Aug. 13, 1968 R. J. CHEN ET AL 3,396,648

APPARATUS FOR TREATING PHOTOGRAPHIC SHEET MATERIALS WITH A LIQUID

Filed April 25, 1966 2 Sheets-Sheet 1

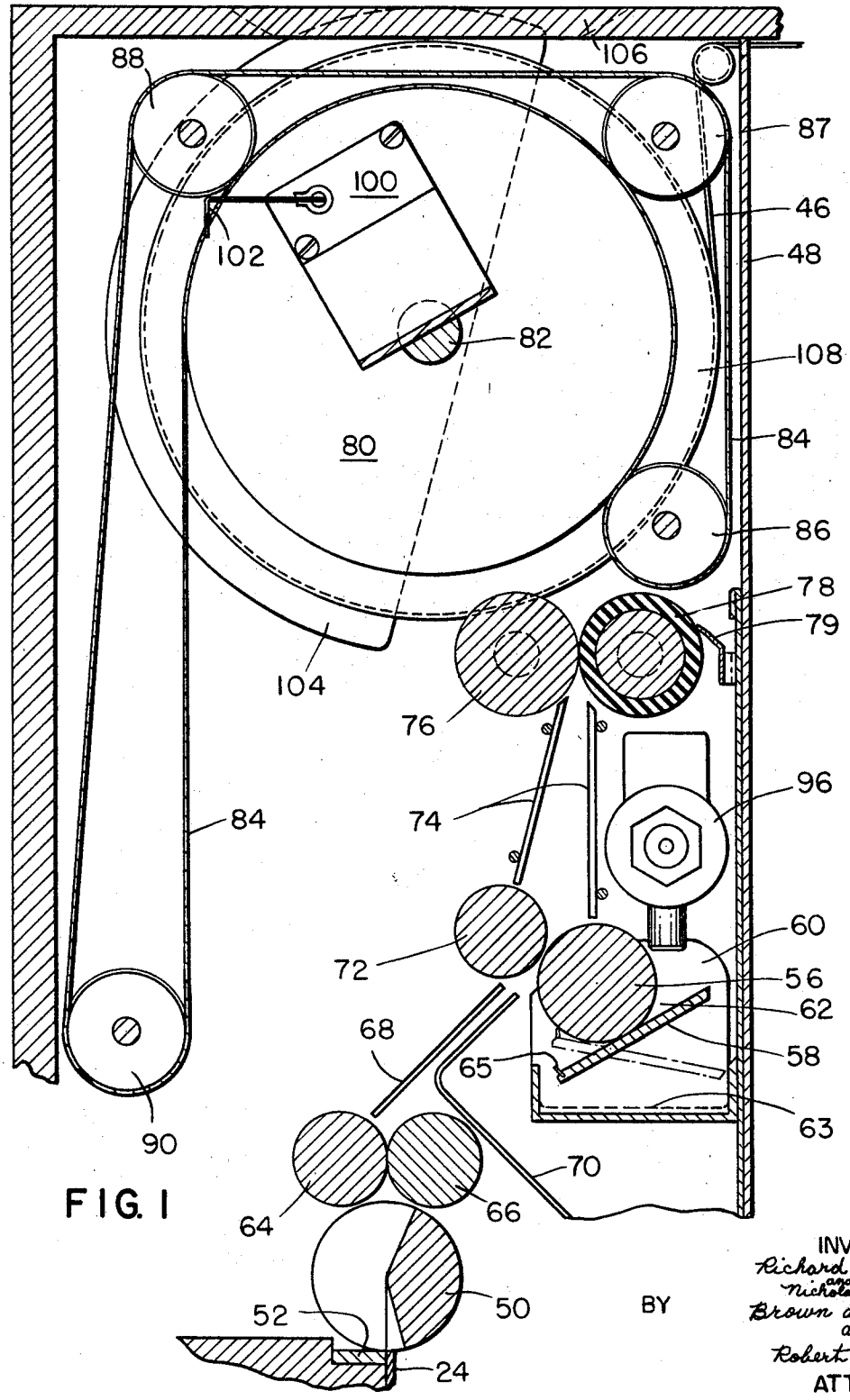


FIG. 1

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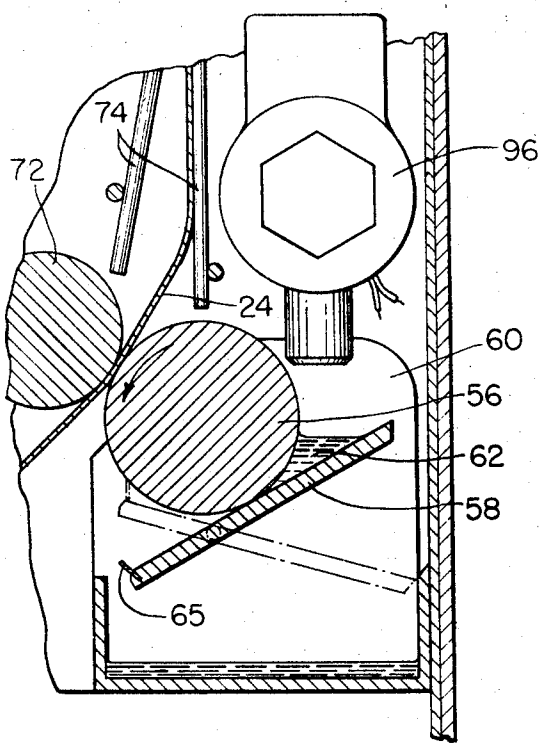


FIG. 2

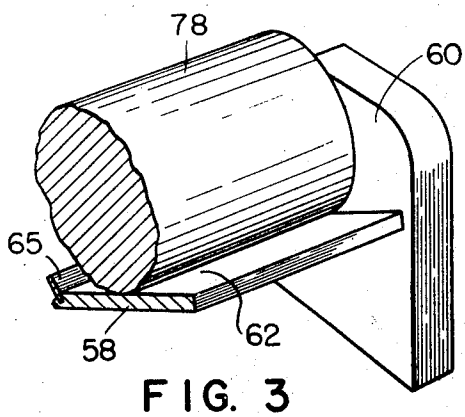


FIG. 3

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3,396,648

# APPARATUS FOR TREATING PHOTOGRAPHIC SHEET MATERIALS WITH A LIQUID

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7 Claims. (Cl. 95—13)

## ABSTRACT OF THE DISCLOSURE

Photographic apparatus for exposing and processing successive sections of a photo-sensitive sheet including an exposure system and a processing section having a roll for applying a processing liquid to an exposed section of said photosensitive sheet. A plate is positioned is tangential contact with the roll to form a trough for receiving a supply of the processing liquid and means are provided for moving the plate to discharge the processing liquid from the trough.

This invention relates to photographic apparatus for treating exposed photosensitive image-recording sheet materials with a liquid processing agent, and particularly to apparatus for applying a non-viscous liquid agent to successive exposed areas of the image-recording sheet materials.

An object of the invention is to provide novel and improved photographic apparatus for applying a predetermined quantity of a liquid processing composition to each of a succession of photosensitive image-recording sheets to effect the treatment of the sheets, preferably to produce visible images therein.

Liquid processing agents employed in photographic processes of the type performed by the apparatus of the invention are substantially non-viscous, i.e., have the viscosity of water, are highly alkaline, and hence corrosive, and are subject to evaporation, deterioration upon exposure to the atmosphere and contamination by residue of the liquid. The problems attendant with applying such a liquid uniformly and in accurately controlled quantities to successive exposed photosensitive sheets are complicated by the necessity for applying the liquid to generally rectangular areas having well defined linear boundaries, applying the liquid to areas of different lengths and at intervals of widely varying duration, storing the liquid in a protected environment until applied to a sheet, and keeping the components of the applicator free of residue of the liquid.

Another object of the invention is to provide apparatus for applying a liquid processing agent of the type and in the manner described, while minimizing exposure of the liquid to the atmosphere and preventing contamination of the liquid applied to each sheet by residue of the liquid remaining after application thereof to a preceding sheet.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

FIGURE 1 of the drawings is an enlarged sectional view of a portion of photographic apparatus embodying the invention;

FIG. 2 is an enlarged fragmentary sectional view of a portion of the apparatus shown in FIGURE 1; and



FIG. 3 is a fragmentary perspective view of components of the apparatus of the invention.

The present invention is embodied in a liquid applicator device particularly designed for incorporation in photographic exposure and processing apparatus of the type shown and described in the copending U.S. patent application of Nicholas Gold et al., Ser. No. 544,774, filed on the same date herewith. Photographic apparatus of this type is particularly designed for reproducing documents and comprises an exposure system including means for supporting successive sections of a photosensitive sheet in position for exposure, means for locating a subject such as a document, page of a book, etc., in position for exposure, means for illuminating the subject, and an optical system including an objective lens for producing an image of the subject on the section of the photosensitive sheet positioned for exposure; and a processing system including means for severing each exposed section of the photosensitive sheet from the remainder of the sheet, applying a liquid processing agent at least to the exposed area of each section to effect visible formation, and advancing the sheet through and from the apparatus.

Apparatus of this type, and particularly the processing section thereof, is especially adapted for use with photographic sheet materials and processing liquids and for performing photographic processes such as are shown and described in the copending U.S. applications Ser. No. 368,622 of Edwin H. Land, and Ser. No. 368,621 of Edwin H. Land et al., both filed May 19, 1964. These applications describe a combination-image-recording and image-receiving sheet comprising a support such as paper, at least one layer containing a light-sensitive material such as a silver halide emulsion, and an outer layer comprising a translucent material such as finely divided titanium dioxide dispersed in a suitable, permeable, colloidal carrier or matrix such as gelatin which is permeable to an aqueous processing liquid. The translucent pigment may be incorporated in the layer containing the light-sensitive material and/or may comprise a separate outer layer which may also contain silver precipitating nuclei and is sufficiently transparent to permit exposure of the light-sensitive layer therebeneath, while at the same time, being sufficiently opaque to provide the requisite background for a positive silver image transferred thereto by diffusion and to mask a negative image formed thereunder. Processing of the exposed image-recording sheet is accomplished by applying an aqueous liquid including a silver halide complexing agent to the side of the sheet opposite the support so as to impregnate the light-sensitive layer with sufficient processing liquid to produce a positive silver transfer image on the surface of the translucent layer.

Reference is now made to FIGURE 1 of the drawings wherein there is illustrated the processing section of photographic apparatus of the type described in the aforementioned Gold et al., application and incorporating the applicator device of the invention. The apparatus includes a rotary knife **50** and anvil **52** between which successive exposed sections of a photosensitive image-recording sheet, designated **24**, are advanced upwardly from exposure position following exposure and a pair of juxtaposed feed rolls **64** and **66** mounted directly above the knife for advancing each section from knife **50** upwardly into the portion of the processing section in which the processing liquid is applied to one side of the exposed photosensitive sheet. The processing liquid is applied by a reverse roll coating technique in which the liquid is adhered to the peripheral surface of a rotating cylindrical applicator roll and the sheet is supported against the periphery of the roll and moved tangent to the roll surface in a direction opposite to the direction of movement of the roll surface for transferring the liquid from the roll to the sheet. The quantity of liquid applied to the

sheet can be controlled by varying the relative speeds of the sheet and roll surfaces to bring more or less liquid into contact with the sheet. The applicator device of the invention includes a generally cylindrical applicator roll **56** mounted for rotation about a substantially horizontal axis. The applicator roll includes a smooth outer peripheral surface and is formed of a rigid material which is impervious to and uneffected by the liquid processing agent, suitable materials for this purpose including metals, ceramics, and organic plastics, with the particular choice of material being dependent on its compatibility with the processing liquid to be applied.

Processing liquid is adhered to the applicator roll for transfer to a sheet by rotating the applicator roll within a container or trough containing the processing liquid so that the peripheral surface of the applicator roll is advanced upwardly from beneath the surface of the liquid and thence into contact with the surface of a sheet advanced in the opposite direction. This container or trough for the processing liquid is designated **62** in the drawings and is defined on one longitudinal side by the periphery of the roll itself, and on the opposite side by a generally flat plate **58** mounted intermediate its edges beneath the applicator roll for pivotable movement about an axis substantially parallel with the axis of rotation of the applicator roll. Trough **62** is generally V-shaped in cross-section, and has a length at least equal to the length of the portion of the cylindrical peripheral surface of the roll adapted to apply the processing liquid. A pair of end members **60** are mounted in engagement with the ends of the cylindrical portion of roll **56** and the ends of plate **58** and provide the ends of the trough while permitting rotation of the roll and pivotal movement of plate **58**.

Plate **58** is pivotable between the operative position shown in which it is located with its upper surface in tangential contact with the roll along a horizontal line extending from one end member **60** to the other and cooperates with the end members and roll to form trough **62**; and an inoperative position, shown in broken lines in FIG. 2, in which the portion of plate **58** on one side of its pivotal axis and defining one side of the trough, is pivoted from contact with the roll downwardly beneath the pivotal axis of the plate. During application of the processing liquid to a sheet, roll **56** is rotated in a counterclockwise direction to apply the liquid in trough **62** as a thin layer to the peripheral surface of the roll as the latter moves upwardly out of the liquid.

Because of its nature, the processing liquid is stored in a container out of contact with the atmosphere and is dispensed from the container into trough **62** immediately prior to application to a sheet and then only in the approximate amount required. A valve **96** located above trough **62** is provided for dispensing predetermined quantities of the processing liquid into the trough. To insure uniform application of a predetermined quantity of the processing liquid over a predetermined area of a sheet, the amount of liquid dispensed into trough **62** is slightly in excess of the amount required so that provision must be made for emptying the trough of any excess liquid following each operation as well as removing residual liquid from the applicator roll to prevent contamination of the liquid applied to the next succeeding sheet. After each application operation, plate **58** is pivoted to its inoperative position for the purpose of dumping excess liquid from trough **62** into an open container **63** provided beneath the plate for collecting unused liquid. An elongated scraper blade **65** is mounted on plate **58** near a longitudinal edge of the plate for engaging the peripheral surface of the roll along a longitudinal line extending from end-to-end thereof, when the plate is pivoted into its inoperative position, and removing residual processing liquid from the roll. Blade **65** is preferably formed of a resilient material having a low coefficient of friction and compatible with the processing liquid, organic plastics such as polytetrafluoroethylene being especially suited for this purpose. Liquid removed from the roll by the scraper blade is also collected in container **63** from whence the solvent, e.g., water, permitted to evaporate.

A sheet to be coated on one side with the processing liquid is advanced upwardly at an angle tangent to the surface of the applicator roll by rotation of feed rolls **64** and **66**, and guides **68** and **70** are provided on opposite sides of the path of movement of the sheet between the feed rolls for guiding the sheet along a path tangent with the portion of the peripheral surface of the applicator roll lying opposite trough **62**. The applicator device also includes means in the form of a backing roll **72** mounted for rotation in juxtaposition with applicator roll **56** for guiding and supporting the sheets against the applicator roll. Means are provided for rotating roll **72** in order to facilitate advancement of each sheet upwardly against the applicator roll during application of liquid to the sheet.

The sheet, following application of liquid thereto, is moved upwardly from between the applicator and backing rolls into the nip of a pair of wringer rolls **76** and **78** which function to remove excess processing liquid from the sheet and continue the upward advancement of the sheet along a predetermined path through the apparatus to provide an imbibition period during which processing of the sheet, i.e., visible image formation, occurs. Guides **74** are provided on opposite sides of the path of movement of the sheets for guiding each sheet from the applicator roll into the nip of rolls **76** and **78**. A scraper blade **79** is mounted in engagement with roll **78** for removing processing liquid adhering to the surface thereof, and this processing liquid is also collected in container **63**.

Processing of each sheet requires that the sheet remain in a light-free environment during an imbibition period of predetermined duration, and for this purpose the apparatus includes means defining a path of predetermined length along which each sheet is advanced from between rolls **76** and **78** within the apparatus at a speed calculated to provide the necessary imbibition time. These means comprise a plurality of circular discs **80** mounted for rotation in axially spaced relation on a shaft **82**, and a plurality of endless belts **84**, each including a portion supported on the periphery of one of discs **80** and a return portion supported on pulleys **86**, **87**, **88**, and **90**. Each sheet **24** is advanced by rolls **76** and **78** upwardly between discs **80** and belt **84**. The pulleys **86** and the belts are advanced to rotate the discs in a counterclockwise direction to move the sheet gripped therebeneath along a circular path around the peripheries of the discs and thence downwardly from engagement with the discs and through an opening in the housing located beneath and adjacent pulleys **90**.

A switch **100** is mounted on shaft **82** and includes an operating lever **102** located in the path of movement of the sheets for controlling the operation of knife **50**. A disc **104** including a portion projecting through an opening **106** in the upper wall of the apparatus is mounted on shaft **82** and provides manual means for varying the position of switch **100** and the operation of the knife to control the length of each sheet processed.

The applicator device of the invention comprises a simple, effective and reliable structure for applying uniformly distributed and accurately predetermined quantities of liquid processing composition to successive photosensitive sheets while protecting the liquid from exposure to the atmosphere, minimizing waste liquid, and removing residual liquid from the applicator between successive operations to prevent contamination of the liquid.

Since certain changes may be made in the above apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. For use in photographic apparatus for exposing and processing photosensitive sheet materials, processing means for applying a processing liquid to successive exposed sections of a photosensitive sheet comprising, in combination:

an applicator having a substantially cylindrical section mounted for rotation about a substantially horizontal axis;

a member having a surface inclined with respect to horizontal and including a section positioned in tangential contact with the peripheral surface of said cylindrical section along at least an axial line extending from end-to-end of said cylindrical section for substantially preventing the flow of processing liquid therebetween and cooperating with the portion of said peripheral surface above said line to form a trough;

means for rotating said peripheral surface of said applicator roll upwardly in contact with said processing liquid in said trough and in a direction opposite to the direction of movement of said sheet past said applicator roll;

means engaging the ends of said cylindrical section and said member for preventing escape of said processing liquid at the ends of said trough;

means for moving a sheet relative to and in contact with said peripheral surface; and

means for moving said member to separate said section of said surface thereof from said peripheral surface and discharge said liquid from said trough.

2. Processing means as defined in claim 1 including means for engaging said cylindrical section along a second axial line ahead of the first-mentioned line for removing said processing liquid from said peripheral surface.

3. In photographic apparatus for exposing and processing photosensitive sheet material, processing means for applying a liquid to an exposed photosensitive sheet comprising, in combination:

a substantially cylindrical applicator roll mounted for rotation about a substantially horizontal axis;

means for moving an exposed photosensitive sheet tangent to and in contact with the peripheral surface of said roll;

a member mounted beneath said roll for pivotal movement about an axis substantially parallel with the axis of rotation of said roll;

said member being pivotal between a first position in which the upper surface of said member is inclined with respect to horizontal and said surface of a section of said member on one side of said pivotal axis is tangent with said surface of said roll at a line of contact located above said pivotal axis and cooperates with said roll to define a trough between said roll and said member and for substantially preventing the flow of processing liquid therebetween, and a second position in which said upper surface of said section of said member is inclined with respect to horizontal away from said roll and located beneath said pivotal axis;

means for rotating said peripheral surface of said applicator roll upwardly in contact with said processing liquid in said trough and in a direction opposite to the direction of movement of said sheet past said applicator roll; and

means for introducing a predetermined quantity of processing liquid into said trough defined by said roll and said member.

4. In photographic apparatus for exposing and processing photosensitive sheet material, processing means for applying a liquid to an exposed photosensitive sheet comprising, in combination:

a substantially cylindrical applicator roll mounted for rotation about a substantially horizontal axis;

means for rotating said roll;

means for moving an exposed photosensitive sheet tangent to and in contact with the peripheral surface of said roll;

a member mounted beneath said roll for pivotal movement about an axis substantially parallel with the axis of rotation of said roll;

said member being pivotal between a first position in which the upper surface of said member is inclined with respect to horizontal and said surface of a section of said member on one side of said pivotal axis is tangent with said surface of said roll at a line of contact located above said pivotal aixs and cooperates with said roll to define a trough between said roll and said member, and a second position in which said upper surface of said section of said member is inclined with respect to horizontal away from said roll and located beneath said pivotal axis, said member including a second section located to the side of said pivotal axis opposite the first-mentioned section of said member for engaging said surface of said roll in said second position of said member to remove said liquid from said surface of said roll; and

means for introducing a predetermined quantity of processing liquid into said trough defined by said roll and said member.

5. In apparatus including a rotary roll for applying liquid to a surface moved relative to and in contact with a peripheral surface of said roll, means for applying liquid to said peripheral surface of said roll during rotation thereof comprising, in combination:

a member mounted beneath said roll for pivotal movement about an axis substantially parallel with the axis of rotation of said roll, said member including a section having an upper surface for engaging said roll along an axial line for substantially preventing the flow of a processing liquid therebetween;

means for pivoting said member between a first position in which said upper surface of said member is inclined with respect to horizontal and said surface of said section is tangent with said peripheral surface of said roll at a line of contact located above and to one side of the pivotal axis of said member, and a second position in which said upper surface of said section of said member is inclined with respect to horizontal away from said roll and is located beneath said pivotal axis;

said upper surface of said section and said peripheral surface of said roll cooperating in said first position of said member to define a trough between said member and said roll;

means for rotating said peripheral surface of said applicator roll upwardly in contact with said processing liquid in said trough and in a direction opposite to the direction of movement of said sheet past said applicator roll; and

means for introducing a predetermined quantity of processing liquid into said trough defined by said roll and said member.

6. For use in photographic apparatus for exposing and processing photosensitive sheet materials, processing means for applying a processing liquid to successive exposed sections of a photosensitive sheet comprising, in combination:

an applicator having a substantially cylindrical section mounted for rotation about a substantially horizontal axis;

means for rotating said applicator;

a member having a surface inclined with respect to horizontal and including a section positioned in tangential contact with the peripheral surface of said cylindrical section along at least an axial line extending from end-to-end of said cylindrical section and cooperating with the portion of said peripheral surface above said line to form a trough;

means engaging the ends of said cylindrical section

and said member for preventing escape of said processing liquid at the ends of said trough;

means for moving a sheet relative to and in contact with said peripheral surface;

means for moving said member to separate said section of said surface thereof from said peripheral surface and discharge said liquid from said trough; and

means for engaging said cylindrical section along a second axial line ahead of the first-mentioned line for removing said processing liquid from said peripheral surface, said last-mentioned means being mounted on said member for movement thereby into engagement with said peripheral surface during movement of said surface of said member from engagement with said peripheral surface.



7. Photographic apparatus as defined in claim 4 including means located beneath said first-mentioned section of said member for receiving liquid running off said member when said member is in said second position.

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