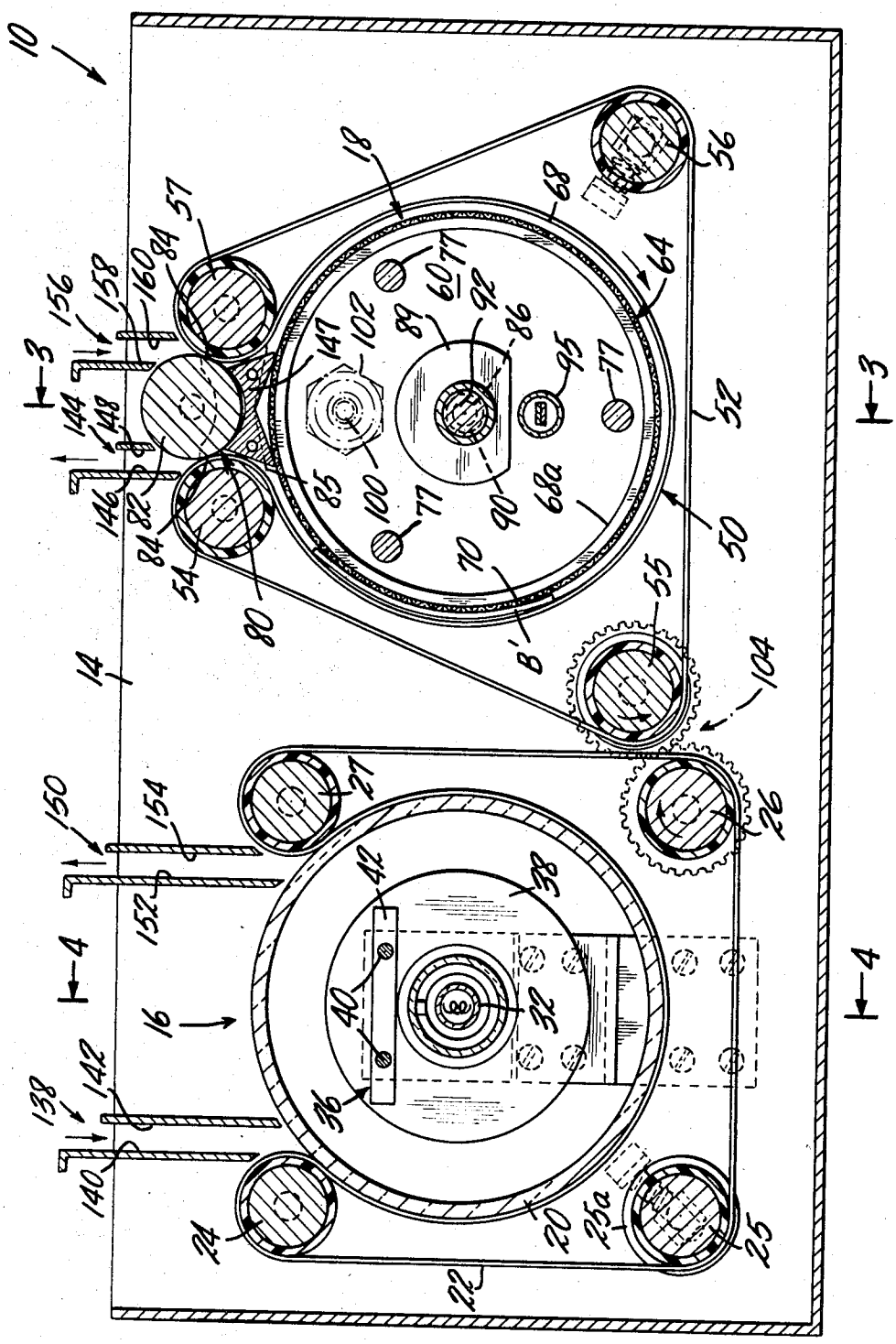
Feb. 23, 1971 R. N. DAVIS ET AL 3,565,523

VAPOR REPRODUCING APPARATUS

Filed Dec. 13, 1967 4 Sheets-Sheet 1

FIG. 1



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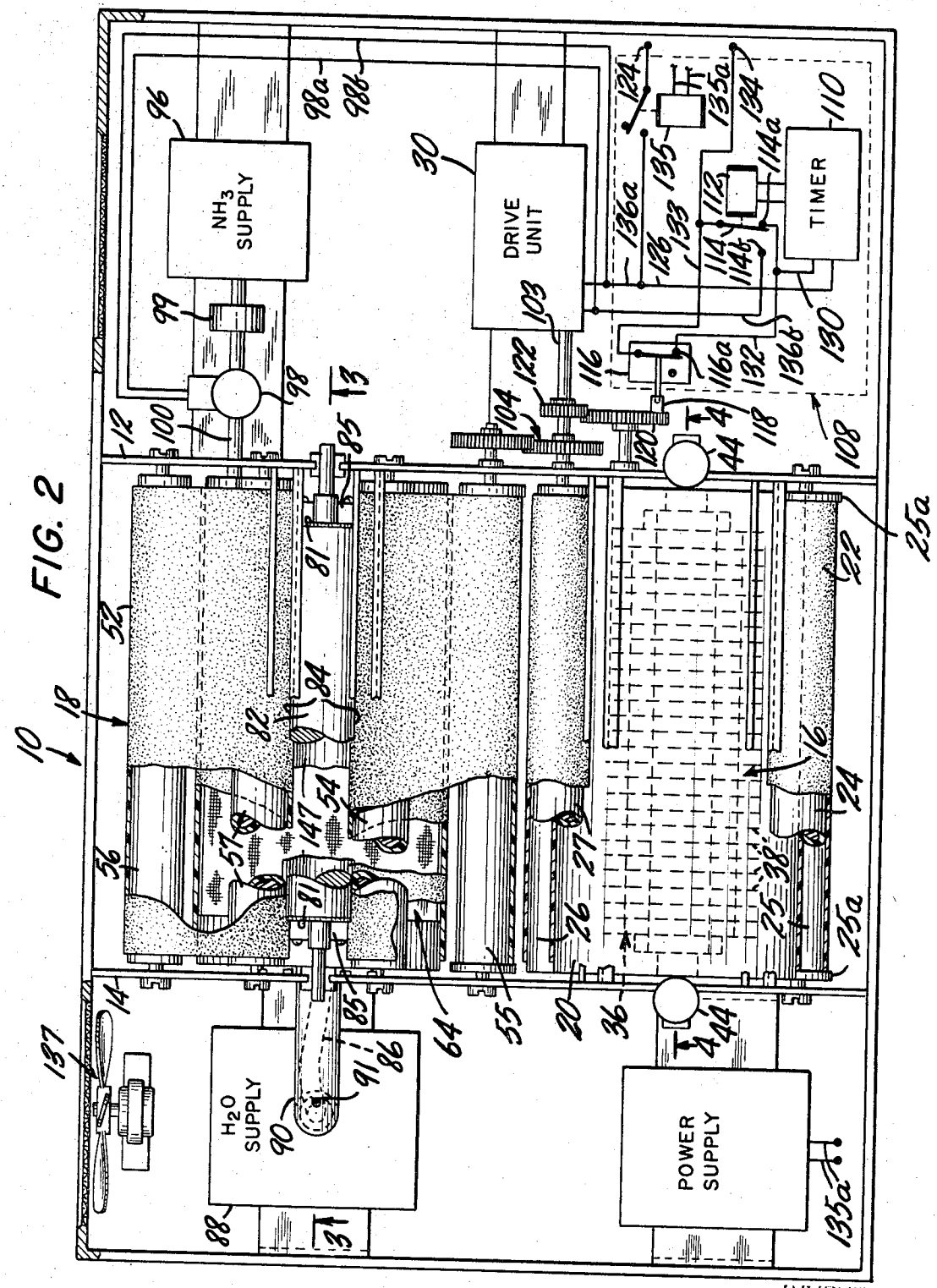
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VAPOR REPRODUCING APPARATUS

Filed Dec. 13, 1967 4 Sheets-Sheet 2

FIG. 2



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VAPOR REPRODUCING APPARATUS

Filed Dec. 13, 1967

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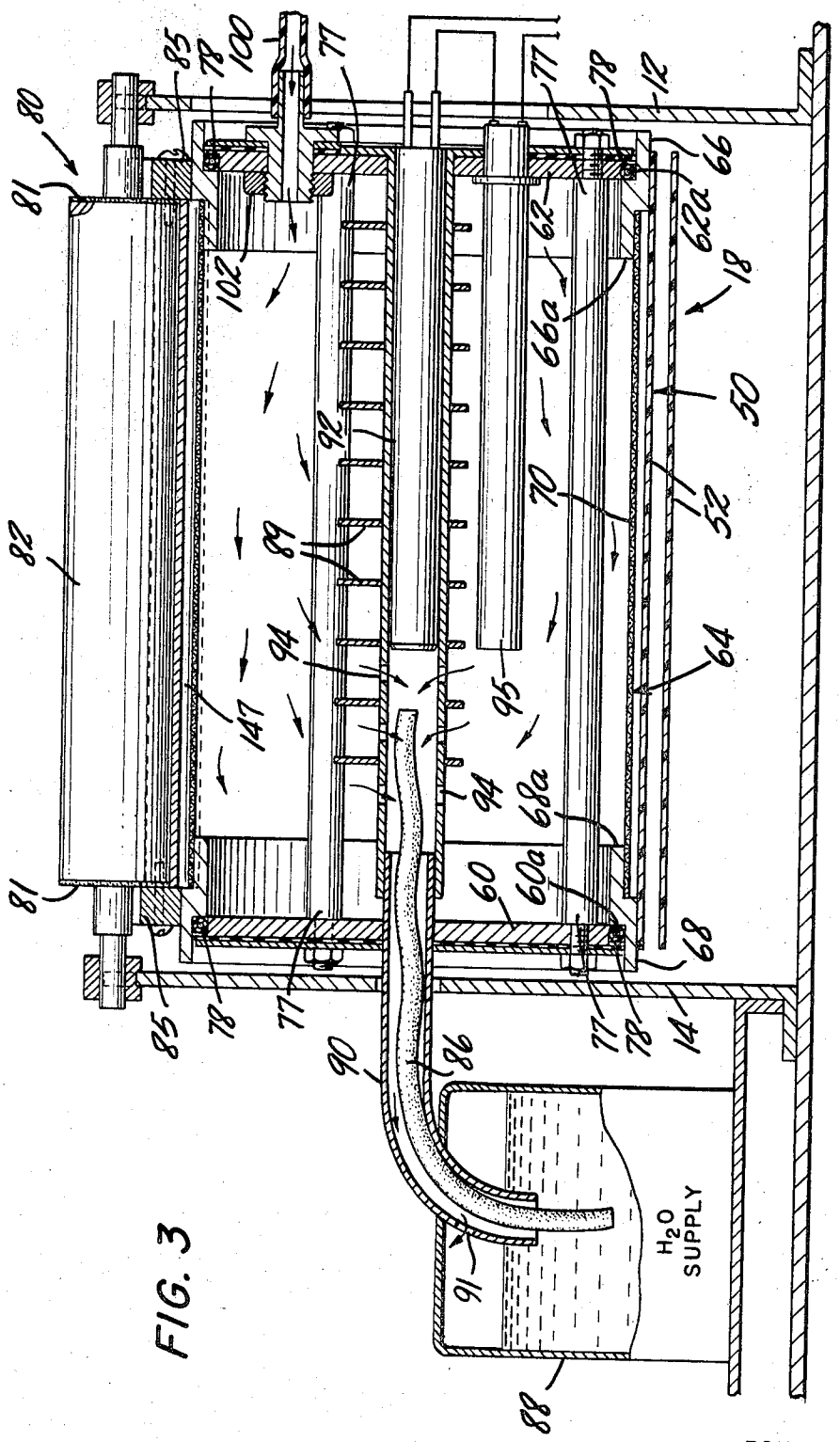


FIG. 3

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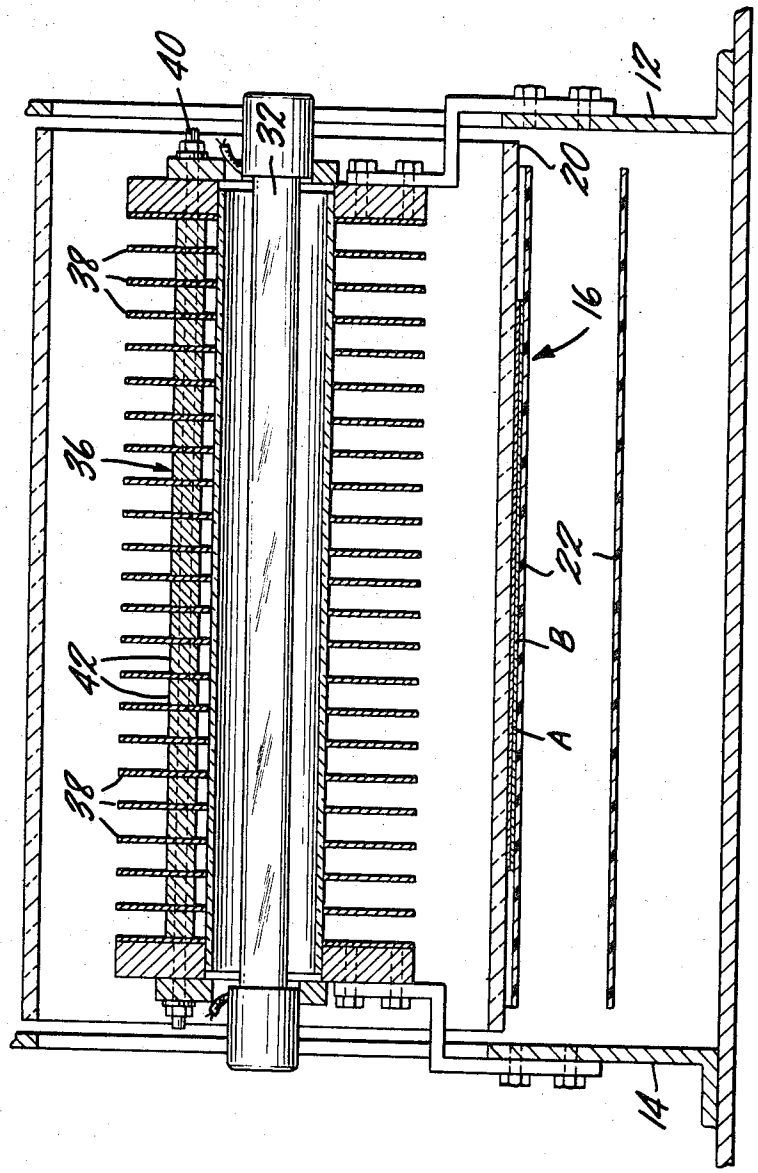
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VAPOR REPRODUCING APPARATUS

Filed Dec. 13, 1967 4 Sheets-Sheet 4

FIG. 4



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Patented Feb. 23, 1971

3,565,523

VAPOR REPRODUCING APPARATUS

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Int. Cl. G03b 26/30
U.S. Cl. 355—106 8 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for exposing and developing light-sensitive material from a master copy comprising an exposure unit having a source of collimated light to which the copy and material are delivered for exposure and a developer unit having a chamber containing a developing vapor to which the exposed material is delivered for development. Both the exposure and developer units include cylindrical members encompassed by belts which are driven to carry the copy or material in sheet form positioned between the cylinder and belt to exposure and developer zones of the cylinders. The units are driven in synchronism in a manner providing rapid delivery to and from a predetermined dwell time at the exposure and developer zones.

This invention relates to apparatus for exposing and developing light-sensitized images by the diazo or similar types of image reproducing techniques.

In the diazo printing process, a light-sensitized paper or film is exposed through a positive or negative transparency (the master copy) and is then developed to produce the image by exposure to a liquid or vapor developing fluid. A number of machines are available for both exposing and developing diazo prints, but most of them are complicated and expensive and are subject to various difficulties in operation. There is a need for an efficient, low cost printer, particularly in the area of diazo printing pertaining to micro-image information storing.

There is provided, in accordance with the present invention, a reproducing apparatus which is easy to operate, inexpensive, and compact and yet provides prints of very high quality and resolution. The apparatus is particularly useful in micro-film work, but its use is by no means limited to this specific area. It comprises an exposure unit and a developer unit, preferably mounted in the same case which may be, for example, a box measuring about 6½ inches high, 12 inches deep and 20 inches wide. It incorporates a number of novel and improved features which enable a unit of such small size to be made without compromising the quality of reproduction. For one thing, both the exposure and developing units are composed of a rotatable cylinder and an endless conveyor belt wrapped around the major portion of the cylinder. To ensure that the belts will track on the cylinders properly and will not creep to one side, at least one of the rolls carrying the respective belts is provided with retaining flanges at each end.

The belts are driven, and in turn drive the cylinders, preferably by a drive unit which is common to both units. Advantageously, the drive is arranged to convey sheets inserted between the belts and cylinders of the units rapidly into the portions of the respective cylinders encompassed by the belts, these portions constituting the exposure and developing zones of the units, then to stop and hold the sheets in the respective zones for a predetermined exposure or developing time, and thereafter to move the sheets quickly out of the machine. By operating the units of the machine in synchronism and by using a system in which the sheets are held in a fixed position and in intimate contact during exposure and development,

the structure of the machine is greatly simplified over that of machines known in the art, and the size is significantly reduced.

In the exposure unit, the cylinder is transparent and is supported solely by the belt, which is maintained under tension so as to hold the cylinder firmly in place and to press the master copy and print together for exposure. The light source includes a mercury vapor lamp and a quartz tube disposed coaxially in the transparent cylinder. In order that the print will not be exposed to the light source until it is positioned in the exposure zone, a light shield is located to restrict the radiation of light to the exposure zone. In the exposure zone, the sheet and master copy are uniformly curved around the cylinder as they are quickly transported into place, and therefore exposure of the print takes place only when the sheets are stopped and precisely positioned with relation to the light source, thereby affording high resolution and excellent quality of the reproduction. Further, it is preferable to provide light collimating fins, or a similar collimating arrangement, so that the light radiating onto the print impinges substantially perpendicularly to it at all points.

The developer unit comprises a pair of fixed, spaced-apart annular end members defining the end walls of a cylindrical chamber and a cylindrical sleeve mounted for rotation on the annular members. The major longitudinal part of the sleeve is gas permeable, for example, a wire mesh, but the end parts are impermeable and are arranged to form a seal with the annular end members. A sealing assembly closes off the part of the cylinder not encompassed by the belts. Thus, the end members, the sealing assembly and the belt cooperate to define a closed chamber where the developing vapor is maintained.

The vapors within the chamber are heated to a predetermined temperature by a heating unit. In the usual diazo process, the developing vapors include a mixture of water vapor and ammonia gas. The ammonia gas is periodically replenished from a pressurized source at a rate corresponding to the rate of use of the gas. Preferably, a pressure container of ammonia gas is connected to ther chamber through a solenoid metering valve which is actuated to puff a measured quantity of ammonia gas into the chamber on each cycle of operation of the printer. The water vapor, the other component of the developing vapor in the chamber, is preferably supplied by means of a water-saturated wick contained in a tube extending into the chamber and located so as to be heated by the heating unit to evolve water vapor from the wick. The tube is of a larger diameter than the wick, thus providing space for ammonia gas to enter the pipe and be absorbed into the water in the wick for evaporation.

For a better understanding of the invention, reference may be made to the following description of an exemplary embodiment, taken in conjunction with the figures of the accompanying drawings, in which:

FIG. 1 is an end view in section taken through the exposure and developer units of the machine;

FIG. 2 is a top view of the machine shown in FIG. 1, but with the top panel of the housing removed and several parts broken away at places to illustrate certain details more clearly;

FIG. 3 is a view in section of the developer unit, taken generally along the line 3—3 of FIG. 1 and looking in the direction of the arrows; and

FIG. 4 is a view in section of the exposure unit, the view being taken generally along the line 4—4 of FIG. 1 and looking in the direction of the arrows.

Referring to the drawings, the printer includes a box-like housing **10** of suitable construction and is provided with a pair of spaced-apart, vertical frame plates **12** and **14** which support the major components of the printer. The space between the frame members **12** and **14** ac-

commodates the exposure unit and the developer unit, which are designated generally by the reference numerals **16** and **18**, respectively. The spaces at the ends of the housing outside of the respective frame members **12** and **14** contain various ancillary components of the exposure and developer units, as will be described below.

The exposure unit **16** comprises a hollow transparent cylinder **20**, preferably made of glass, which is carried by a tightly tensioned endless belt **22** (FIG. 1), the cylinder **20** being supported solely by the inner run of the belt **22** which encompasses a major portion of its circumference. The belt **22**, which may be rubber or fabric coated with rubber or other suitable material, is supported by four carrier rolls **24** to **27**, inclusive, and is driven (in the manner to be described below) by a drive unit **30** (FIG. 2) in the direction indicated by the arrow on the roll **27** (FIG. 1). One roll **25** is provided with conventional mounting means which is adjustable so as to push the belt **22** as required to maintain it properly tensioned.

The light source for the exposure unit **16** is composed of a tubular quartz mercury vapor lamp **32**, which extends between and is mounted on the vertical frame members **12** and **14**. The exposure zone of the exposure unit is constituted by the portion of the circumference of the cylinder **20** encompassed by the belt **22**, as defined by a light shield **36** affixed between the frame members **12** and **14** and dimensioned to restrict the radiation of light to the exposure zone. In order to provide impingement of the light on the master and the film or paper which will make up the final print in a direction substantially perpendicular to them, i.e., radially with respect to the light source and the axis of the cylinder, a series of closely spaced collimating fins **38** (FIGS. 2 and 4) surround the light source **32**. Advantageously, the fins **38** are mounted on the light shield **36**, which includes a pair of spaced-apart rods **40** fastened to the frame members **12** and **14** and supporting the fins **38** and a series of elongated spacer elements **42**. The fins **38** and spacer elements are clamped together to form a unitary light shield and collimating structure.

One problem met effectively and inexpensively in the printer of the invention is that of maintaining the belt in a properly tracking position on the rolls **24** to **27** and the cylinder **20**. In particular, one or more of the rolls **24** to **27** has flanges (e.g. **25***a*) at each end which confine the edges of the belt **22** therebetween. The flanges are preferably made from a low friction material such as "Teflon." In addition, the surfaces of the rolls may be coated with "Teflon" to afford relative slippage between the rolls and the belt. Meanwhile, the cylinder **20** is kept centered by wheels **44** (FIG. 2) mounted on the frame members **12** and **14** and engaging the ends of the cylinder.

The developer unit **18** (FIG. 1), in a manner similar to the exposure unit, comprises a cylinder **50** and an endless belt **52** carried by rolls **54** to **57**, inclusive, wrapped around the cylinder. One of the rolls **56** has a conventional mounting which is adjustable to enable the roll **56** to be pushed outwardly against the belt **52** so as to be mounted to maintain the proper tension therein. Also, centering wheels (not shown) may engage the ends of the cylinder assembly, and one or more of the rolls **54** to **57** is provided with flanges made from a low friction material such as "Teflon" to maintain the belt centered on the cylinder **50**, as with the similar construction of the exposure unit.

The cylinder of the developer unit is composed of a pair of fixed, spaced-apart end members **60** and **62** (FIG. 3) suitably bracketed on the frame members **12** and **14** and a cylindrical sleeve assembly, designated generally by the reference numeral **64**, mounted for rotation on the end members **60** and **62**. The sleeve assembly **64** consists of a pair of end rings **66** and **68** and a tubular wire mesh or screen element **70** extending between the rings **66** and **68**. The belt **52** is wrapped around the sleeve assembly and extends beyond the ends of the wire screen element **70** so as to overlie portions of rings **66** and **68** and form a seal with them to define, in part, a closed chamber within the cylinder **50** where the developing vapor is maintained.

The end members **66** and **68** of the sleeve assembly **64** include inwardly extending flanges **66***a* and **68***a*, respectively, which assist in longitudinally centering the sleeve assembly **64** on the end members. Also, the inside parts of peripheral edges of the end plates **60** and **62** are formed with grooves **60***a* and **62***a* (FIG. 3) and receive O-rings **78** of a low friction material, such as "Teflon" or "Delrin." The O-rings **78** form a bearing surface upon which the end member portions **66** and **68** of the sleeve assembly **64** can freely rotate and, moreover, provide a seal between the end members and the sleeve assembly. The end members **60** and **62** and the parts making up the sleeve assembly **64** (i.e., the end rings **66** and **68** and the tubular screen element) are held together by tie bars **77**.

A further element which defines the chamber for the developing vapor is a longitudinally extending sealing assembly **80**. The sealing assembly **80** includes a sealing roll **82** which is journaled in the end members **12** and **14** and straddles the belt carrier rolls **54** and **57**, the lines of engagement at the nips between the sealing roll **82** and the portions **84** of the endless belt constituting seals for closing off the chamber at the space between the belt loop portions **84**. The sealing assembly **80** also includes an end plate **85** mounted at each end of the sealing roll **82** which forms a seal with (1) the respective end of the sealing roll, (2) the portion of the endless belt **52** which is adjacent thereto, and (3) the surface of the respective end rings **66** or **68**. At each end of the roll **82** is a ring **81** made of "Teflon" or a similar material having low friction and an ability to form a good gas seal, the rings **81** engaging the end plates **85** and facilitating rotation of the sealing roll relative to them while maintaining a good seal.

Thus, the developing unit includes a closed chamber defined by (1) the belt **52** tightly encompassing the sleeve assembly **64** over the major portion of its surface, (2) the end members **60** and **62**, which are made gas tight with the sleeve assembly by the O-rings **78**, (3) the sealing roll **82**, and (4) the end plates **85**.

During operation of the machine, the chamber is kept filled with a developing vapor composed of water vapor and anhydrous ammonia gas (NH_3). The water vapor is supplied by a saturated felt wick **86** which is located within a metal tube **90**, both the wick and the tube extending from a water tank **88** (FIG. 2) into the interior of the cylinder **50**. The tube **90** also provides space for the vapor within the chamber to enter the tube by virtue of the diameter of the tube being sufficiently larger than the diameter of the wick to allow vapor to enter the space between the wick and the inner wall of the tube **90**. A hole **91** located just above the highest water level of the water tank **88** is provided to vent the tube to the water tank. The entry of ammonia gas into the tube brings it into contact with the water in the wick, which absorbs it for later evaporation into the developing vapor.

A rod type heating element **92** (FIG. 3) extends into the chamber from the end opposite the tube **90** through a finned jacket **89** adapted to radiate heat from the rod. The end portion of the tube **90** extends a short distance in telescoping relation into the finned jacket **89**, the wick **86** extending further into the jacket. Accordingly, the heating element heats the end of the wick and also heats the jacket **89**, which in turn heats the wick, and evolves water vapor into the chamber. The water vapor enters the chamber from the tube **90** through holes **94** in the jacket, the holes also admitting vapor into the tube. The heating element **92** is controlled by a thermostat **95** to maintain the developing vapor in the chamber at a predetermined temperature.

The anhydrous ammonia gas component of the developing vapor is supplied from a pressurized tank **96** (FIG. 2) through a solenoid metering valve **98** and a conduit **100** to a nozzle **102** (FIG. 3) mounted in the end plate **62**. When the printer is in operation, the valve is opened periodically to puff a measured quantity of anhydrous ammonia gas into the chamber. The quantity and frequency of replenishment of the ammonia in the chamber is related to the rate of use in developing prints. This may be accomplished, for example, by employing a device known variously as a flow "snubber" or "leak," a porous member that slowly leaks gas at a known rate from a higher to a lower pressure zone. A flow snubber **99** (shown schematically in FIG. 2) is installed in the supply conduit **100** upstream from the valve **98** and slowly releases ammonia from the tank to a part of the conduit between it and the valve. The valve is then periodically opened to release the accumulated gas in that conduit part into the chamber.

The developer unit **18** is driven by the same drive unit **30** that drives the exposure unit **16** so that the exposure unit and developer unit are driven in synchronization. To this end, the drive shaft **103** of the drive unit **30**, which may be of any suitable variety, many types of which are known to those skilled in the art, is directly coupled to the roll **26** and through suitable gearing **104** drives the roll **55** from the roll **26**.

Control of the drive unit **30** to obtain the desired sequence of advance and dwell of the exposure unit **16** and developer unit **18** is provided by a control unit **108**, an exemplary control circuit being illustrated schematically in FIG. 2 of the drawings. The control unit **108** shown in FIG. 2 includes a timer **110** of any suitable type, many of which are well known to those skilled in the art and are commercially available. An appropriate timer manufactured by General Time is a solid-state type and includes a relay **112** having a double-throw switch **114** which is normally closed to pole **114***a* when the timer is energized and running but at the end of the timer cycle is thrown to pole **114***b*.

The timer **110** is periodically turned on to provide a dwell period of predetermined duration by a microswitch **116** which is actuated by a fixed pin **118** on a gear **120** meshing with a pinion **122** on the shaft **103** of the drive unit **30**. The ratio between the gear **120** and the pinion **122** is such that the gear makes one complete revolution while the drive unit **30** advances a master film and print to the exposure position in the exposure unit and advances a print to the developing position in the developer unit **18**. The pin **118** on the gear actuates the microswitch **116** to stop the drive unit and provide the dwell period.

More particularly, when the pin **118** on the gear **120** engages the actuator of the microswitch **116**, the switch arm is closed to pole **116***a* to complete a circuit from one power source terminal **124** through a conductor **126** to the timer **110**, from the timer through conductors **130** and **132**, across the microswitch **116**, and through a conductor **133** to the other power source terminal **134**. Connected in conductor **126** is a voltage-controlled relay **135** which is connected by its leads **135***a* to the lamp power supply. The relay **135** is normally open but closes when the lamp voltage comes up to its maximum value upon start-up of the machine. The relay **135** thus ensures that the printer drive does not start up until the lamp illumination is sufficiently high properly to expose a print.

With the relay **135** closed and upon engagement of the pin **118** with the microswitch actuator **116***b*, the microswitch is closed to complete the circuit through the timer, as described above, and thus start it. At this point, the drive unit is operating and the gear **120** is rotating. Upon start-up of the timer **110**, the timer relay switch element **114** shifts from pole **114***b*, with which it is then engaged, to pole **114***a*, thus disconnecting the drive unit **30** from the power source terminal **134** and completing a circuit branch from the timer **110** to power source terminal **134** through contact **114***a* engaging the relay switch element **114** and the conductor **133**. The drive unit **30**, therefore, comes to rest with the gear pin **118** in engagement with the microswitch **116** so that the latter is still closed. The timer **110** measures out a predetermined dwell time during which the drive unit is stationary as required for exposure and development, respectively, of the materials in the exposure and developer units.

When the timer cycle is completed, the relay **112** is automatically de-energized so that the timer relay switch element **114** disengages the pole **114***a* and re-engages the pole **114***b*, thereby breaking the circuit to the timer and shutting it off and at the same time completing a circuit from the power source terminal **134**, across the relay switch **114** and through conductor **136***b* and to the power source terminal **124** through conductors **126** and **136***a* to energize the drive unit **30**. This causes the gear **120** to move the pin **118** quickly out of engagement with the microswitch **116** before the timer **110** has a chance to restart. Accordingly, the drive unit is energized and operates to drive the exposure unit and developer unit of the machine to advance simultaneously the sheets in the respective exposure and developer units to or from, as the case may be, the dwell stations.

After one revolution of the gear **120**, which corresponds to a drive cycle sufficient to transport out materials previously in the exposure and developer units and transport new materials into the units, the pin **118** again engages the microswitch **116** to restart the timer **110** and begin another dwell cycle, as described above.

As mentioned previously, during each drive or advance part of the operating cycle of the printer, ammonia gas is admitted into the developer unit chamber from the supply **96**. This is accomplished by opening the valve **98** during the advance, the valve being connected by leads **98***a* and **98***b* to the conductors **136***a* and **136***b* and thus being energized and opening whenever the drive unit is energized and operating.

Inasmuch as the exposure and developing zones of the respective units **16** and **18** straddle the mid-point of movement of a sheet around the cylinders, the time required for moving a sheet into the respective units is the same as the time required to move the sheet out of the unit. Accordingly, the operating sequence of the control unit described above comprises advancing cycles of equal length in which sheets are moved into or out of the respective units alternating with dwell periods in which a sheet resides in the exposure or developing zones of the respective units. During each dwell period, an operator can insert a new sheet of material into the entrances to the respective units.

A further component of the printer is a suitable cooling system for the lamp, which may also serve as an exhaust system for drawing off the small amounts of developing vapor that might leak into the housing from the developer unit and blowing them out. This component of the apparatus is represented schematically by the cooling fan unit **137** mounted within the housing as shown in FIG. 2. Such a unit causes a vacuum within the machine so that air flows to the fan from various parts of the printer. It can be constructed in any suitable manner known to those skilled in the art.

In operation, the master copy to be duplicated and a sheet of diazo film or paper which will form the print (designated by the letters A and B respectively in FIG. 4) are manually placed in superimposed relation and inserted into the exposure unit through a slot **138** defined by guide members **140** and **142** (FIG. 1). If an exposed print (B' in FIG. 3) is ready to be developed, it is inserted into a slot **156** between guides **158** and **160** leading to the developer unit. The sheets to be exposed and developed are inserted during the dwell period of the operating cycle,

and unless a machine has just been started up, a master and print will usually be in the exposure zone and an exposed print in the developing zone and are receiving exposure and development, respectively, during the dwell period.

When the dwell period ends, as controlled by the timer **110** of the control unit **108**, the drive unit is energized to drive the belts of both the exposure unit **16** and the developer unit **18**, the sealing roller **82** of the developer unit being rotated through its engagement with rollers **54** and **57**, so that the newly inserted materials in the units are picked up between the belts and the cylinders of each unit and quickly transported into the exposure and developing zones of the respective units. Also, any materials previously in the units are transported out as the belts are driven, the then exposed print and the master copy in the exposure unit being delivered through a slot **150** defined by guides **152** and **154**, and the developed print in the developer unit being directed by a guide member **147** so as to be delivered between the rolls **82** and **54** and through a slot **144** defined by guides **146** and **148**. Meanwhile, the ammonia in the developer unit chamber is replenished by opening the valve **98** during the drive or advance stage. The advance cycle continues for a time sufficient to appropriately position the newly inserted materials in the exposure and developing zones of the respective units and to completely transport completed materials from the two units.

When the pin **114** on the gear **116** again engages the microswitch **112**, after one revolution, the microswitch is closed to start the timer, and, as described above, the timer runs through the dwell cycle and at the end of the dwell initiates another advance cycle. Continuing in the manner described above, therefore, a succession of prints may be exposed and developed. Preferably, the machine operates continuously through alternating dwell and advance cycles. Nonetheless, it will be apparent to those skilled in the art that a pushbutton control operation to initiate an operating cycle that provides one exposure and development at a time and is composed of advance, dwell and advance portions can readily be provided. Also, the machine might also be modified to provide continuous transport of the materials so that they are moved at a uniform rate into and out of the units.

The above-described embodiment of the invention is merely exemplary, and those skilled in the art will be able to make numerous variations and modifications of it without departing from the spirit and scope of the invention. All such variations and modifications are intended to be included within the scope of the invention as defined in the appended claims.

We claim:

1. Apparatus for exposing and developing light-sensitive material from a master copy comprising an exposure unit having a transparent hollow cylinder, a source of collimated light within the cylinder, a belt wrapped around the major part of the cylinder and supporting the cylinder, and means for delivering the copy and material in superimposed relation to a position for exposure to light, the copy and material being received between the cylinder and belt, the light source of the exposure unit having a light shield and collimating structure including a plurality of parallel plates closely spaced to block light rays radiating in directions other than a direction substantially radially from the axis of the cylinder, and spacer means between the plates forming a light shield extending parallel to the axis of the cylinder and restricting the radiation of light to the part of the cylinder about which the belt is wrapped; a developer unit having a chamber, means for maintaining a developing vapor in the chamber, and means for delivering exposed material to a position communicating with the developing vapor for developing the exposed material; and means for driving the delivering means of both units in synchronization to move the copy and material rapidly into said positions, hold them in those positions for a predetermined time and then move them rapidly out of the positions and out of the apparatus.

2. Apparatus according to claim **1** wherein the means for maintaining a developing vapor in the chamber includes means for dispensing one of the vapor components into the chamber in a gaseous state, a source of the other vapor component in its liquid state, conduit means extending from the source into the interior of the chamber, wick means within the conduit for conducting the liquid vapor component from the source into the interior of the chamber, and means for heating the conduit to in turn heat the liquid component and evolve it as a vapor into the chamber.

3. Apparatus according to claim **1** wherein the means for maintaining a developing vapor in the chamber includes a source of the material developing gas under pressure, and means for dispensing a measured quantity of the gas into the chamber at intervals related to the rate of the use of the gas.

4. Apparatus according to claim **3** wherein the means for maintaining a developing vapor in the chamber includes a source of water vapor having a wick maintained substantially saturated with water and means for heating the wick to evolve water vapor therefrom.

5. Apparatus according to claim **4** wherein the heating means also maintains the vapors in the chamber at a predetermined temperature.

6. Apparatus for exposing and developing light-sensitive material from a master copy comprising an exposure unit having a source of collimated light and means for delivering the copy and material in superimposed relation to a position for exposure to the light; a developer unit having a chamber, means for maintaining a developing vapor in the chamber, and means for delivering exposed material to a position communicating with the developing vapor for developing the exposed material, the chamber of the developer unit including fixed spaced-apart annular members constituting the end walls, a cylindrical sleeve mounted for rotation about the annular members, the major longitudinal center part of the sleeve being gas permeable and the end parts of the sleeve being gas impermeable and arranged to form seals with the annular members and define the chamber therewith, a gas impermeable belt wrapped around the major portion of the circumference of the sleeve and encompassing the permeable part and at least a portion of each end part, said belt being wrapped around a pair of spaced rolls at points where it leaves the sleeve, and a sealing assembly outside the sleeve and out of contact with its permeable part and engaging the gas impermeable belt to form seals therewith, the sealing assembly including a sealing roll straddling the space between the belt-carrying rolls and engaging the belt to form said seals along the nip with each belt-carrying roll, whereby the sealing assembly, belt and end walls define a chamber for the developing vapors; and drive means for driving the delivering means of both units in synchronization to move the copy and material rapidly into said positions, hold them in those positions for a predetermined time and then move them rapidly out of the positions and out of the apparatus.

7. Apparatus according to claim **6** wherein the seal assembly further comprises fixed end seal members adjacent each end of the sealing roll and forming seals with (1) the parts of the belt wrapped around the belt-carrying rolls, (2) the end parts of the sleeve and (3) the ends of the sealing roll.

8. Apparatus for exposing and developing light-sensitive material from a master copy comprising an exposure unit having a rotatable transparent cylinder, an endless belt wrapped around the major part of the cylinder surface and defining with the cylinder an exposure zone for receiving the master copy and a member to be printed, a light source arranged to provide collimated light radiating from the cylinder axis, and a light shield positioned to restrict the radiation of light to the exposure zone

where the copy and member are uniformly curved around the cylinder, a developer unit having a pair of spaced-apart annular end members, a cylindrical sleeve mounted for rotation about the end members, the major longitudinal center part of the sleeve being gas permeable and the end parts of the sleeve being gas impermeable and being arranged to form seals with the end members, a gas impermeable belt wrapped around the major part of the sleeve circumference and encompassing the permeable part and forming seals with the end parts thereof, a sealing member outside the sleeve and out of contact with its permeable part and engaging the gas impermeable belt to form seals therewith, the sealing member, end members and belt defining a closed chamber, and means for maintaining a developing vapor within the chamber, the belt defining with the sleeve a developing zone wherein a member to be developed is in communication through the gase permeable part of the sleeve to the chamber, and drive means coupled to the respective belts to move them in synchronization with each other to rotate the cylinders and move the copy and member rapidly into the respective exposure and developing zones, hold them in the zones for a predetermined dwell time and then move them rapidly out of the zones.

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