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3,424,074

SEALING MEANS FOR PHOTOGRAPHIC PROCESSING APPARATUS

Filed Nov. 2, 1966

Sheet 1 of 2

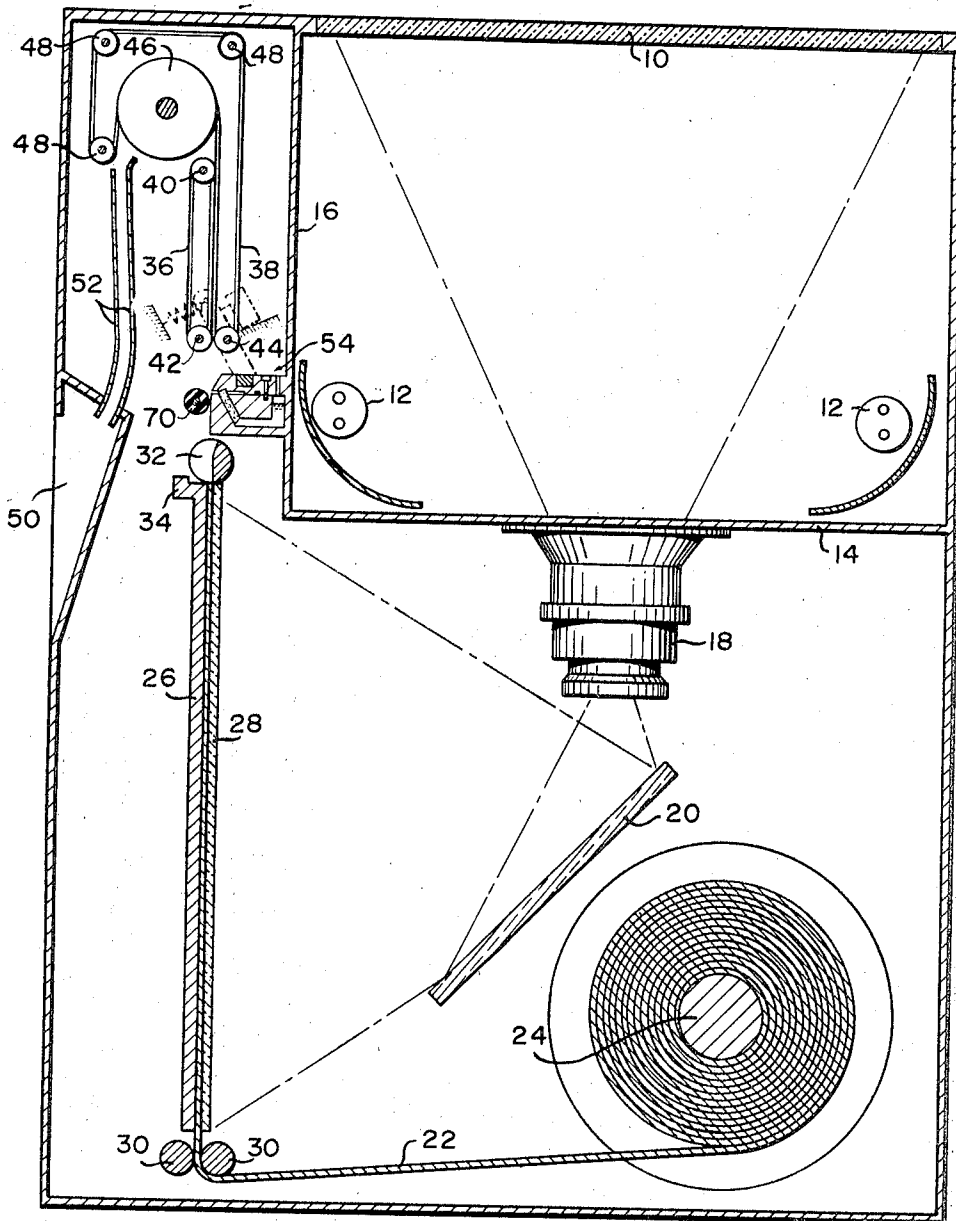


FIG. 1

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Sheet 2 of 2

FIG. 2

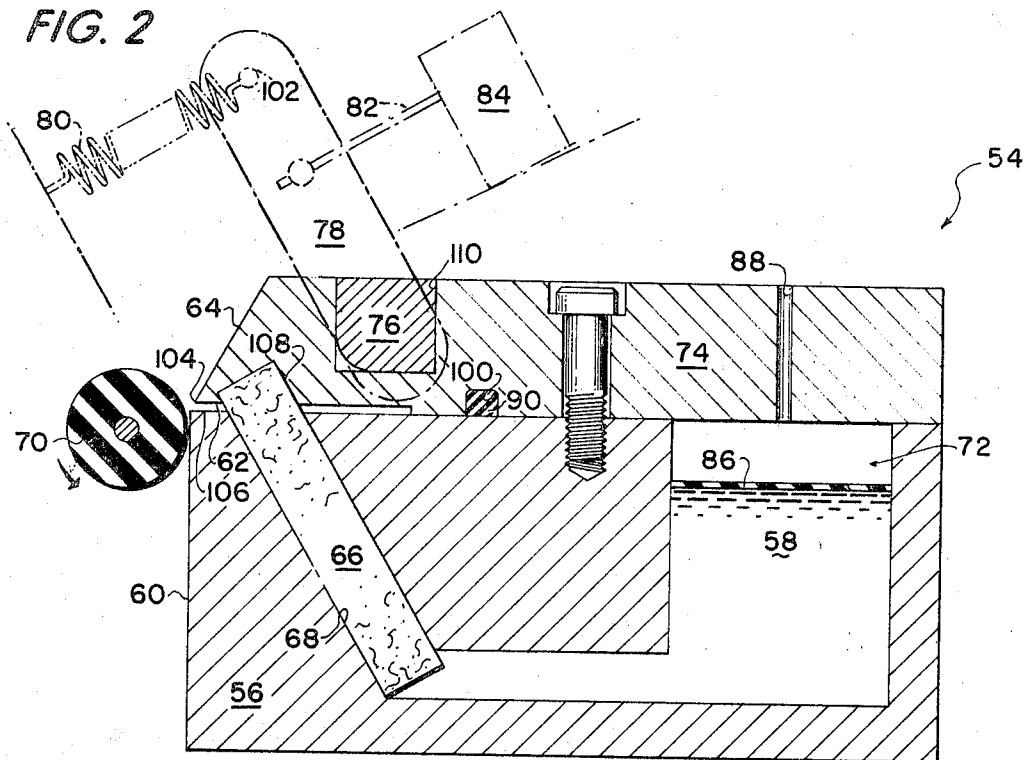


FIG. 4

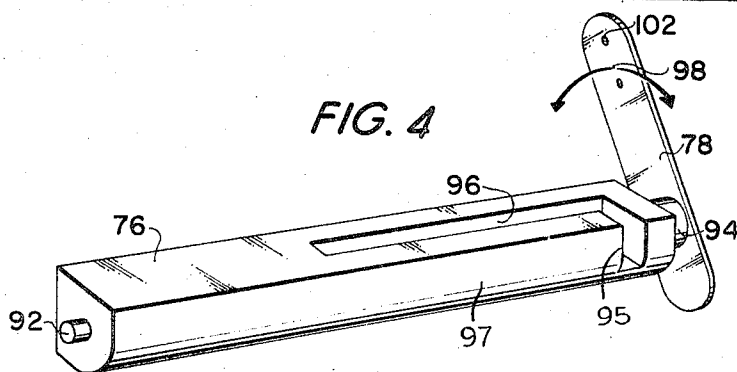
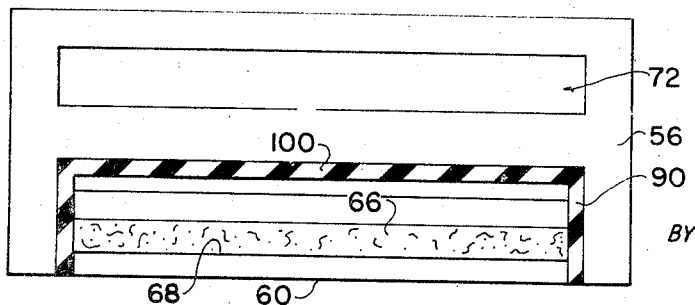


FIG. 3



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1

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SEALING MEANS FOR PHOTOGRAPHIC PROCESSING APPARATUS

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8 Claims

ABSTRACT OF THE DISCLOSURE

An applicator including a container having a supply of a nonviscous liquid therein and a cover, said liquid being subject to deterioration due to evaporation and contact with the atmosphere. Surfaces of the container and the cover cooperate to define a capillary slot through which the liquid flows by capillary action for subsequent application to a sheet of material. The cover is provided with a member for distorting a portion of the cover to close the capillary slot when the applicator is not in use thereby protecting the liquid from the adverse effects of the atmosphere.

This invention relates generally to sealing means and more particularly to a means for sealing off from the atmosphere a container of a nonviscous liquid used in the treatment of exposed photo-sensitive, image-recording sheet material in a photographic processing apparatus, thereby preventing the evaporation of such liquid and the leakage thereof within the apparatus.

Our previously filed, copending U.S. patent application, Ser. No. 568,493, filed July 28, 1966, discloses a novel photographic processing apparatus wherein a nonviscous liquid reagent is applied to a light-sensitive, image-recording sheet material to produce a visible image in a layer thereof. Such apparatus may include a camera, a document duplicator, or the like, in which the light-sensitive material is exposed. Such liquid processing reagents are generally highly alkaline and are subject to deterioration due to evaporation and contact with the atmosphere, thus requiring that the liquid be confined in such a way as to protect the apparatus and the operator from the corrosive effects of the liquid and to preserve the quality and stability of the reagent itself. To prevent such evaporation or leakage, it is necessary to seal off the chamber which contains such liquid reagent during such times when such liquid is not being used in the image producing process.

In our previously filed application the liquid reagent was shown as confined within a chamber maintained substantially at ambient pressure. A capillary channel containing appropriate wicking material, such as polypropylene, is used for conducting the liquid from such chamber to a capillary slot, the length of such slot being at least equal to the width of the area of the sheet material which is to be treated. The slot dimensions are such that an aqueous, alkaline liquid having a viscosity substantially the same as that of water will flow through the slot by capillary action.

The sheet material to be treated is carried past the slot opening by frictional engagement with a backing roll which is mounted adjacent said capillary slot, the surface of said roll being essentially tangent to a front support surface of the liquid applicator container.

Following each liquid application operation, our previous application discloses that the capillary slot may be sealed simply by pressing the backing roll against the surfaces which form the slot opening so that the surface of the roll engages such surfaces on opposite sides of and at the ends of the slot. Suitable means are provided for displacing the applicator container and the backing roll

2

relative to one another so that the latter is pressed against the slot opening to seal the slot opening.

However, it has been found that, while such means is satisfactory for a time, continued contact of the surface of the roll with the liquid reagent is detrimental over an extended time period. The liquid reagent tends to stick to the surface of the roll where it dries and cakes thereon after the roll has been disengaged from the slot opening and harmful contamination of the roll results. Moreover, some of the liquid which sticks to the roll is subsequently carried to the rear side of the sheet material as it passes by the applicator section, where it produces an undesirable staining and similar contamination to the back surface of the sheets.

This invention, however, overcomes such disadvantages and discloses an improved and novel means for providing a more effective seal at the capillary slot. In the invention, the liquid applicator section comprises a lower container, or chamber portion and an upper cover portion, the latter having embedded therein a torsion bar, the twisting force on which is controlled by the coordinated action of a torque, or rotating force, in one direction, which in a particular embodiment may be due to spring means attached thereto, and a force in the opposite direction, which in a specific embodiment may be due to a solenoid device, the movable shaft of which is also attached thereto. Under the action of the spring force, for example, (the solenoid not being actuated) the torsion bar is caused to twist in a manner such as to cause the front section of the upper cover of the liquid container to deform uniformly and to move downwardly toward the front section of the lower container to close the capillary slot in a manner described in more detail below. The slot is, thus, maintained in a normally closed condition. When the force in the opposite direction is actuated, it overcomes the force of the spring and causes the front section of the upper cover portion to lift upwardly to open the slot.

Although the cover portion is made of a relatively rigid material, the configuration of the front section thereof is formed as described below so as to be relatively easily deformable under the action of the closing force involved. A suitable U-shaped gasket means is positioned under compression between the container and its cover to seal the remaining sides of the slot to prevent leakage of liquid reagent there through. The torsion bar is also fashioned to provide a uniform twisting force along its entire length so that the capillary slot is completely sealed off and no gaps occur along its length.

A more detailed description of such a sealing arrangement for use in a photographic processing apparatus is described in the accompanying drawings with reference to the following figures wherein:

FIG. 1 is a sectional, elevational view of the overall photographic apparatus which embodies the sealing means of the invention;

FIG. 2 is an enlarged sectional view of the liquid applicator portion thereof constructed in accordance with the invention;

FIG. 3 is a plan view of the lower container portion of the applicator section of FIG. 2; and

FIG. 4 is a perspective view of the torsion bar which is embedded in the upper cover portion of the liquid applicator section shown in FIG. 2.

In the sectional drawing of FIG. 1, the overall photographic processing apparatus is shown in the form of a document copying device comprising means for exposing successive areas of a combined image-recording and image-receiving sheet, means for severing successive sections of the sheet, each containing an exposed area, from the remainder of the sheet and means for processing the successive sections of the sheet, including means for applying

a nonviscous (e.g., viscosity of water) liquid reagent to one side of the sections.

The apparatus comprises exposure means including a window 10 in the upper wall of the housing of the apparatus for supporting an original, e.g., document, in position for exposure to light from lamps 12 mounted within an enclosed chamber separated from the remainder of the interior of the housing by a lower wall 14 and a side wall 16. Light reflected from an original positioned on window 10 is transmitted by a conventional objective lens, which is part of a lens and shutter assembly 18, toward a focal plane in the apparatus at which the lens forms an image of the original. The optical system includes, in addition to the lens of assembly 18, a mirror 20 positioned beneath the lens for reflecting light toward one side of the housing and means for supporting a light-sensitive, image-recording sheet at the focal plane of the lens.

A supply of light-sensitive, image-recording sheet material, designated 22, is provided coiled on a spool 24 in the lower portion of the apparatus behind mirror 20. The means for positioning successive sections of the sheet in position for exposure include a support plate 26 and a juxtaposed transparent plate 26 located substantially at the focal plane of the lens. Sheet 22 is withdrawn from spool 24 and moved upwardly between plates 26 and 28 by a pair of juxtaposed feed rolls 30 located beneath and adjacent the lower edges of the plates.

A rotary knife 32 and anvil 34 are mounted above and adjacent the upper edges of plates 26 and 28 for severing successive exposed sections of the image-recording sheet as each section is advanced upwardly from between the plates between the knife and anvil. In operation of the apparatus, a section of the image-recording sheet positioned between plates 26 and 28 is advanced, following exposure, upwardly past the knife into engagement with liquid applicator means and then through a sheet conveyor system designed to deliver the sheets from the applicator to an exit opening in the housing of the apparatus and to provide a delivery period of sufficient duration to permit completion of the processing of the image-recording sheet within a dark environment. The sheet delivery system includes two sets of endless conveyor belts 36 and 38. The belts 36 are mounted on support rolls 40 and 42, and belts 38 extend from support rolls 44, juxtaposed with support roll 42, upwardly in juxtaposition with belts 36 and around an enlarged drum or discs 46 and thence back to support roll 44 by way of support rolls 48 spaced around the periphery of drum or discs 46. The conveyor belts 38 which contact the side of the sheets to which the liquid is applied are preferably quite narrow in order to limit the area of contact between the belts and the sheet and, in the preferred form, may comprise conventional O-rings.

The housing of the apparatus includes an opening 50 through which the processed sheets are delivered and a pair of guides 52 extending from the opening upwardly toward the points of tangency between belts 38 and discs 46 for guiding the sheets from between the belts and discs downwardly through opening 50.

The liquid applicator of the invention designated as element 54 in FIG. 1 is shown in detail in FIGS. 2-4 as comprising a lower portion in the form of an elongated container 56, including a chamber 72 for holding a quantity of processing liquid 58, and an upper portion in the form of an elongated cover 74. Chamber 72 is maintained substantially at ambient pressure by providing an opening 88 in cover 74 between the atmosphere and the reservoir. A diaphragm 86 is secured within chamber 72 to protect liquid 58 from air admitted through opening 88 in a manner similar to that described in our previous application.

Container portion 56 and chamber 72 therein are approximately equal in length to the width of the area of the photo-sensitive sheet material to be treated. Container portion 56 includes a front section providing a generally planar front support surface 60 at least equal in length

to the width of the sheet material to be treated for guiding and supporting the sheet material during application of the processing liquid. Support surface 60 terminates at one side of a capillary slot 62 formed between the front sections of container portion 56 and cover portion 74, such slot being at least equal in length to the width of the area of the sheet material to be treated and having a width of capillary dimension such that an aqueous alkaline liquid having a viscosity substantially that of water will flow therethrough by capillary action. The front section of cover portion 74 provides a surface 64 set back from surface 60 by approximately the width of capillary slot 62. The applicator including the portions thereof providing the container and cover for the processing liquid, surfaces 60 and 64 and capillary slot 62, may be formed of any material that is compatible with the processing liquid and preferably a material that is wet by the processing liquid in order to encourage flow thereof by capillary action. Suitable materials include organic polymers such as the acrylics, glass, ceramics and metals.

Liquid 58 is conducted from chamber 72 to capillary slot 62 by a multiplicity of capillary channels. In the embodiment shown in FIG. 2, this multiplicity of capillary channels is provided by a fibrous wick 66 formed, for example, of a nonwoven fabric composed of fibers of a material, such as polypropylene, which is compatible with the processing liquid, and enclosed in a channel 68. Applicator 54 includes a section providing channel 68 at least approximately equal in length to capillary slot 62 and communicating between capillary slot 62 and the lower portion of the reservoir of liquid in chamber 72. Wick 66 substantially fills channel 68 which, as shown in FIG. 2, extends from the bottom of the reservoir upwardly and at an angle to a position above the level of capillary slot 62. By virtue of this construction, liquid 58 is raised within channel 68 to a level above slot 62 and provides a supply head in the capillary slot.

It has been discovered that a single capillary slot provides the best means for accurately metering the quantity of the processing liquid applied to the sheet material and uniformly distributing the processing liquid in contact with the sheet material. A multiplicity of capillary channels for conducting the liquid from the reservoir to the metering and distributing capillary slot provides assurance of an adequate supply of the liquid to the capillary slot despite the clogging or plugging of a number of the supply capillaries. The processing liquid is applied to sheet 22 by moving the sheet upwardly against surface 60 across capillary slot 62 and surface 64 in a direction generally perpendicular to the length of the capillary channel.

It has been discovered that the quantity of liquid applied is directly related to the width of capillary slot 62 and the linear rate of movement of the sheet material past the capillary channel as well as relatively non-critical factors such as the depth of the liquid in the reservoir. The simplest form of control over the quantity of liquid applied is achieved by varying the speed of movement of the sheet material past the capillary slot. The applicator including the container of liquid lends itself to fabrication from inexpensive materials so that the applicator may be initially supplied with sufficient liquid to process a predetermined quantity of sheet material and may be thrown away when the liquid is expended. In apparatus such as a document copier, it may be desirable to provide a more permanent applicator structure, a separate reservoir for the processing liquid, together with means for feeding the processing liquid from the reservoir to a chamber in the applicator and controlling the level of the liquid within the chamber in the applicator.

A backing roll 70 preferably having a surface with a high coefficient of friction, e.g., an elastomer such as polyurethane, is mounted with its surface tangent to surface 60 closely adjacent the edge of capillary slot 62.

Means are provided for rotating roll 70 (in a counter-clockwise direction) for supporting and moving a sheet against surface 60 across slot 62. In the operation of the document copier shown in FIG 1, sheet 22 is advanced upwardly past knife 32 between surface 60 and roll 70 and thence into engagement between belts 36 and 38 at rolls 42 and 44 and rotation of all of the sheet-advancing rolls and belts is coordinated to insure movement of the sheet material at a constant predetermined speed particularly during processing including liquid application and the subsequent processing period.

Following each liquid application it is desirable to seal capillary slot 62 to prevent leakage or evaporation of the liquid within such slot. The invention described in this application discloses a novel method for providing an efficient sealing means for this purpose. As shown in FIGS. 2-4, cover portion 74 of applicator 54 has a torsion bar 76 embedded in a groove 110 in the front section thereof. Torsion bar 76 is shown in more detail in the perspective view of FIG. 4 wherein the left-hand end of torsion bar 76 is adapted to be held firm within cover 74 at pin 92. The right-hand end of torsion bar 76 extends to an edge portion 95 which is substantially flush with the surface of the side wall of cover 74 and there after bar 76 has a crank arm 78 fixedly attached thereto by a shaft 94, arm 78 thereby being capable of pivoting about the axis of shaft 94. An elongated opening 96 is cut out of the right-hand portion of torsion bar 76 by an appropriate machining process so that when crank 78 is actuated to move in one direction or the other, as shown by arrowhead 98, the twisting force which results therefrom is applied and distributed uniformly along the entire length of torsion bar 76. Opening 96 extends approximately one-half the length of torsion bar 76.

Slot 96 limits the amount of force which can be transmitted by the weakened portion 97 of bar 76 to the adjacent edge of slot 110. Once portion 97 is transmitting a predetermined force to slot 110, any attempt to increase the transmitted force by rotating arm 78 will result in a narrowing of the slot 96. It has been found that due to minute differences in the manufacture of the bar 76 and groove 110 a contact along the entire length of bar 76 with the front wall of groove 110 is not always possible, i.e., portion 97 may be in contact with and transmitting forces to the wall of groove 110 while the remainder of the bar is transmitting forces which may range from zero to a value less than that of portion 97. It has also been found that the capillary slot may be fully closed at the end adjacent arm 78 and partially open at the opposite end. Under this condition further rotation of arm 78 would break the cover 74 due to the excess forces being transmitted by portion 97 were it not for slot 96. Slot 96, in this latter condition, permits further torque to be transmitted to bar 76 to permit the left-hand side (as viewed in FIG. 4) of bar 76 to transmit greater forces without further increasing the forces being transmitted by portion 97.

In order to prevent leakage of the liquid between cover portion 74 and container portion 56, a U-shaped gasket 90 partially encloses capillary slot 62 and the upper portion of capillary channel 68, as shown in FIGS. 2 and 3. The parallel side arms of gasket 90 extend inwardly into applicator 54 from the front of slot 62 to a location behind the extension of slot 62 beyond the recessed groove 108 which forms the upper part of capillary channel 68. Gasket 90 abuts the upper surface of container portion 56 and fits under compression into a correspondingly shaped groove 100 in cover portion 74.

In the particular embodiment shown, the end of crank 78 not attached to torsion bar 76 has a spring 80 attached thereto at opening 102, the other end of spring 80 being fixedly attached to a suitable frame piece (not shown) within the interior of the document copying apparatus. Spring 80 thereby imparts a counter-clockwise force to

crank 78 thereby applying a torque, or rotating force, to torsion bar 76 so that the front section of cover 74 becomes mechanically distorted and the lower edge 104 of surface 64 comes into contact with the lower surface 106 of slot 62 along the entire length of slot 62 so as to completely seal off such slot and the liquid contained therein from the atmosphere.

Under the action of spring 80, the opening of slot 62 is normally maintained in a closed position. When it is desired to apply the appropriate amount of liquid reagent to a sheet of material to be treated, a solenoid 84 having a movable shaft 82 fixedly attached to crank 78 is appropriately actuated so as to apply a force in the opposite direction sufficient to overcome the force of spring 80 and thereby rotate crank 78 in a clockwise direction. Rotation of crank 78 in turn reduces the torque applied to torsion bar 76 and restores the bar to its undistorted shape. The front section of cover 74 is thereby caused to move in an upward direction to its undistorted position and edge 104 moves upward from surface 106 to open slot 62 during the time period when the light-sensitive sheet material passes by such opening. While the solenoid is thus actuated, appropriate liquid reagent is applied to the light sensitive sheet material as it passes by the slot in a manner described in our previously filed application.

Although cover portion 74 is normally made of a rigid material, the configuration of its front section is such as to cause it to be relatively easily distorted under the action of the force of spring 80. Such distortion primarily results from the weakening of such front section by the presence of groove 110 into which torsion bar 76 is inserted. Thus, under the twisting motion of torsion bar 76, the clearance provided by the extension of slot 62 into applicator 54 permits the front section of cover 74 to pivot downwardly in a counter-clockwise direction as depicted in the figure so that the opening of slot 62 is appropriately closed.

The sealing system of the invention provides a more effective and longer lasting seal than that obtained by merely pressing backing roll 70 against the opening of slot 62. In the arrangement shown, the torsion bar receives a uniformly distributed twisting force all along its length so that a correspondingly uniform seal across the opening of slot 62 is achieved. Variations in the sealing system described herein may occur to those skilled in the art without departing from the basic scope of the structure shown. Hence, the invention is not to be construed as limited to the specific elements shown and described herein except as defined by the appended claims.

What is claimed is:

1. A photographic processing apparatus for applying a predetermined quantity of a nonviscous liquid reagent uniformly to each of a succession of areas of photographic sheet material comprising, in combination:

an applicator member including a lower container portion and an upper cover portion, said lower container portion having an outer surface for supporting a photographic sheet;

means within said applicator member for providing a reservoir for holding a nonviscous liquid reagent;

an elongated capillary slot formed between said upper cover portion and said lower container portion and extending into said applicator member from said outer surface, said slot terminating at one side at said outer surface and its other side within said applicator member;

capillary channel means within said applicator member communicating with said capillary slot at said other side thereof and with said reservoir for conducting a flow of liquid from said reservoir to said capillary slot; and

means for distorting said upper cover portion to close said capillary slot.

2. A photographic processing apparatus in accordance with claim 1 wherein said distorting means includes
 a first means for applying a distorting force to said cover portion in one direction to maintain said capillary slot in a normally closed position; and
 a second means for applying a force to said cover portion in the opposite direction to overcome the distorting force applied by said first means whereby said capillary slot is opened in response thereto.

3. A photographic processing apparatus in accordance with claim 1 wherein

said cover portion is made of a relatively rigid material, the front section of which is sufficiently weakened so as to become distorted in response to the operation of said distorting means.

4. A photographic processing apparatus in accordance with claim 3 wherein said front section includes

a recessed groove formed therein;
 a torsion bar inserted in said recessed groove; and
 said distorting means includes means for applying a rotating force to said torsion bar to pivot said front section in a downward direction in response thereto to close said capillary slot.

5. A photographic processing apparatus in accordance with claim 4 wherein said torsion bar is weakened in the region near the end at which said rotating force is applied so that said twisting motion is uniformly applied along said bar.

6. A photographic processing apparatus in accordance with claim 1 wherein said applicator means includes a U-shaped gasket means positioned under compression between said lower container portion and said upper cover portion for preventing leakage of said nonviscous liquid reagent between said upper and lower portions.

7. A photographic processing apparatus for applying a predetermined quantity of a nonviscous liquid reagent uniformly to each of a succession of areas of photographic sheet material comprising, in combination:

an applicator member including a lower container portion and an upper cover portion, said lower container portion having an outer surface for supporting a photographic sheet;

means within said applicator member for providing a reservoir for holding a nonviscous liquid reagent;

an elongated capillary slot formed between said upper cover portion and said lower container portion and extending into said applicator member from said outer surface, said slot terminating at one side at said outer surface and its other side within said applicator member;

capillary channel means within said applicator member communicating with said capillary slot at said other side thereof and with said reservoir;

means for distorting said upper cover portion to close

said capillary slot, said means including spring means for applying a distorting force to said cover portion in one direction to maintain said capillary slot in a normally closed position; and

solenoid means for applying a force to said cover portion in the opposite direction to overcome the distorting force applied by said spring means whereby said capillary slot is opened in response thereto.

8. A photographic processing apparatus for applying a predetermined quantity of a nonviscous liquid reagent uniformly to each of a succession of areas of photographic sheet material comprising, in combination:

an applicator member including a lower container portion and an upper cover portion, said lower container portion having an outer surface for supporting a photographic sheet;

means within said applicator member for providing a reservoir for holding a nonviscous liquid reagent; an elongated capillary slot formed between said upper cover portion and said lower container portion and extending into said applicator member from said outer surface, said slot terminating at one side at said outer surface and its other side within said applicator member;

capillary channel means within said applicator member communicating with said capillary slot at said other side thereof and with said reservoir;

means for distorting said upper cover portion to close said capillary slot;

a U-shaped gasket means positioned under compression between said lower container portion and said upper cover portion for preventing leakage of said nonviscous liquid reagent between said upper and lower portions,

said U-shaped gasket means including two parallel sides extending from the opening of said slot into said applicator member to a region beyond the extension of said slot therein and beyond the upper portion of said capillary channel means, said gasket means thereby partially enclosing said slot and said capillary channel means.

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