle mount traverses the drum through the flexible curtains while molding the curtains from each other to accommodate the nozzle parts.

The nozzle may be advanced or retracted respecting the drum periphery by means of a screw 46 threaded to the stem 30 and controlled by a winch 47 seated against the plate 54.

The nozzle and its mount is made to traverse the drum by means of a lead screw 52 which engages a threaded portion 53 of the nozzle mounting. The lead screw 52 is journaled in the bearings 55 and carries at one end a gear 56 which meshes with chain 57 passing over gear 58 connected to the rotor of a reversing motor 59. The chain drive mechanism is housed in a chamber 62 secured to the end of the housing B near one end of the chamber 41.

The supply of liquid-borne abrasive 60 is contained by a sump 62. As best shown in Fig. 2

the circulating system which feeds the liquid-borne abrasive 60 to the nozzle 27 is like that described in the Eppler Patent No. 2,462,480. It includes a sump 62 into which drain the funnel shaped drain boards 63 disposed immediately below the housed drum 13. An outlet pipe 64 leads from the sump, preferably slightly above the bottom of the sump, to inlet 65 of a centrifugal pump 66. Pump 66 is driven by the motor 67 and is of a type specifically designed to handle liquids containing foreign matter. The pump outlet 68 leads to pipe 69 which divides at the fork 72 into a recirculating pipe branch 73, leading back through the down spout 74 to the sump, and to a nozzle supplying branch 75 which connects with the flexible conduit 76 feeding the water and abrasive passage 77 of the nozzle. Jetting force is provided by means of the compressed air tube 78 connected to passage 79 which is axially aligned with the nozzle opening 27.

Pump 66 is desirably of a capacity in excess of the requirements of the nozzle so that a substantial portion of the abrasive-carrying liquid is being recirculated at all times from the pump outlet back into the sump through the by-pass branch 74. In this manner the liquid in the sump is constantly agitated to maintain the abrasive in suspension.

Present requirements in lithography are for several different types each of press plate grains and proof plate grains, each with the proper characteristics to hold minute details, and also to retain moisture in a controllable manner. A deep but close grain seems most desirable for press plates, and a finer grain with less depth for proof plates.

Although details of operations may vary somewhat for different types of plates to be grained, a typical setting for a press plate size 68½ by 54¾ inches is to direct the nozzle approximately radially at the drum periphery from a distance of 2¼ inches from the drum periphery. The outlet of the nozzle is approximately one inch in diameter. The stream of liquid-borne abrasive is projected under air pressure of approximately 60 pounds per square inch. The composition of the liquid-borne abrasive 60 is desirably a 35% or larger suspension by volume of aluminum oxide of 120 to 150 mesh in water.

Aluminum oxide is particularly suited to plate graining as the grain-like particles thereof are unusually tough and resist size reduction even after repeated impact with the work. Although some fine grit in the solution is desirable to polish and smooth the grain produced by the larger abrasive, an excessive amount of grit would tend to nullify the graining action of the larger abrasive. Other abrasives in solution, such as silica and the others mentioned in the Eppler Patent No. 2,462,480 have been used with success however.

A 2% solution of a metallic chromate such as sodium bichromate is desirably added to the solution as it has been found to improve the grained surface and aids the final cleaning of the plate and to some degree prevents rusting of the pipes in the machine.

The nozzle is driven along the drum at a speed of 8¾ inches per minute and the drum revolved at 31½ R. P. M. One pass of the nozzle consuming 9½ minutes is all that is required for new plates and albumin processed plates, and only two passes consuming 19 minutes are required for regained deep etched plates.

It is readily observed that the speed of drum

rotation is substantially greater than of nozzle traverse. Consequently the impact area of the plate receiving the abrasive will repeatedly overlap each time the drum rotates and as the stream describes a helical pattern of low pitch over the exposed plate surface.

Different settings are made for different sizes and types of plates. In practice the nozzle drive has a range of from $2\frac{1}{4}$ inches of travel per minute to $11\frac{3}{8}$ inches per minute; and the drum can be rotated in a range from $1\frac{1}{2}$ R. P. M. to 44 R. P. M. The air pressure is also widely variable. The optimum settings for a specified type and size of plate having been noted, all plates of that type and size subsequently treated are given the same treatment and then receive a grain which is of uniformly high quality and of equal performance when used in the press.

Abrasive of 120-150 mesh is relatively heavy compared to the liquid carrier and will rapidly settle to the bottom of the sump as soon as the pump action is interrupted. Consequently, rather than stop the pump when cutting action is to be halted, it is preferred to shut off the supply of compressed air in the pipe 78. This will have the desired result without giving the abrasive an opportunity to settle out.

The drum in housed position receives power at its gear 18 from motor 83 which is equipped with a variable speed transmission and is connected through the belts 84 and 85 to a gear 86 which drives the drum through gear 18. The drive gear 86 is mounted upon swingable arm 87 pivoted to bracket 89 on pintle 82. The bracket 89 is welded or otherwise firmly secured to an upright frame member 3 of the machine. The pintle 88 further provides a bearing for the axially spaced pulleys 92 which transmit power from belt 84 to belt 85 and thence to pulley 93 keyed to axle 94 which turns the driving gear 86.

Also fixed to the bracket 89 is a sector 95 which is provided with spaced notches 96. Arm 87 is provided with a hand grip 97 and with a push rod 98 which may be manipulated by thumb pressure on the push button 99 to retract or advance the detent or pawl 100 carried by the arm into or out of the notches 96 in the sector 95. The handle 97 is provided with an inner cavity 111 which houses a compression spring 112 which normally biases the detent 100 into one of the sector notches 96. At least two notches are provided to define drive engage position, as shown in Fig. 3, and drive disengaged position, as shown in Fig. 2, in which latter position the arm is swung away from drum gear 18 and clear of the drum transport path between housed station B and exposed station A.

Sector 95 further provides a support for a switch 113 having a handle 114 extending into the path of switch actuator 115 carried by the arm 87. The handle and actuator are so disposed that the switch will be closed automatically when the drive is engaged. The switch 113 is for the purpose of stopping the supply of compressed air to the nozzle when the drum is not rotating and is disposed in the electrical interlock system of the machine in a manner to be hereinafter described more in detail.

One drive only is required to operate the drums. The gear 18 is disposed at corresponding ends of the respective drums when two exposed stations are used so that the respective gears come into proper alignment with the single drive mechanism regardless of which drum is housed.

As the splash of the liquid carrier against the

drum carried plate creates a fog within the housing a large ventilating chamber, indicated generally as 117, is disposed at the top of the housing B to provide for exhaust of used air and constant resupply of fresh air to the housed chamber. Centrifugal fans 118 powered by the motors 119 through conventional drives 120 draws the air from the housed chamber through the water washed filters 123 and out the exhaust vents 124. As considerable abrasive is entrained in the air and captured by the filters 123 they are desirably water washed at intervals to return the abrasives to the sump. The constant discharge of air from the housed chamber through the exhaust vents 124 insures an indraft of air into the treating chamber through the various apertures and overlapping joints between the housing cover and the housing and through the curtains from the nozzle drive mechanism so as to dispel the fog and impede the escape of abrasive laden mist from the chamber into proximity with the several drive mechanisms and into the atmosphere of the room in which the machine is located.

As before stated, and as best shown in Figs. 12 and 13, the plate 14 is enveloped or wrapped about drum 13 prior to the bodily transport of the drum from the exposed station to the housed station. The manner of applying the plate to the drum and the novel means of clamping the plate to the drum to facilitate its application and to insure a close fit therebetween is of particular interest.

The drum is provided with upstanding lugs 126 and 127 near its opposite ends. The plate is provided with apertures 128 and 129 near opposite ends of one margin. As a preliminary step to clamping the plate to the drum the apertured margin of the plate is engaged with the lugs to steady and accurately align the plate while the clamp bars are applied.

The drum is further provided with laterally spaced clamp bars 132 and 133 which are pivoted at 134 and 135 to the brackets 136, 137 secured to one end of the drum. The clamp bars 132 and 133 are further respectively provided with pressure applying clamps including fixed pivots 138 and 139 and movable pivots 141 and 142 which carry the swingable latches 140 at the other end of the drum. The latches 140 engage the notches 149 at the free ends of the clamp bars.

The next step in applying the plate to the drum is to firmly clamp the margin 144 of the plate 14 between the resilient rubber foot 143 of clamp bar 132 and the drum periphery.

A rubber roller 144, best shown in Fig. 12 is then swung on its dual arms 145 against the plate. The arms are pivotable on their pintles 146 which are secured to frame members 147 to the indicated dotted line position. The roller is gravity biased against the plate to tension the plate between the drum lugs 126 and 127 and the roller so that when the drum 13 is rotated through nearly a complete revolution the plate will be wrapped about the drum periphery to closely conform thereto.

After the plate is completely wrapped about the drum periphery the second clamp bar 133 is pressured against the opposed margin 148 of the plate 14 and clamped into position. The roller may then be swung on its arm to retracted position so as to clear the drum for transport between the exposed and housed stations. Roller retraction is assisted by the counterbalanced weight 151 suspended by cord 152 from arm 145. Weight 151 is guided in the cylindrical tube 153. Each arm

145 is desirably provided with a counterbalancing weight and the arms are reinforced by the cross rod 150 extending therebetween. As best shown in Fig. 12 the arms 145 are curved complementary with the drum and spaced therefrom to provide clearance for the clamp bars to rotate during plate wrapping operations.

The clamp bars 132, 133 and the drum periphery 164 between the clamp bars are protected from the abrasive jet by a cover 165 of inexpensive sheet metal. The cover completely overlies the clamp bars and is extended to also cover the latches. The cover is further provided with downturned flanges 166 and is secured to upstanding bolt 168 by wing nut 167. Cover 165 must be replaced at intervals as it is worn by the abrasive.

As best shown in Fig. 1 each exposed station is provided with an underhung drain board 154 and a drain spout 155 which discharges the liquid-borne abrasive, which drips from the drum after it is removed from the treating chamber, through a filter 156 which reclaims the abrasive and thence to the sewer indicated generally as 157.

When the plate is first positioned upon the drum 13 it is conventionally covered with a preserving coating applied thereto for storage purposes when the plate was taken from the press room. This coating should be washed from the plate at the exposed station prior to graining. For this purpose a hose connection 158 is provided at each of the exposed stations and the plate may be sponged off with the assistance of the water directed thereagainst from the hose 159.

After the drum has undergone the graining process it is normally coated with a thin layer of abrasive. The abrasive is largely washed off in the housed station by directing a stream of water from the hose 162 against the plate periphery. The housed station is provided with a hose connection 163 to service the hose 162. After the drum is transported on its carriage from the housed station to the exposed station it is further washed with hose 159 to completely remove the abrasive which is collected by the filters 156.

An interlocked control system integrates the drum drive control, the nozzle carriage drive control, and the nozzle air blast control so as to prevent the jetting of the abrasive against the plate surface except when the drum is rotating and the nozzle is traversing the drum.

In the arrangement to be described the various interlocks prevent the abrasive from wearing one portion of the plate more than any other portion and thus insure uniformity of grain and prevent inadvertent spoilage of a plate by uncontrolled excessive blasting of one portion thereof.

An electrical circuit to accomplish this control is diagrammatically illustrated in Fig. 11. The feeder line wires 171, 172 are connected through main switch 173 to the incoming power cable 174. The nozzle transport motor 59, with forward and reversing coils 175 and 176, is connected across the lines 171, 172 through the separately actuated switches 177, 178, one for each coil. Switches 177, 178 are independently closed by solenoids 181 and 182 which are connected across the lines through limit switch 186 and manual switch 184 in series; and limit switch 187 and manual switch 185 respectively. The switches 177, 178 are normally biased open by the springs 180, 183 and each solenoid circuit is closed only when the series

limit and manual switches are closed simultaneously.

The limit switches 186, 187 are actuated by movement of the nozzle carriage 38, best shown in Fig. 5. The switches 186, 187 are provided with switch levers 188, 189 which are alternately actuated at the opposite ends of actuator rod 192 disposed therebetween. The rod 192 is supported on bearings 190 and carries spaced collars 193, 194 proximate the switches which are alternately engaged by the switch actuator yoke 195 depending from the carriage 38. Contact with the collar is made at each end of the nozzle traverse so as to open the switch 186 or 187 thus deenergizing the solenoid and opening either switch 177 or 178 to stop the motor. The limit switches 186, 187 are biased to normally closed position by the springs 196 so that upon the opening of one switch the other switch is biased by the spring to closed position. Thereupon the closing of the appropriate manual switch 184, 185 will reenergize the other solenoid to close the appropriate switch 177, or 178 to reenergize the motor in opposite direction.

As the manual switches 184, 185 are normally biased to open position the solenoids are each provided with a holding circuit indicated as 197, 198 to maintain the respective solenoids energized when the manual switch is released.

The air valve control 201 for the supply of air to the nozzle is disposed in series with the switches 199 and 200 which are connected for coordinate action with the switches 177 and 178 so that energization of nozzle transport motor 59 is a prerequisite to the jetting of the liquid abrasive against the plate. Furthermore, the drum drive switches 113 which are actuated by movement of the arm 87 are likewise in series with the air valve control 201. Consequently, liquid abrasive jetting is likewise dependent upon closure of switches 113. In this manner abrasive jetting will not occur unless the drums are rotating.

The improved method of graining the plate as hereinbefore described includes the novel steps of mounting a plate on a cylindrical path while the plate is at an exposed station, transporting the plate to a housed station, axially traversing the drum with a stream of liquid-borne abrasive while the drum is rotating, and then returning the plate to the exposed station to remove the plate.

Plates grained by the above described method and apparatus are of materially higher quality than plates grained by prior art methods. Prior art grained plates are observed to be characterized by a grain of irregular depth with deep figures, shallow grain, frequent undercuts, and uneven widely spaced tops. The method and apparatus herein described produces a deep and close grain with even tops facilitating minute detail in the finished lithographic work.

We claim:

1. The method of graining a plate in a machine having an exposed station, a housed station, and a drum movable between said stations, comprising the steps of enveloping the drum with the plate at the exposed station, transporting the plate and enveloped drum to the housed station, revolving the drum and plate, traversing the exposed surface of the revolving plate with a stream of fluid-borne abrasive, automatically interrupting the stream at the end of stream traverse, transporting the drum and plate from the housed station to an exposed station, and removing the plate from the drum, plus the in-

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intermediate steps of rinsing the plate at the housed and exposed stations prior to removing the plate from the drum.

2. In a method of the character described, the steps of clamping an edge margin of a plate to a drum, pressing the plate to the drum with a roller mounted for free turning movement, revolving the drum to roll the roller away from the clamped margin whereby the plate is tightened against the drum, and clamping an opposed edge margin of the plate to the drum.

3. The method of claim 2 plus the initial steps of aperturing the first clamped edge margin of the plate to align with an upstanding lug on the drum periphery and engaging said apertured margin with said lug to orient said margin between said drum and clamp.

4. In a plate graining machine the combination with a rectilinear track and a carriage movable on said track, said carriage being provided with bearings, of a cylindrical drum mounted for rotation on an axis parallel to the track in the bearings, means at one position along the track for rotating said drum, a nozzle mounted proximate the track at said position for rectilinear traversing movement respecting the drum and means for traversing the nozzle, means of supplying to the nozzle fluid-borne abrasive, and means for forceably jetting said abrasive from the nozzle toward the drum.

5. The device of claim 4 in further combination with integrated control means including jet control means dependent upon drum rotation and upon nozzle traversing movement.

6. The device of claim 4 in further combination with a housing at said position along the track, said housing providing a treating chamber within which nozzle traversing movement takes place.

7. In a plate graining machine the combination with a treating chamber and a loading platform adjacent the treating chamber, said treating chamber comprising a housing having a side opening adjacent the loading platform providing communication therebetween and a hinged cover providing access to the interior of the treating chamber, said cover having a portion extending at least partially across the side opening of the housing to partially close the opening when the cover is closed and swingable away therefrom to expose the opening, of a track between said chamber and platform, a carriage movable on said track, said carriage being provided with bearings, a cylindrical drum rotatably mounted on the carriage bearings, said drum being provided with an axle carried by the bearings and with driven means on the axle, said carriage being further provided with a shield between the drum and driving means and adapted to cooperate with the housing cover flange to separate the drum from the driven means when the drum is disposed within the housing with the cover closed.

8. The device of claim 7 wherein the carriage shield and cover flange overlap, said drum axle being further provided with a disk disposed to closely parallel the shield and flange and to substantially span the central portion of the joint between the shield and flange.

9. In a plate graining machine having an exposed loading platform, a housed treating chamber and a cylindrical drum with an axially aligned driven part, said drum being movable between said platform and chamber including a position in the chamber with the driven part ex-

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posed, a drum driving mechanism comprising in combination with said driven part, a driving part engageable with said driven part, a pivotal mounting for said driving part whereby said part is movable laterally from the path of drum movement, and lock means for selectively fixing the position of the driving part in engagement with said driven part and in disengaged position out of the path of drum movement.

10. The drive mechanism of claim 9 wherein the mounting for the driving part comprises a pivotal arm, said lock means comprising a fixed sector and a manually operable detent carried by the arm and releasably engageable with the sector at selected positions of the driving part.

11. In a plate graining machine having a rotatable cylindrical drum carrying a plate and a fluid-borne abrasive jetting nozzle, a mounting for the nozzle including a carriage and a track paralleling the drum, a nozzle drive mechanism comprising a threaded portion fixed to the mounting, a lead screw paralleling the track and engaged with the mounting thread, power means for turning the lead screw and control means including switch elements actuated by carriage movement to stop the carriage at the end of each nozzle traverse of the drum, said switch elements being interconnected, said interconnection comprising means for opening one switch automatically upon closure of another.

12. In a plate graining machine having a rotatable cylindrical drum carrying a plate and a fluid-borne abrasive jetting nozzle, a mounting for the nozzle including a carriage and a track paralleling the drum, a nozzle drive mechanism comprising a threaded portion fixed to the mounting, a lead screw paralleling the track and engaged with the mounting thread, power means for turning the lead screw and control means including switch elements actuated by carriage movement to stop the carriage at the end of each nozzle traverse of the drum, a housing enclosing the drum, said housing including a separate chamber housing the nozzle mounting and drive mechanism, said nozzle extending into the drum housing and into proximity to the drum, said drum housing and drive mechanism chamber being separated by a pair of flexible self supporting curtains extending from the sides of the housing to overlap the nozzle mount, said mount being of streamlined contour in the plane of nozzle movement to conform the curtains to the mount.

13. The device of claim 12 provided with a second pair of overlapping curtains spaced from said first pair to provide a flexible baffle between said drum housing and drive mechanism chamber.

14. In a plate graining machine having a cylindrical drum to peripherally support a normally flat plate thereabout, a plate clamp mechanism comprising paired clamp bars mounted on the drum, said clamps being individually separable from the drum periphery to respectively receive opposed margins of the plate between the respective clamps and drum periphery, in combination with a roller normally biased against said drum periphery to coact with one of said clamps to tension the plate between said clamp and roller as the plate is rolled on the drum.

15. In a plate graining machine having a cylindrical drum to peripherally support a normally flat plate enveloped thereabout and a fluid-borne abrasive jetting nozzle mounted to traverse said drum, said drum being provided with an up-

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standing lug and said plate having an apertured margin engageable with said lug, a plate clamp mechanism comprising a first clamp bar to secure said apertured margin of the plate against the drum with said aperture aligned with the drum lug, a roller having a pivoted mounting adapted to selectively pressure the plate against the drum periphery as the drum is rotated to envelope the drum with the plate, and a second clamp bar to clamp the opposite margin of the plate to the drum periphery.

16. The mechanism of claim 15 wherein said first and second clamp bars are laterally spaced and are provided with a mutually embracing cover to protect the respective clamp bars and the drum surface between the clamp bars from the abrasive.

17. In a plate graining machine having a rotatable drum, a nozzle mounted to traverse the drum, a supply to the nozzle of liquid borne abrasive and means for forceably jetting the abrasive toward the drum, an interlock control system comprising means for controlling abrasive jetting, and means dependent upon drum rotation and nozzle traversing movement for actuating the abrasive jetting control means.

18. The interlock control system of claim 17 wherein the interlock control system comprises an electrical circuit including a switch operative to control abrasive jetting, a switch closed upon commencement of drum rotation, and a switch closed on commencement of nozzle traverse movement, said switches being in series to make abrasive jetting dependent on drum rotation and nozzles traversing movement.

19. In a plate graining machine having a rotatable drum, a nozzle mounted to traverse the drum and drive means for the nozzle, a supply to the nozzle of liquid-borne abrasive and means for forceably jetting the abrasive toward the drum, an interlock control system comprising

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means for controlling abrasive jetting, means for controlling nozzle drive, said nozzle drive control means including means for stopping nozzle traverse at each end of the drum, said abrasive jetting control means being responsive to said stopping to stop the jet and responsive to nozzle drive starting to start the jet.

20. The interlock control system of claim 19 wherein nozzle driving and abrasive jetting are electrically controlled, said nozzle drive control means comprising a switch closed upon nozzle traversing movement, said nozzle jetting control comprising an electrically energized element in series with said switch.

21. The device of claim 20 in combination with a second nozzle drive switch, said switch being in parallel with said first mentioned switch, said switches being alternately opened and closed by means responsive to the direction of nozzle traverse.

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