United States Patent

[11] **3,559,558**

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[54] **ROTARY PROCESSING APPARATUS FOR PHOTOLITHOGRAPHIC PLATES**
8 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **95/93,** 95/89
[51] **Int. Cl.** **G03d 3/08**
[50] **Field of Search** ..... 95/89, 93, 94; 118/304, (Inquired); 101/(Inquired); 134/(Inquired)

[56] **References Cited**
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3,088,391	5/1963	Sigler	95/93
3,271,226	9/1966	Staehle et al.	95/89X
3,416,920	12/1968	Limberger et al.	95/89X
3,435,748	4/1969	Cannon	95/89

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ABSTRACT: An automatic rotary-processing apparatus for photolithographic plates having a magnetic drum on which the plate is fastened while it is processed. The apparatus contains a developer tray, a rinse chamber incorporating a squeegee, pressure-scrubbing rolls, washing sprays, a treatment chamber having sprays, and a squeegee. The apparatus may also include a drying member for the processed plate. The plate is automatically moved in sequence through the developing tray, rinse chamber, treatment chamber, and past the squeegee and drying member. Mechanism are provided for controlling the operation of the squeegees, scrubbing rolls, and sprays.

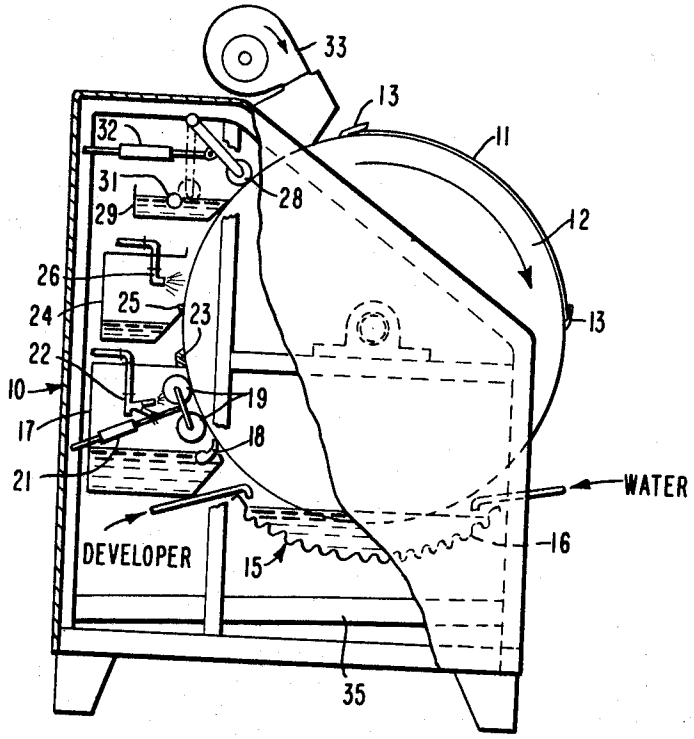

FIG. 1

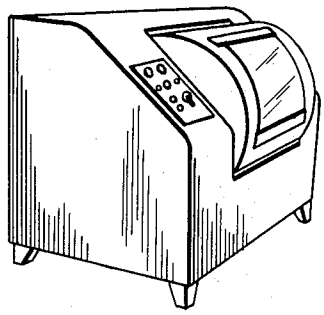

FIG. 4

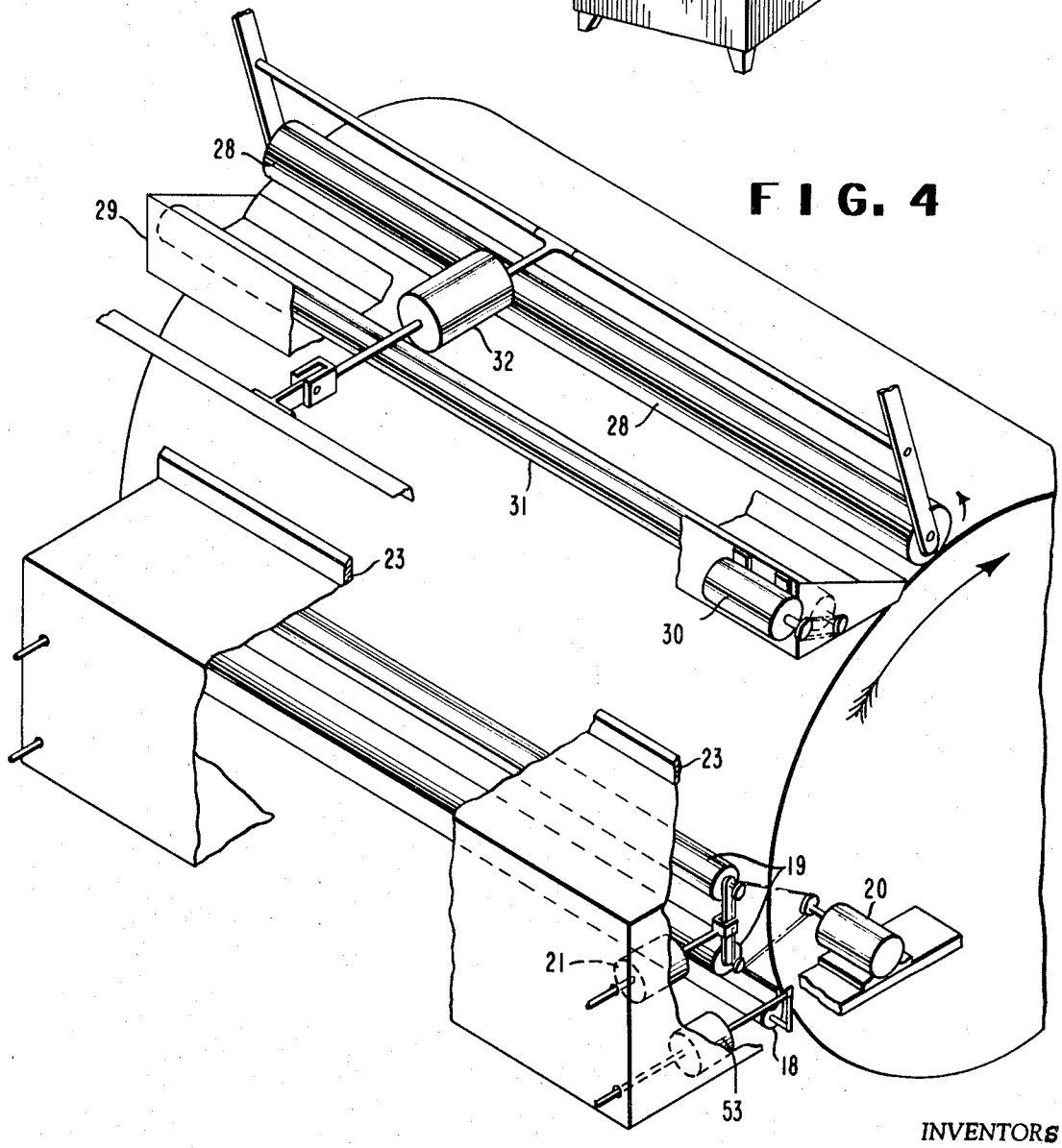

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FIG. 2

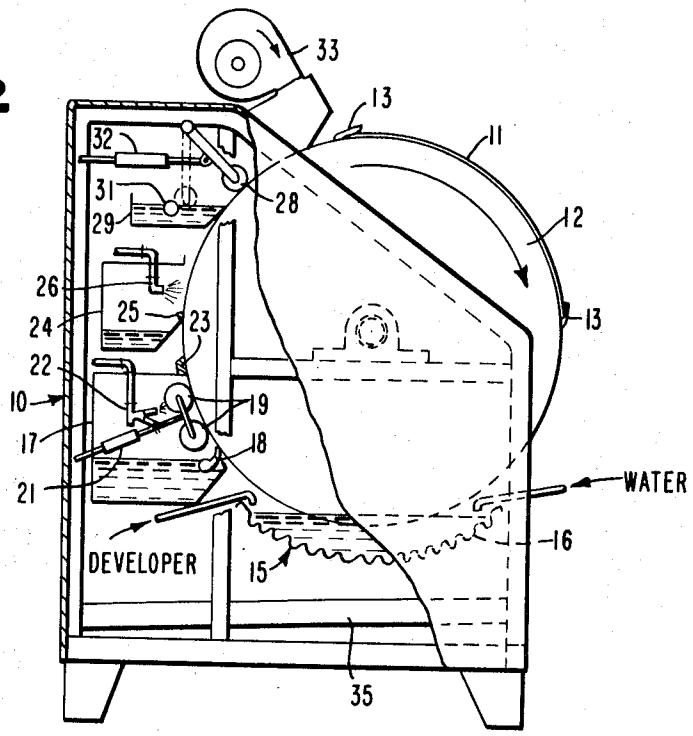
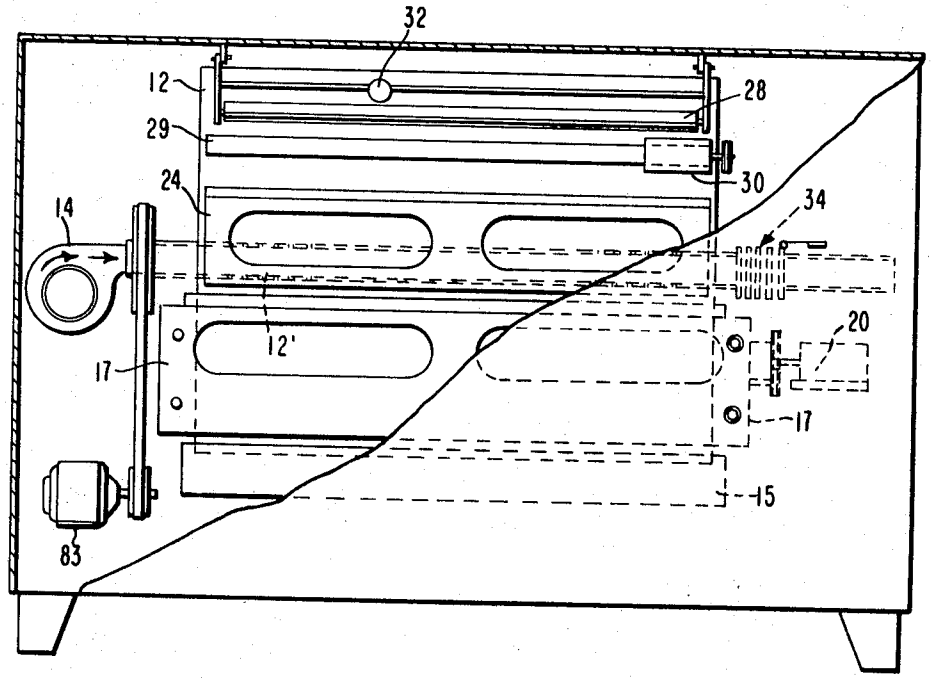


FIG. 3



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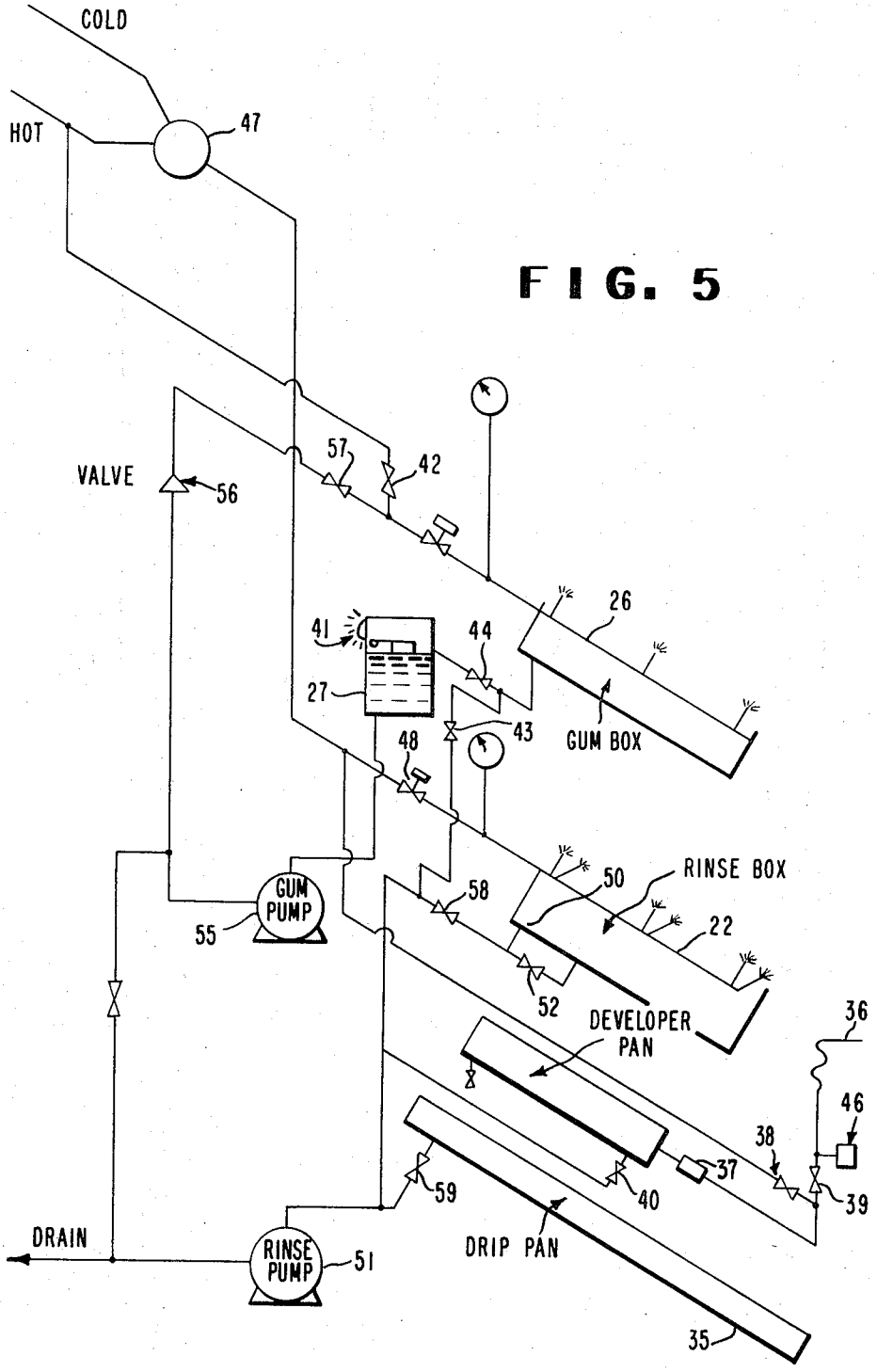

FIG. 5

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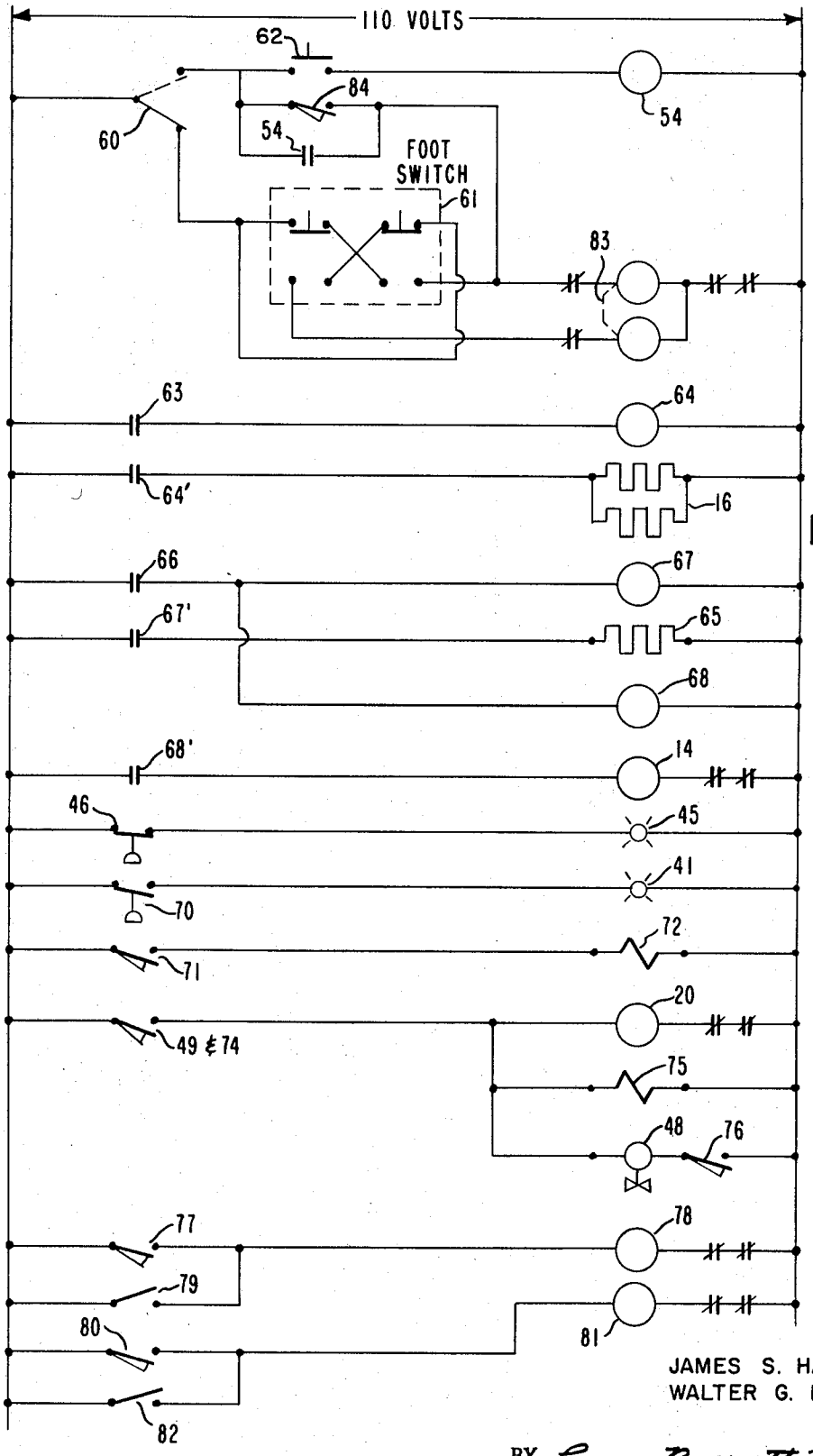

FIG. 6

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ROTARY PROCESSING APPARATUS FOR PHOTOLITHOGRAPHIC PLATES

BACKGROUND OF THE INVENTION

In order to process a photopolymer aluminum lithographic plate such as that described in Alles, U.S. Ser. No. 560,889 filed June 27, 1966, now abandoned, an apparatus is needed which will provide an easily controlled, reproduceable developing process. The apparatus of this invention accomplishes the development by combining a soaking action provided by a pool of developer with the scraping and scrubbing action of a squeegee and scrubbing rolls to remove softened unpolymerized material.

Assignee's copending application by Krikelis, Ser. No. 698,168 filed Jan. 16, 1968 discloses a linear lithoplate processor in which a plate is sequentially soaked in a developer, sprayed with water to erode softened portions of the sensitive coating, dried, treated with a gum arabic solution; and polished.

Sigler, U.S. Pat. No. 3,088,391 discloses a rotary-processing machine for photopolymer sheet materials in which the sheet is fastened to a drum with mechanical clamps and rotated while being sprayed with a developer to produce a relief image.

SUMMARY OF THE INVENTION

The invention is a lithographic plate-processing apparatus for automatically processing a presensitized lithographic plate having a photohardenable sensitive layer by a series of steps arranged in combination to provide a continuous and complete processing of an exposed plate which comprises a frame carrying, in combination:

a. a rotary drum for supporting and carrying the exposed plate;
b. a developer pan adapted to supply a developer solution to the layer on the plate as it rotates, to soften the unexposed areas of the layer;
c. adjacent the pan, a rinsing chamber adapted to remove the unexposed portion of the photohardenable layer from the surface of the plate by a rinsing solution, said rinsing chamber having in combination:
   1. squeegee means adapted to remove part of the softened unexposed photohardenable layer;
   2. one or more rolls adapted to scrub the plate and remove additional unexposed parts of the layer;
   3. spray means adapted to flush the plate and rolls with an aqueous washing solution;
d. a treating chamber having spray means adapted to apply a treating liquid to the surface of the plate;
e. means adapted to remove excess treating liquid from the plate;
f. optionally, means adapted to dry the surface of the plate; and
g. means for controlling the sequential operation of the parts of the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus of the present invention can embody a construction and arrangement of parts that is apparent from the following description when read in conjunction with the accompanying drawings. In the drawings:

FIG. 1 is an isometric front view of the apparatus;
FIG. 2 is a side elevation with parts in section;
FIG. 3 is a rear elevation;
FIG. 4 is an isometric view of the rinse chamber and squeegee roll;
FIG. 5 is a plumbing diagram; and
FIG. 6 is an electrical diagram.

The novel apparatus and its operation will be described with reference to the processing of an exposed presensitized lithographic plate having a photohardenable image layer such as that described in Alles, U.S. Ser. No. 560,889, filed June 27, 1966.

Referring to the drawings, in which the same number always refers to the same part in each of the drawings, the apparatus consists of a frame **10** to which are attached the component parts of the apparatus. The sequential operation of the parts of the apparatus can most easily be seen in FIG. **2**.

An exposed plate **11** is clamped to drum **12** by fastening means, e.g., strips **13** of plastic material, e.g., rubber having embedded therein magnetic material. The strips extend over the edges of the plate. The processing cycle is started, the drum revolving at about 1 revolution per minute in the direction indicated. The drum is maintained at a temperature of 90° F. by a hot air blower (**14**, FIG. **3**) which blows heated air into the drum through its hollow perforated axle **12'**. The plate is carried by the revolving drum through the developer solution in tray **15**, which can have a curved bottom to reduce the volume of developing solution. The solution is maintained at a desired temperature, e.g., 90° F. by an electrical heating platen or blanket **16**.

The plate next passes through rinse chamber **17**. As it passes through the rinse chamber, squeegee **18**, which can be moved by pneumatic means or other means **53**, rotates from a retracted position in the water in the rinse chamber. Scrub rolls **19** press against the surface of the plate and remove unexposed areas of the photopolymerizable layer which have been softened by the developer. In operative position, the squeegee prevents rinse water from running into the developer pan. At the same time, the rinse rolls **19** are rotated opposite to the drum motion by electric motor **20**. The rolls are pressed against the plate by air cylinders **21** and complete removal of the unexposed photopolymerizable coating. The water sprays **22** are actuated automatically to flush away the removed material and to prevent matting of the scrub roll nap. Excess water is removed from the plate by a resilient wiper **23** near the exit from the rinse chamber. After the plate passes through chamber **17**, the water sprays and scrub rollers are deactivated, the rollers are retracted, and the squeegee is returned to its storage position beneath the surface of the water in the rinse chamber, its other surface being cleaned by the scrub roll as it returns.

The plate then passes through the treatment chamber **24** traversing first a flexible (e.g., rubber) seal **25**. When the plate enters the treatment chamber the treatment liquid sprays **26** are activated circulating treatment liquid from the treatment liquid reservoir **27** through the sprays and onto the plate, from which it drains back to the treatment liquid reservoir. After the plate has passed through the treatment chamber, the treatment spray is deactivated.

A squeegee roll **28** then removes the excess treatment liquid from the plate. This roll can be stored in a water tank **29** and rotated while in storage by an electric motor **30** through a friction drive roll **31**. The roll is pressed against the plate automatically by an air piston **32** when the plate arrives at this station and is retracted after the plate has passed.

Optionally a drying station **33** may be included equipped with a hot air blower and distribution ducts for directing the warm air onto the plate surface to dry it.

When the drum has rotated one full revolution so that the plate has returned to its original position the drum stops and the operator may remove the processed plate.

The automatic sequence of operations is accomplished by cams **34** (FIG. **3**) on the drum axle which operate electrical switches at the proper times, said electrical switches in turn controlling valves and relays to activate the air pistons, electric motors, and pumps which accomplish the processing steps.

A drip pan **35**, which covers the bottom of the processor, collects any liquid which escapes from the various parts of the processor. From this pan the liquid is pumped to the drain.

A versatile piping system (FIG. **5**) allows all functions of the processor to be performed with only two pumps. Developer solution is replenished from a storage reservoir **36** through a float valve **37**. The water supply is connected to the developer pan by opening valve **38** and closing valve **39**, in place of the

developer reservoir when the machine is to be idle for long periods such as over a weekend. The water replenishes evaporative losses from the developer pan without altering the concentration of the developer solution. The developer pan is drained through a solenoid valve **40**. This valve is opened for a portion of each cycle to drain off some developer. The fraction of the cycle during which this valve is open is adjusted by a control so that regardless of the size plate processed, the same amount of developer per cycle is removed from the developer pan. In this way the developer is kept at the proper strength.

A mixing valve **47** supplies water at the proper temperature to the sprays in the rinse chamber. These sprays are controlled by the solenoid-operated valve **48**, which is in turn controlled by a switch **49** actuated by a cam on the drum axle. A pressure gauge is provided on the front panel. The water drains from the rinse chamber through the overflow drain **50** and is pumped by the pump **51** to the drain. A bypass valve **52** is provided for completely draining the rinse chamber for cleaning. The developer pan is replenished from a disposable developer reservoir **36**. The level in the developer pan is controlled by a float valve **37**. When the developer reservoir **36** is empty, a pressure switch **46** turns on a warning light **45** and the reservoir is replaced.

In the normal operation of the treatment system the treatment solution pump **55** pumps treatment solution from the reservoir **27**, through the check valve **56** and valve **57**, to the sprays **26**. Spent treatment liquid drains back to the reservoir through valve **44**. When the liquid level in the treatment liquid reservoir is low a float switch operates a warning light and the operator replenishes the solution. The treatment pump is activated at the proper time by a switch controlled by a cam on the drum axle.

To clean the machine, valve **42** is opened to admit hot water to the treatment chamber sprays. Valve **44** is closed and valve **43** is opened to pump the waste water to drain. By closing valves **40**, **58** and **43** and opening valve **59**, liquid in the drip pan is removed by the pump **51**.

The electrical diagram of the processor is shown in FIG. **6**. When a plate is being loaded onto the drum the switch **60** is placed in the "LOAD" position. In this position a foot switch **61** having two positions "FORWARD" and "REVERSE," allows the operator to move the drum forward and backward for convenience in loading the plate while his hands are left free to manipulate the plate. After the plate is loaded, switch **60** is placed in the "RUN" position. When the momentary contact switch **62** is closed, time delay relay **54** is closed and starts the drum motor **83** in the forward direction. As the drum rotates the drum drive cam closes the switch **84** so that when the time delay relay drops out after 30 seconds the motor continues to run. When the drum completes one full revolution the drum drive cam allows the switch **84** to open and the drum stops.

The developer is kept at the proper temperature by a heating blanket **16** which is controlled by a thermostat **63** acting through relay **64** and its switch **64'**. The drum temperature is maintained by the air heater **65** and air blower **14**, operated by the drum thermostat **66** through the air heater relay **67** and the air blower time delay relay **68** with respective switches **67'** and **68'**.

The developer pressure switch **46** activates the developer warning light **45** when low developer level in the developer reservoir causes the pressure to drop below a preset minimum.

A float operated treatment liquid level switch **70** is closed when the level of the treatment solution in its reservoir **27** falls too low; this lights the treatment solution level warning light **41** to inform the operator that replenishment of the treatment solution is required.

The squeegee cam closes the squeegee switch **71** at the proper time during the operating cycle. The squeegee switch **71** in turn activates the four-way solenoid valve **72** which controls the double acting air cylinder **53** which moves the squeegee **18**.

The scrub roller cam closes switch **74** at the proper time in the operating cycle (slightly after the squeegee cam activates the squeegee switch). This starts the scrub roller drive motor **20**, activates the scrub roll air cylinder four-way valve **75** to press the scrub rollers **19** against the drum **12**, and opens the rinse spray solenoid valve **48**. The limit switch **76** is closed only when the squeegee is pressed against the drum. Thus the sprays **22** cannot be turned on unless the squeegee **18** is in a position to seal off the developer pan **15** from contamination by rinse water.

The rinse pump cam closes switch **77** to start the rinse pump through the rinse pump starter **78** and pump the waste rinse water to the drain. A manual bypass switch **79** is provided for operating the rinse pump **51** at other times, e.g. during cleaning of the apparatus.

The treatment solution pump cam closes switch **80** when the plate reaches the treatment station. This starts the treatment solution pump **55** through the treatment solution pump starter **81**. A manual bypass switch **82** is provided for operating the treatment solution pump at other times, e.g. during cleaning of the apparatus.

A number of modifications are possible in the construction and arrangement of this apparatus.

The air cylinders may be replaced with electrical solenoids or a hydraulic system with appropriate logic. Different types of squeegees, e.g., rolls, flexible elastomeric strips, may be used. Electrical or hot air heating systems may be used. Means may be incorporated to buff the surface of the plate. Replenishment of the liquids in the various chambers of the machine may be by automatic or manual means.

The drum of this machine may be made of a magnetic corrosion resistant metal alloy. For other liquid-containing parts of the apparatus, ordinary corrosion resistant allows such as stainless steel are suitable. The frame and cover may be made from conventional construction materials such as painted steel or aluminum. Other materials such as wood, or plastic may be used where suitable.

The squeegee rolls may be made of rubber, chloroprene, polysilicones or other elastomeric material. The scrub rolls are covered with a deep pile fabric.

Spring-biased metal or plastic clips can be used in place of the magnetic fastening means **13**.

The invention has the advantage that presensitized lithoplates can be processed by the apparatus in less than half the time required for hand-processing. Skilled personnel are not required to operate this apparatus.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

We claim:

1. A rotary-processing apparatus for an exposed lithographic plate comprising a frame carrying, in combination:

a. a rotary drum for supporting and carrying the exposed plate having a photohardenable layer, into:

b. a developer pan adapted to supply a developer solution to such an exposed layer;

c. adjacent said pan, a rinsing chamber adapted to remove the unexposed portion of the exposed layer by a rinsing solution; said rinsing chamber having in combination:

1. a squeegee adapted to remove part of the softened, unexposed layer,

2. roll means adapted to scrub the layer and remove additional unexposed parts of the layer,

3. spray means adapted to flush the plate with an aqueous processing solution;

d. a treating chamber adapted to apply a treating liquid to the surface of the plate, and;

e. means adapted to remove excess treating liquid from the plate.

2. An apparatus according to claim **1**, wherein the drum has a surface of ferromagnetic material, and includes fastening means for the plate which consists of a magnetic material embedded in a flexible plastic strip.

3. An apparatus according to claim 1, wherein the drum is hollow and is provided with means for passing a heating fluid into its interior.

4. An apparatus according to claim 1 provided with pneumatic means for activating and deactivating the squeegee.

5. An apparatus according to claim 1 provided with pneumatic means for activating and deactivating said roll means.

6. An apparatus according to claim 1 provided with means for maintaining a level of developer solution in the developer pan.

7. An apparatus according to claim 1 provided with means for activating and deactivating said means adapted to remove excess treating liquid from the plate.

8. An apparatus according to claim 1 having:

f. means adapted to dry the surface of the plate; and

g. means for controlling the sequential operation of the parts of the apparatus.