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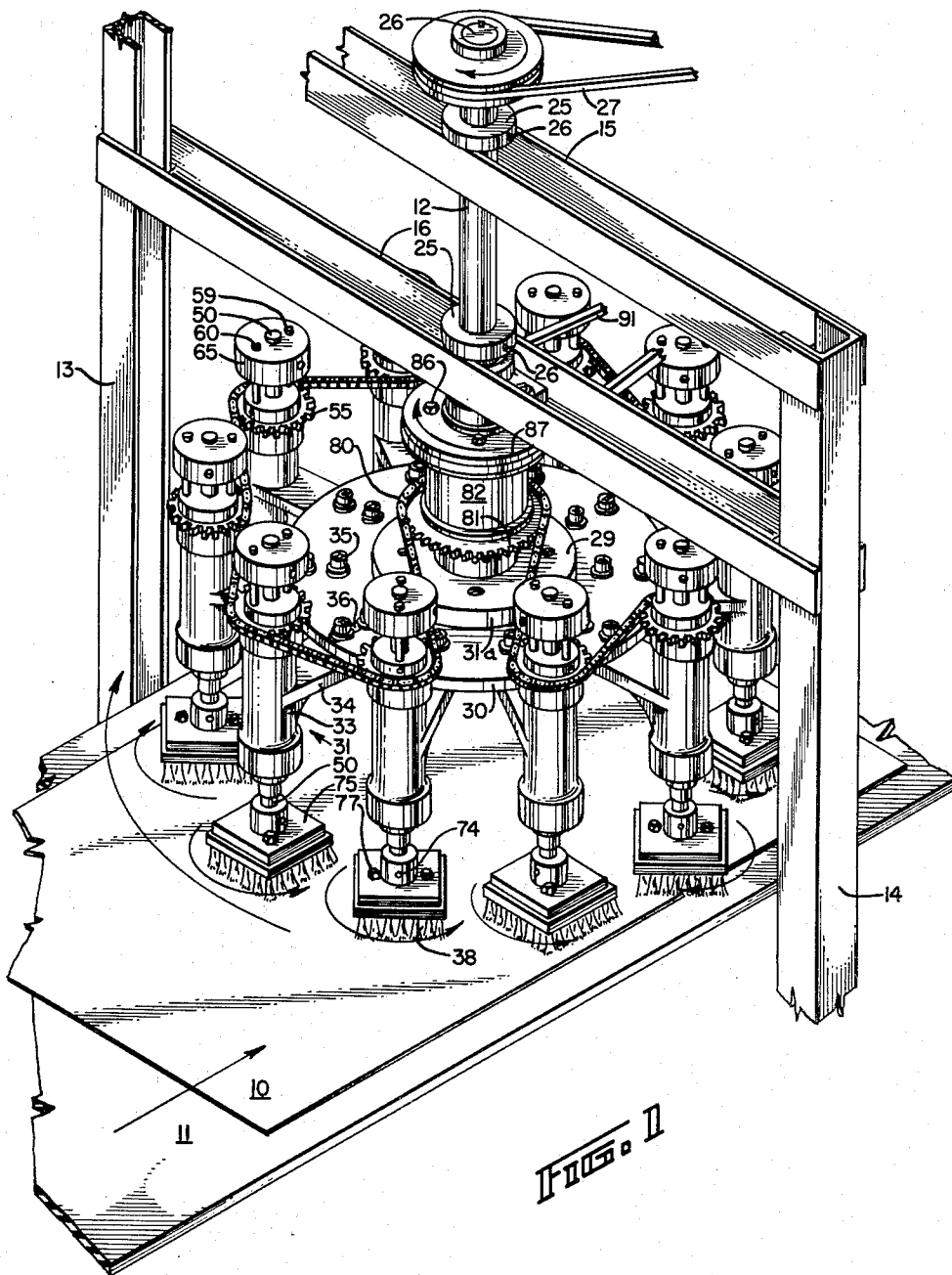
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2,948,087

PLATE GRAINING APPARATUS

Filed Nov. 3, 1958

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

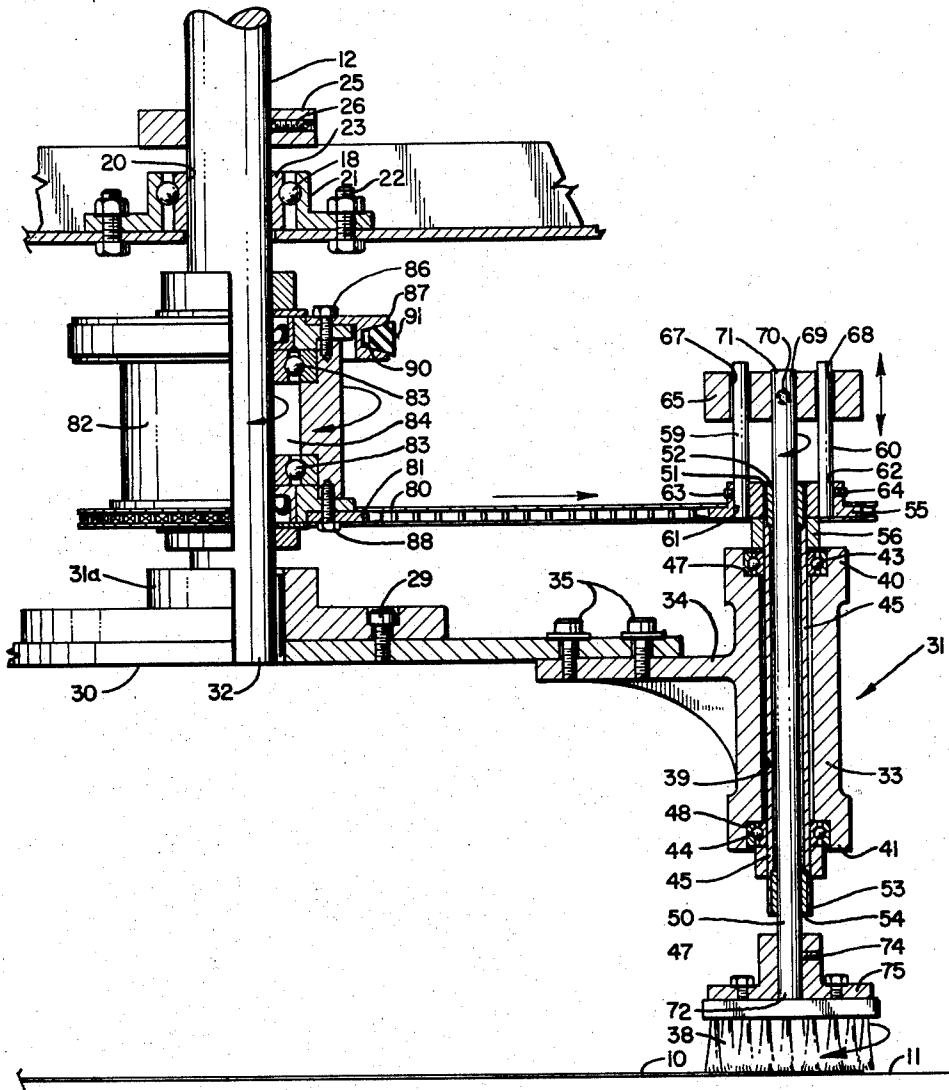


FIG. 2

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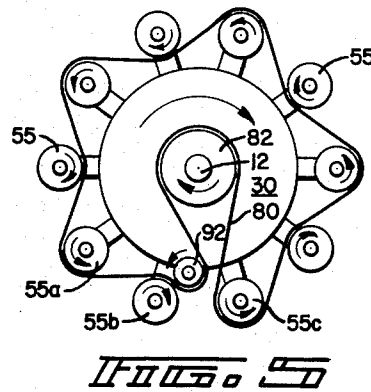
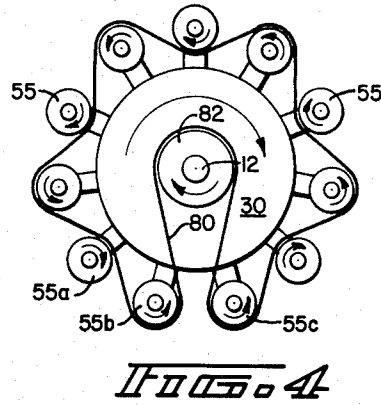
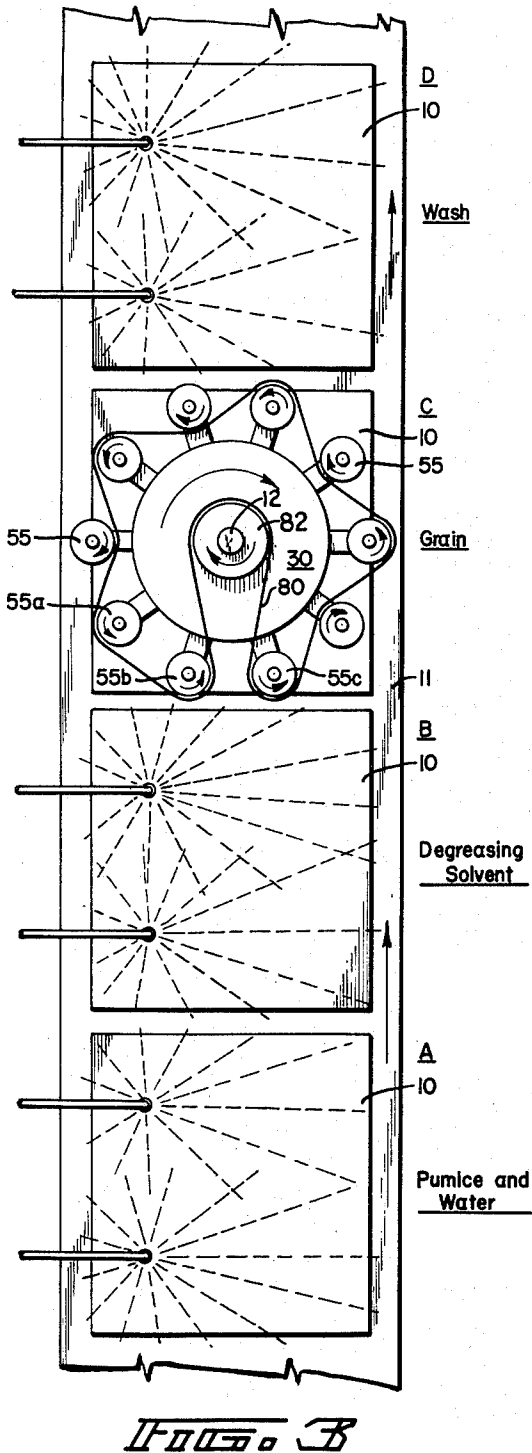
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PLATE GRAINING APPARATUS

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9 Claims. (Cl. 51—120)

This invention relates to an apparatus for preparing a plate of aluminum, zinc, plastic or the like for use in photolithographic processes by imparting a grain of minute depressions to the surface of the plate. These depressions are utilized to carry solutions which keep the plate in desensitized condition on non-printing areas thereof, yet retain an ample supply of a light-sensitive solution on the printing areas of the plate.

While apparatus for graining lithographic plates are known in the art, such apparatus have proved incapable of producing a plate with the degree of uniformity of grain necessary for exceptionally fine workmanship. Thus machines in which spherical marbles are agitated over a layer of pumice and water on a plate have produced an uneven grain which can never be reproduced exactly, since it was produced by the chance contact of marble against pumice. Machines employing brushes which extend outwardly from a cylindrical surface and contact a plate tend to apply the grain in streaks, and the uniformity and depth of grain is subject to the degree of wear of the individual brush strands.

Accordingly, it is an object of this invention to provide a plate graining apparatus which imparts a definite, well-defined and uniform grain to a lithographic plate.

It is another object of this invention to provide a plate graining apparatus which applies an unusually fine grain of minute cups to a lithographic plate.

It is still another object of this invention to provide a plate graining apparatus which applies a grain to lithographic plates without appreciably wearing down the surface of a plate so that a plate may be regained and reused many times. An apparatus according to this invention has, for example, been used to grain an aluminum plate $\frac{7}{1000}$ of an inch thick from 20 to 30 times, thus greatly lowering the cost of the lithographic process.

According to this invention, the actual graining of a plate is accomplished by a plurality of brushes acting on a thin layer of pumice and water overlying the surface of the plate. The brushes are held in fixed, spaced relationship to each other. Further parts of the apparatus include means to revolve the brushes together about a single axis and means to rotate the brushes individually about substantially parallel axes, so that each brush revolves and rotates simultaneously.

In order to revolve the brushes, which are fixed along the circumference of a flat, circular support or carrier, the support rotates on its axis about a shaft. The brushes are individually rotated by means of a chain drive from a drum axially mounted on the shaft for rotation independent of the shaft. The chain drive and the shaft may be actuated by independent power sources.

Each brush is secured along the circumference of the circular support by a holder which comprises a vertical sleeve having an axial bore therethrough. While the sleeve is fixed to the support, a tube is rotatably mounted on bearings within the sleeve, and a bushing or oilite bearing within the tube permits a spindle mounted therein to move axially with respect to the tube. Each tube is

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rotated by a planetary gear, which is moved by a chain drive actuated by a sun gear on the drum.

The spindle projects upwardly and downwardly of the tube. On its downward projection is fixed a removable brush to force the pumice against the plate. On its upward projection is fixed a removable weight to exert an axial, downward force on the spindle and brush in the direction of the plate. Weights may be interchanged so that the force on the brush, and thus the depth of the grain produced, may be varied. As the frictional force between the oilite bearings and the spindle is not sufficient, in itself, to rotate the spindle at a proper speed, pins extending upwardly from the planetary gear through apertures in the spindle-bound weight function to rotate the weight and, consequently, the spindle.

An important feature of the invention is the actuation of the planetary gears of the brush holders so that, generally, adjacent brushes rotate in opposed directions. Such counter-rotation has the effect of keeping the pumice over the plate throughout the graining of the plate. If all the brushes rotated in the same direction, the pumice would soon be swept from the plate and the graining would become uneven.

It is, however, not possible to have all adjacent brushes rotate in opposite directions off the same chain drive unless an idler wheel or other device is utilized. When there is an even number of brushes, three adjacent brushes must rotate in the same direction; when there is an odd number of brushes, two adjacent brushes must rotate in the same direction. Through the use of an idler wheel, every adjacent brush of an even number thereof may be driven in an opposite direction of rotation.

These and other objects, features and advantages of this invention will become more apparent from the following detailed description of an illustrative embodiment of the invention. The detailed description hereinafter refers to the accompanying drawings, which form a part hereof, and in which:

Fig. 1 is a perspective view of an embodiment of the invention;

Fig. 2 is a side elevational view, partly in section, of important parts of the apparatus;

Fig. 3 is a diagrammatic illustration of a method using the apparatus of Figs. 1 and 2;

Fig. 4 is a diagrammatic illustration of a modified form of the apparatus, and

Fig. 5 is a diagrammatic illustration of a further modified form of the apparatus.

Referring now to the drawings, and in particular to Figs. 1 and 2 thereof, the plate graining apparatus is illustrated in position to force pumice or similar abrasives (not shown), such as sand, powered glass, silicates and oxides, against a plate 10 lying on a movable belt 11 and carried by that belt into graining position beneath the apparatus. The abrasive is conventionally applied to the plate 10 with water, so that a thin layer of abrasive suspended in water is formed on the upper surface of each plate 10 before the plate passes beneath the graining apparatus.

The apparatus has, as its prime mover, a shaft 12 vertically suspended between the relatively heavy bars 13 and 14 and supported for rotational movement by the cross beams 15 and 16. In a conventional manner the shaft 12 is journaled in bearings 18 for rotation in apertures 20 in the beams 15 and 16. The outer bearing races 21 are attached to the beams 15 and 16 by means of bolts 22, while the inner bearing races 23 are bonded about the shaft 12.

The weight of the shaft 12 and those parts of the apparatus connected to the shaft is supported by the bearings 18 and the collars 25, which overlie the bearings 18 and keep the shaft 12 from sliding through the bearings. The collars 25 are attached to the shaft 12 for rotation

therewith by set screws 26. The beams 15 and 16 also support the inner bearing races 23, which thus sustain the weight of the shaft 12 and the parts held thereby.

Rotation of the shaft 12 is accomplished by a pulley 25 positioned on the upper end 26 of the shaft 12 and a belt 27 driven by a primary motor (not shown) of standard construction.

Rotation of the shaft 12 causes rotation of a flat, circular support or carrier 30, which is firmly bolted at 29 to a collar 31 at the lower end 32 of the shaft 12. The support 30 has a relatively large radius and is of sturdy construction to bear the brush holders 31 spaced along the circumference of the support 30. The apparatus of Fig. 1 is shown with ten holders, but as will be seen in Fig. 4, other numbers of holders can be used. In actual practice the number of holders will depend upon the physical dimensions of the support 30, the larger the support the greater number of holders which can be used. The larger the plate 10 to be grained, the greater the diameter of the support 30 and the number of holders 31 required.

Each of the holders 31 has a sleeve or casting 33 with an arm 34 integral with the sleeve and extending outwardly therefrom in a horizontal plane. The arm 34 may be fixed directly to the support 30 by bolts 35 mounted in registered, threaded apertures in the arm 34 and the support 30. Such attachment is shown in the drawings. An alternative method of attachment is to have a series of slots 36 extending radially inwardly from a point near the circumference of the support 30 toward the axis of the support. For the purposes of illustration, one such slot 36 is shown in Fig. 1. Bolts 35 passing through the slot 36 and apertures in the arm 34 retain the holders 31 in an inwardly or outwardly adjusted position. In an embodiment of the invention in which the slots 36 are to be utilized, each holder will have its corresponding slot, so that all the holders may be adjusted relative to the dimensions of the plate to be grained. Slots 36 may alternatively be formed in the arm 34 instead of the support 30.

The brush holders 31 function to maintain the brushes 38 in vertical position exerting a force on the plate 10 and the layer of pumice on the plate. The holders 31 also maintain the brushes 38 so that they may be individually rotated. In order to accomplish these functions a sleeve 33 of each holder 31 is held in substantially vertical position. An elongated bore 39 extends uniformly through the axial region of the sleeve 33 except at the upper end 40 and the lower end 41 of the sleeve. Annular grooves formed at these ends provide space for bearings 43 and 44, which permit a tube 45 mounted in the bore 39 to rotate while the sleeve 33 remains stationary. Because the bearing 43 abuts the shoulder 47 and the bearing 44 abuts the shoulder 48 of the sleeve 33, the tube 45 is fixed against axial movement.

Mounted within the tube 45 for rotational movement therewith is a spindle 50, which is longer than either the sleeve 33 or the tube 45. As may be most clearly seen in Fig. 2, the tube 45 has portions extending both upwardly and downwardly beyond the sleeve 33. At the upper end 51 of the tube 45 an annular recess formed in the inner surface of the tube provides a seat for a bushing or oilite bearing 52. At the lower end 53 of the tube 45 a similarly formed annular recess provides a seat for a similar bushing 54.

The spindle 50 does not contact the tube 45 directly, but fits snugly within the bushings 52 and 54 so that, while the spindle 50 rotates with the bushings 52 and 54, it is also capable of axial motion relative to those bushings.

Rotational movement is imparted to the tube 45 and the spindle 50 by a planetary gear 55 fixed to the upper end 51 of the tube 45. No relative motion is permitted between the planetary gear 55 and the tube 45. Directly below and providing a rest for the planetary gear 55 is

a spacing ring 56 fixed to the inner race of the bearing 43. Thus the planetary gear 55, the spacing ring 56 and the tube 45 all rotate together. The spacing ring 56 is fixed to the gear 55 and allows the gear 55 to function without directly contacting the stationary sleeve 33.

As the planetary gear 55 rotates, two pins 59 and 60, axially aligned with the spindle 50 and held in bores 61 and 62 in the planetary gear 55 by set screws 63 and 64, revolve about the axis of the spindle 50. The purpose of the pins 59 and 60 is to rotate a weight 65 in accordance with the rotation of the planetary gear 55. The weight 65 has three bores sunk therein: eccentrically located bores 67 and 68 to allow passage of the pins 59 and 60 therethrough, and an axial bore 69 which snugly receives the spindle 50. One or more set screws 70 keep the weight 65 fixed to and rotatable with the spindle 50 at the upper end 71 thereof, the weight 65 being spaced from the planetary gear 55.

Attached to the lower end 72 of the spindle 50 by means of a set screw 74 is a brush head 75, to which a suitable brush 38 of brass wire, nylon, stainless steel or the like is bolted at 77. By release of the set screw 74 or by other means the entire brush head 75 and the attached brush 38 are removable for repair or replacement.

From this detailed description of a holder 31 it will be seen that constant force in a downward direction is maintained on a brush 38 by the weight 65, for the spindle 50 is able to move vertically within the bushings 52 and 54 and the weight 65 tends to force the spindle 50 toward the plate 10. The weight 65 is easily removed by loosening the set screw 70, so that the depth of the grain applied to the plate 10 may be varied, the heavier the weight utilized the deeper the grain applied.

Due to the relatively heavy load carried by each spindle 50, the rotation of a planetary gear 55 does not impart sufficient torque to the spindle 50 through the bushings 52 and 54 to cause the spindle 50 to rotate uniformly at the desired angular velocity. This is because the fit of the spindle 50 within the bushings 52 and 54 must be free enough to permit the axial movement of the spindle therein. The pins 59 and 60, therefore, assume most of the burden of rotating the spindle 50, while bushings 52 and 54 assist primarily in maintaining such motion once it has been established.

Rotational motion is applied to the gear 55 by means of a chain 80, which is itself actuated by a sprocket wheel 81 positioned on the lower portion of a generally cylindrical drum 82 axially mounted on the shaft 12. The sprocket wheel 81 acts as a sun gear for the train of planetary gears 55 which revolve about the sprocket wheel 81.

The drum 82 is connected to the shaft 12 by means of bearings 83, the drum 82 being spaced from the shaft 12 at 84 to provide room for the inner races and balls of the bearings 83. While the drum 82 is held against axial movement with respect to the shaft 12, the drum 82 is capable of rotational movement independent of the shaft 12 and may rotate when the shaft 12 is at rest. The drum 82 can also rotate when the shaft 12 is rotating, either at the same speed or at a faster or slower speed than the shaft 12. The drum 82 and the shaft 12 can be rotated in the same or opposite directions, but the vibration which occurs when the directions of rotation are opposed makes it preferable to have the shaft and drum rotate in the same direction.

A secondary source of power (not shown) operates the drum 82. Secured to an upper portion of the drum 82 by bolts 86 is an outwardly turned flange 87. As illustrated, the sun gear 81, connected to the drum 82 by bolts 88, and the flange 87 occupy opposed positions on and project approximately the same distance from the drum 82. The flange 87 is provided with a groove 90 in the outer surface thereof to receive a V-belt 91 in frictional engagement with the sides of the groove 90. The V-belt 91 is moved by the secondary source of power.

An important feature of this apparatus is the direction

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of rotation of the planetary gears or sprockets 55, and consequently the spindles 50, as caused by the chain 80. As seen in perspective view in Fig. 1 and diagrammatically in Fig. 3, one embodiment of the invention when an even number of holders 31 is used is to loop one chain portion coming off the sun gear 81 outside the first two planet gears 55a and 55b and the other chain portion from the sun gear 81 outside the planet gear 55c, all three planet gears being adjacent. The remainder of the chain 80 is alternately looped inside and outside adjacent planet gears 55 until the continuous chain has been completed. In this arrangement all adjacent planet gears 55 rotate in opposite directions except gears 55a, 55b and 55c, which rotate in the same direction. If the sun gear 81 rotates clockwise, planet gears 55a, 55b and 55c rotate counterclockwise.

Another arrangement of the chain 80 where an even number of holders 31 is used is shown in Fig. 5. This arrangement is the same as that of Figs. 1 and 3 except that the chain 80 is looped inside, not outside planet gear 55b and an idler sprocket or wheel 92 supports the chain 80. In this arrangement each planet gear rotates counter to its adjacent gear, this holding true even in the case of the gears 55a, 55b and 55c. Idler sprocket 92 does not rotate a brush 38.

Still another arrangement of the chain 80 suitable for use when an odd number of planet gears 55 is to be used, is illustrated in Fig. 4. Here only adjacent planet gears 55b and 55c rotate in the same direction, the other adjacent gears rotating in opposite directions. Planet gears 55b and 55c rotate in a direction counter to the direction of rotation of the sun gear 81.

It has been determined that rotation of adjacent spindles 50 in opposite directions tends to keep pumice on the surface of the plate 10 as that plate passes beneath the brushes 38. The pumice is, in addition to being forced against the plate 10, also forced back and forth between adjacent brushes. Where spindle rotation is in the same direction, the pumice is quickly pushed off the surface of the plate 10 and uneven graining results.

The steps of a method of using the apparatus according to the present invention are set forth diagrammatically in Fig. 3. A mixture of pumice and water is applied to a plate 10 at A, and a degreasing solvent is applied at B. The graining of the plate 10 is accomplished through the use of the apparatus of the invention at C. At D the plate 10 is washed free of solvent and pumice. The plate is then dried and treated further as desired. The belt 11 carries the plate 10 through these steps of the method in the order named.

In practice, a belt speed of approximately 3 feet per minute has been found satisfactory. Also, it has been found advantageous to rotate the spindles 50 and the shaft 12 in the same direction, practical speeds being 1100 to 1300 r.p.m. for each spindle 50 and 60 to 100 r.p.m. for the shaft 12.

While a preferred embodiment of the invention has been described hereinbefore and illustrated in the accompanying drawings, it will be apparent that the novel features of the invention may be embodied in other forms. It is desired, therefore, that the invention be limited only by the scope of the following, appended claims.

What is claimed is:

1. An apparatus for applying a grain to the surface of a plate, comprising a plurality of rotatable brushes for forcing pumice against the surface of said plate to put a grain on said surface, means for holding said brushes in fixed, spaced relationship to each other and against said pumice on said plate, means for revolving said brushes together about a single axis, and means for rotating said brushes individually about substantially parallel axes, adjacent ones of said brushes being rotated in opposed directions by said rotating means, so that each of said brushes simultaneously revolves and rotates to force said pumice against said plate and the opposed directions of

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rotation of said adjacent ones of said brushes tends to keep said pumice on said plate.

2. An apparatus for applying a grain to the surface of a plate for use in photolithographic processes, comprising a plurality of rotatable brushes for forcing pumice against the surface of said plate to put a grain on said surface, means for holding said brushes in fixed, spaced relationship to each other and against said pumice on said plate, means for revolving said brushes together about a single axis, and means for rotating said brushes individually about substantially parallel axes, a majority of adjacent brushes rotating in opposite directions, said rotating means including a drum having an axial bore there-through and carrying means imparting rotational motion to said drum and a sprocket wheel for transmitting said rotational motion of said drum to planetary gears, each of said planetary gears rotating one of said brushes, said rotating means also including a chain overlying said sprocket wheel and opposite portions of adjacent gears, so that each of said brushes simultaneously revolves and rotates to force said pumice against said plate and the opposite directions of rotation of adjacent brushes tend to keep said pumice on said plate.

3. An apparatus for applying a grain to a plate as claimed in claim 2, in which there are an odd number of brushes and an odd number of corresponding planetary gears, and only two adjacent planetary gears rotate in the same direction.

4. An apparatus for applying a grain to a plate as claimed in claim 2, in which there are an even number of brushes and an even number of corresponding planetary gears, and only three adjacent planetary gears rotate in the same direction.

5. An apparatus for applying a grain to a plate as claimed in claim 2, in which there are an even number of brushes and an even number of corresponding planetary gears, one of said planetary gears having an idler wheel adjacent thereto, said chain overlying a portion of said idler wheel, and no adjacent planetary gears rotate in the same direction.

6. In an apparatus for applying a grain to the surface of a plate, comprising a plurality of rotatable brushes positioned adjacent to said surface for applying a force against said surface, means holding said brushes in spaced relationship to each other adjacent to said plate, means for revolving said brushes together about a single axis so that there is a succession of brushes contacting one after another an area of said plate to be grained, and means for rotating said brushes individually about substantially parallel axes, adjacent brushes of said succession being rotated in opposed directions by said rotating means.

7. In an apparatus for applying a grain to the surface of a plate, said apparatus including a plurality of brushes located adjacent to said surface for applying a force thereagainst and a support positioned substantially parallel to said plate for supporting said brushes in spaced relation to each other; individual means for holding each of said brushes, said means comprising a sleeve attached to said support and having an elongated bore there-through, a tube journaled in said bore for rotational movement with respect to said sleeve, a portion of said tube forming an inner bearing surface, and a spindle positioned in said tube and against said bearing surface for axial movement with respect to said tube and for rotation therewith, one of said brushes being connected to said spindle at one end portion of said spindle.

8. An apparatus for applying a grain to the surface of a plate, said apparatus including a plurality of brushes located adjacent to said surface for applying a force thereagainst and a support positioned substantially parallel to said plate for supporting said brushes in spaced relation to each other; individual means for holding each of said brushes, said means comprising a sleeve attached to said support and having an elongated bore there-

through, a tube journaled in said bore for rotational movement with respect to said sleeve, a portion of said tube forming an inner bearing surface, a spindle positioned in said tube and against said bearing surface for axial movement with respect to said tube and for rotation therewith, said spindle having portions thereof extending upwardly and downwardly from said tube, and a weight carried by said spindle on said upwardly extending portion for exerting a downward force on said spindle, one of said brushes being connected to said spindle at said downwardly extending portion of said spindle.

9. In an apparatus for applying a grain to the surface of a plate, said apparatus including a plurality of brushes located adjacent to said surface for applying a force thereagainst and a support positioned substantially parallel to said plate for supporting said brushes in spaced relation to each other; individual means for holding each of said brushes, said means comprising a sleeve attached to said support and having an elongated bore there-through, a tube journaled in said bore for rotational movement with respect to said sleeve, a portion of said tube forming an inner bearing surface, a spindle positioned in said tube and against said bearing surface for

axial movement with respect to said tube and for rotation therewith, said spindle having portions thereof extending upwardly and downwardly from said tube, a weight carried by said spindle on said upwardly extending portion for exerting a downward force on said spindle, a brush connected to said spindle at said downwardly extending portion of said spindle, a gear wheel mounted on said tube for rotation with said tube and said spindle, and power means for imparting rotary motion to said gear wheel and thereby rotating said brush.

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