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3,249,031

PHOTOGRAPHIC APPARATUS FOR TREATING A SHEET WITH A LIQUID

Filed Feb. 7, 1964

2 Sheets-Sheet 1

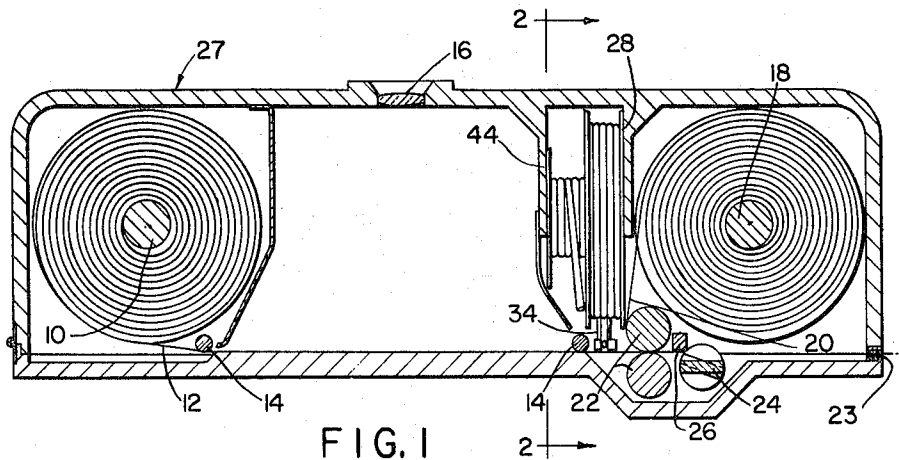


FIG. 1

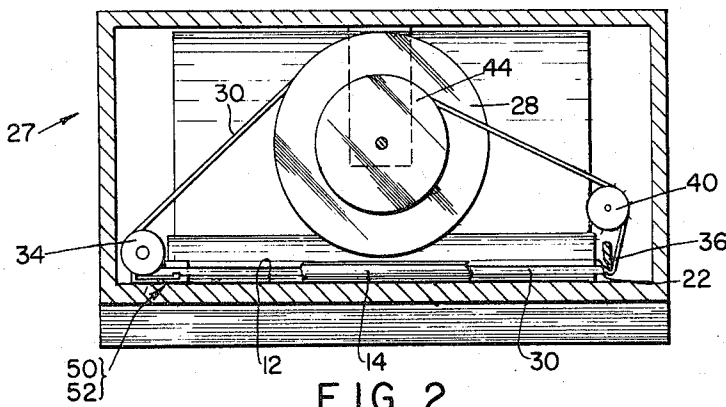


FIG. 2

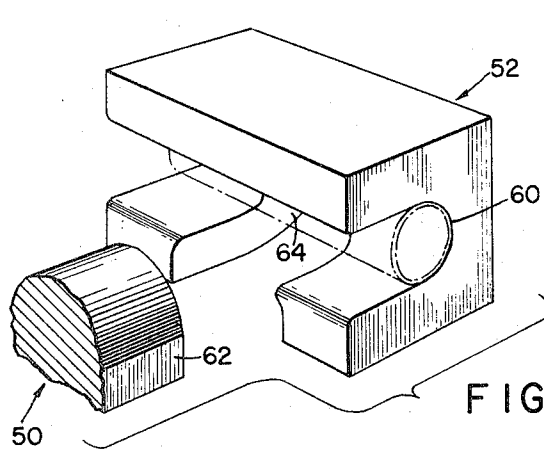


FIG. 4

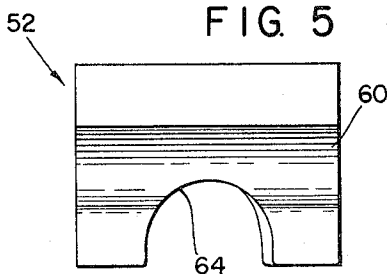


FIG. 5

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2 Sheets-Sheet 2

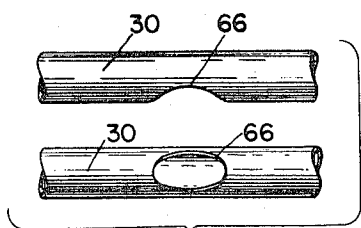


FIG. 8

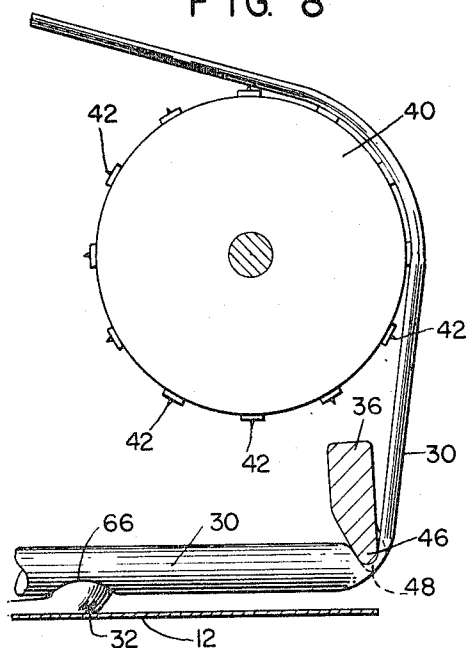


FIG. 6

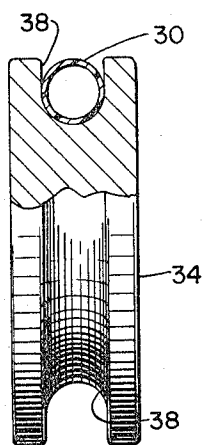


FIG. 7

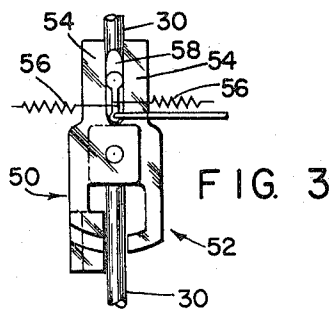


FIG. 3

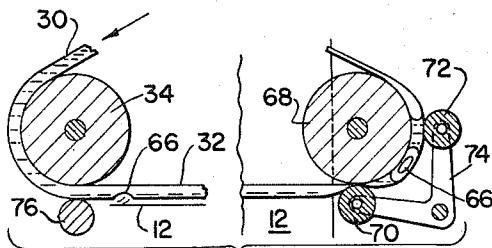


FIG. 9

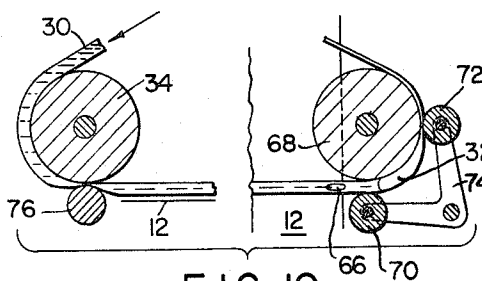


FIG. 10

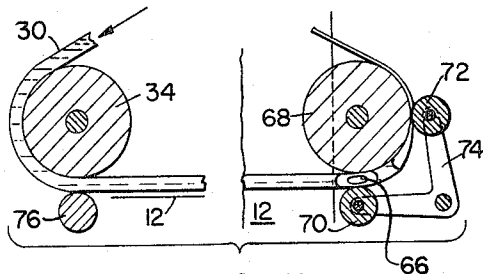


FIG. 11

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**PHOTOGRAPHIC APPARATUS FOR TREATING
A SHEET WITH A LIQUID**

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Filed Feb. 7, 1964, Ser. No. 343,368
7 Claims. (Cl. 95—13)

This invention relates to photographic apparatus for exposing successive areas of a photosensitive image-recording sheet and treating the exposed areas with a viscous liquid distributed in contact with said areas.

A number of types of photographic apparatus have been proposed including, for example, cameras, document copiers and the like, in which successive areas of a photosensitive image-recording sheet are exposed and each exposed area is treated with a viscous liquid distributed in contact therewith preferably to produce a transfer image in an area of a second sheet superposed with the image-recording sheet. The viscous liquid is distributed in contact with an area to be treated by progressively superposing the area with another surface, usually the surface of a second sheet, and pressing the two sheets together along a line progressively from one edge of the area toward the opposite edge of the area by moving the sheets into superposition relative to and between a pair of juxtaposed pressure-applying members. A predetermined quantity of the viscous liquid is supplied to the sheets intermediate the sheets near the line at which the sheets are brought into superposition preferably as a uniformly distributed elongated mass extending from side to side of the areas. The mass of liquid remains substantially stationary with respect to the pressure-applying members as the sheets are advanced relative to and between them in contact with the mass of liquid. The liquid employed usually includes water and photographic processing agents which are highly alkaline, oxidize readily and are rendered quite viscous by the inclusion of an agent such as a high molecular weight compound, e.g., sodium carboxymethyl cellulose, which tends to harden when the water (or other solvent) evaporates or is absorbed from the liquid. Such a liquid obviously presents numerous problems of storage, handling and dispensing as required, as well as subsequent distribution in contact with an area of a sheet. This last step will be facilitated if the viscous liquid is dispensed as a uniformly distributed elongated mass extending from side to side of the area to be treated.

In the apparatus of the type of which the present invention is concerned, the image-recording sheet (and second sheet) is moved through the apparatus intermittently and the interval between exposure and processing of a particular area and exposure and processing of the next succeeding area may vary substantially, for example, from seconds to days. This characteristic of the apparatus further complicates the problems involved in storage, handling and dispensing a highly viscous, corrosive, oxidizable and air hardening liquid.

In the copending U.S. patent application of Robert M. Briber, Serial No. 343,367 filed Feb. 7, 1964, entitled Photographic Apparatus for Treating a Sheet With a Liquid, there is described apparatus for dispensing successive, predetermined quantities of a viscous photographic processing liquid onto a sheet as a succession of uniformly distributed, elongated masses of predetermined lengths extending transversely of the direction of movement of the sheet. In this apparatus, a viscous processing liquid is dispensed from successive sections of predetermined length of a single, elongated, disposable, tubular container filled with the liquid, whereas the practice has been to dispense the processing liquid from the

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trailing end of a container as the latter is moved in the direction of its other (leading) end across a sheet. The trailing end is usually unconfined and unguided during movement and may not move in a straight line thereby dispensing a curved, rather than the desired straight, mass of liquid. The apparatus described includes means for supporting and guiding both ends of successive sections of a tubular container as the liquid is dispensed from each of said sections during movement thereof relative to and across a surface on which the liquid is dispensed.

An object of the present invention is to provide, in photographic apparatus of the type described, novel and improved means for compressing the container to dispense the viscous liquid contents of the container from an opening there in.

Another object of the invention is to provide apparatus as described including means for compressing the container so constructed and functioning as to remain free of contamination by the liquid.

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 is an elevation view showing in section and somewhat schematically, photographic apparatus embodying the invention;

FIG. 2 is a sectional view taken substantially along the line 2—2 of FIG. 1;

FIG. 3 is a bottom plan view of a device incorporated in the apparatus;

FIG. 4 is a fragmentary perspective view of the device of FIG. 3;

FIG. 5 is an elevation view of a component of a device of FIG. 3;

FIG. 6 is an enlarged view similar to FIG. 2 showing in detail components of the apparatus;

FIG. 7 is a view partially in section showing a component of the apparatus;

FIG. 8 includes fragmentary plan and elevation views of a section of a container employed in the apparatus; and

FIGS. 9, 10 and 11 are somewhat schematic, sectional views of another embodiment of the apparatus illustrating the operation thereof, the left hand portion of each of the figures showing a portion of the apparatus in elevation and the right hand portion of each of the figures showing a portion of the apparatus in plan.

The liquid-supplying and dispensing system incorporating the invention may be embodied in photographic apparatus such as a camera, printing or document-copying apparatus in which successive areas of a photosensitive image-recording sheet are exposed and advanced into superposition with successive areas of a second sheet and the two sheets are moved between a pair of juxtaposed pressure-applying members for distributing a processing liquid between superposed areas of the sheets. The processing of the image-recording sheet by a liquid may result in the production of a positive image on the second sheet by a diffusion transfer process in which image-forming substances are transferred from the image-recording sheet to the second sheet. For examples of such processes reference may be had to U.S. Patents Nos. 2,543,181, issued February 27, 1951, and 2,662,822, issued December 15, 1953, both in the name of Edwin H. Land. In the apparatus of the invention a predetermined quantity of processing liquid to be distributed between and in contact

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with each pair of superposed areas of the image-recording and second sheets is provided on one of the sheets adjacent an edge of the area thereof over which the liquid is to be distributed, in the form of a uniformly distributed, elongated mass extending substantially in a straight line from side to side of the area. The liquid-dispensing system of the invention is designed to provide successive, predetermined quantities of the liquid in this manner for distribution between successive superposed areas of the image-recording and second sheets, and to dispense accurate quantities of the liquid in precisely arranged masses at specific locations one of the sheets; and utilizes a disposable container in which sufficient liquid is supplied to process a predetermined number of areas of the image-recording sheet.

Reference is now made to FIGS. 1 and 2 of the drawings wherein there is illustrated, somewhat schematically, photographic apparatus for exposing and processing an image-recording sheet. The apparatus comprises a spool 10 for holding a supply of photosensitive image-recording sheet material 12, and guide means 14 for locating successive areas of the image-recording sheet in position for exposure to light from a suitable exposure means shown as a lens 16; it being understood, however, that the exposure and guide means may include any of the conventional systems for holding and exposing photosensitive sheet material including exposure systems of cameras, printers, document copiers and the like. The apparatus includes a second spool 18 for holding a supply of a second or print-receiving sheet 20 and a pair of juxtaposed pressure-applying members in the form of rolls 22 between which the photosensitive and second sheets are advanced in superposition for distributing a processing liquid between the sheets to form a sandwich. The sandwich is advanced from rolls 22 a predetermined distance within the housing and thence through an exit passage 23 provided in the housing with suitable light seals such as flocking and the like. The apparatus also includes a cutting device comprising a rotary knife 24 and anvil 26 for severing successive portions of the sandwich, each including an exposed area of the image-recording sheet, from the remaining portions of the sheets so that the portions of the sheets comprising the sandwich may be separated from one another at the end of a processing period of predetermined duration. The apparatus may include other conventional components commonly associated with cameras, printing devices or document-copying devices, together with means for driving rolls 22 and/or other means for advancing the two sheets and the sandwich through the apparatus during and intermediate exposure and processing, and a housing for supporting and enclosing the operative components of the apparatus and the light-sensitive sheet material employed in the apparatus.

The fluid-dispensing system is located in position for dispensing a viscous liquid onto the image-recording sheet intermediate guide means 14 and rolls 22 adjacent the rolls. In the form above shown in FIGS. 1 through 6, the liquid-dispensing means comprise a spool 28 mounted above sheet 12 for holding a supply of an elongated tubular container 30 filled with a viscous processing liquid designated 32. The processing liquid may consist of one or more of a variety of chemical agents useful in photography, and may include, for example, an aqueous alkaline solution of a silver halide developer and a silver halide complexing agent. The liquid also includes a viscosity adding agent such as a high molecular weight material, for example, sodium carboxymethyl-cellulose preferably in a quantity sufficient to give the liquid a jelly-like consistency such that the liquid, under normal conditions, flows very slowly or not at all. A viscosity at 20° C. in the range 100-200,000 centipoises is suggested by way of example of a suitable viscosity.

Tubular container 30 is formed of a material which is flexible, preferably resilient, compatible with the proc-

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essing liquid and impermeable to the liquid, the vapor thereof and air. Suitable materials for this purpose are organic plastics and many elastomers, and as an example of a particular material, copolymer of vinyl chloride and vinylidene such as sold by Dow Chemical Company under the trade name "Saran" has been found to be especially useful. The container may have almost any cross-sectional configuration although rounded cross sections are preferred so long as the internal cross-sectional area is substantially uniform throughout the liquid containing portion of the tubular container. The material comprising the container and the shape of the container are such that substantially all of the liquid contents of the container can be extruded therefrom by progressively compressing or pinching the container. The liquid within a section of the container is dispensed as an elongated mass approximately equal in length to the section from which it is dispensed and accordingly the cross-sectional area of the container is governed by the quantity of the liquid required to be dispensed in a mass of predetermined length.

The liquid-dispensing means in the form shown in FIGS. 1 through 7, comprise a guide roll 34 located adjacent one edge of sheet 12 and a guide bar 36 located adjacent the opposite edge of the sheet for supporting a section of container 30 transversely of the direction of movement of the sheet and closely adjacent the sheet. Guide roll 34 preferably includes a groove 38 in its periphery shaped to conform to the external shape of container 30 so as to prevent compression of the container as the container is drawn in tension around the guide roll in the groove. The liquid-dispensing means include means for drawing the container from spool 28 around guide roll 34 across sheet 12 and around guide bar 36, comprising a drive roll 40 mounted above guide bar 36. Drive roll 40 is provided on its periphery with radially projecting pins 42 having sharpened points for piercing the container to provide a secure engagement with the container for moving the container, when drive roll 40 is rotated in a counterclockwise direction (viewing FIG. 6). Container 30, from which the liquid has been ejected, is advanced from drive roll 40 to a take-up spool 44 shown mounted coaxially with supply spool 28.

Guide bar 36 includes a relatively sharp corner 46 around and against which the container is drawn to compress and flatten the container for squeezing the liquid contents of the container therefrom. Guide bar 36 also includes flanges 48 adjacent corner 46 for guiding container 30 around the corner and preventing the container from coming off the guide bar. The container is emptied at corner 46 so that drive roll 40 and pins 42, which engage the emptied container, may be subject to contamination by any of the liquid which may remain adhered to the outside of the container in the region of the opening therein through which the liquid is dispensed. It is for this reason that positive engagement means in the form of pins 42 are provided for engaging and advancing the container rather than a drive depending on friction to advance the container.

The fluid-dispensing means also include means adjacent the edge of the sheet nearest guide roll 34 for forming an opening in the container, preferably in the lower portion thereof, at least equal in area to the internal cross-sectional area of the container through which the liquid is ejected from the container. In the form shown in FIGS. 3 through 5, these last-mentioned means comprise a punch 50 and die 52 mounted in juxtaposition with one another adjacent opposite sides of the path of movement of container 30. The punch and die are mounted for movement toward one another and the container on pivoted levers 54 and are biased apart from one another by springs 56. A cam 58 is provided for pivoting the levers so as to move the punch and die toward one another into engagement with container 30. Die 52 is formed in the side facing container 30 with a channel 60

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having a U-shaped cross section conforming to the external cross section of the container for engaging the container and preventing movement thereof relative to the die during a punching operation. Punch 50 includes a cylindrical section 62 which cooperates with a cylindrical channel 64 in the lower side of die 52 to engage and cut a semi-circular notch 66 (see FIG. 8) in the lower portion of container 30 when the punch and die are moved toward one another into engagement with the container so that cylindrical section 62 enters cylindrical channel 64. Notch 66 is also an ellipsoidal opening 66 and although the punch and die cut a notch in a portion of container 30 filled with the liquid, the punch and die tend to remain relatively free of the liquid inasmuch as the punch and die, upon first engaging the container, pinch the container so as to squeeze the liquid from between portions of the wall of the container which is cut to form opening 66. For this reason, the punch passes through little if any liquid so that there is little or no accumulation of liquid on the punch and die. Movement of the punch and die horizontally into and from engagement with a container and the viscosity of the liquid, preferably such as to prevent flow of the liquid from the opening, contribute to insuring that the punch and die remain free of contamination by the liquid.

To process an exposed area of image-recording sheet 12, cam 58 is rotated to move punch 50 and die 52 toward one another into engagement with the container and one another to form an opening 66 in the container adjacent an edge of sheet 12. Immediately upon withdrawal of the punch and die from engagement with the container, and while the sheet remains stationary, drive roll 40 is rotated to draw container 30 around corner 46 of guide bar 36 compressing the container at the corner and ejecting the liquid contents of the section of the container between the guide bar and opening 66 through opening 66 as the container and opening move across sheet 12. Liquid 32, being quite viscous, is extruded from container 30 directly into contact with sheet 12 to form an elongated mass extending substantially from side to side of the sheet, or from side to side of the exposed area thereof; and since the section of the container from which the liquid is dispensed is supported at both ends, this mass of liquid is bound to be straight. The container is advanced around guide bar 36 until the portion of container 30 including opening 66 is just past corner 46. The tension on the container is maintained so that the portion of the container bent around corner 46 is pinched closed effectively sealing the container against escape of the liquid and the admission of air to the container. Immediately following dispensing of an elongated mass of the liquid onto sheet 12, the sheet is immediately advanced into superposition with sheet 20 between rolls 22 and the mass of liquid is carried by sheet 12 into the bite of the rolls between the convergent portions of the two sheets to form a meniscus remain substantially stationary as the sheets move between the rolls. Rolls 22 may be constructed to spread the liquid from this meniscus as a thin layer between the sheets or the rolls may be constructed to squeeze the major portion of the viscous material from between the sheets while the sheets absorb the liquid from the mass as they move in contact with the mass of liquid. The two sheets are pressed together to form a sandwich which is advanced between knife 24 and anvil 26 until the exposed area has been advanced between rolls 22 and the knife and anvil whereupon knife 24 is rotated to sever the sandwich. The sandwich, depending upon the materials employed and the process performed, may be advanced directly from the apparatus at rolls 22, or may be advanced into a processing chamber within the apparatus from whence the sandwich may be withdrawn when processing is complete. The sheets comprising the sandwich are separated from one another at the end of the processing period during which, for example, a positive transfer print is formed in second sheet 20.

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It is possible and may be desirable, in the embodiment of the invention shown, to commence the advancement of sheet 12 relative to container 30 as opening 66 approaches the edge of the sheet while the container is still moving. Because the liquid is viscous and tends to adhere to the sheet in preference to adhering to the container, this premature movement of sheet 12 tends to withdraw the liquid from the container in the region of opening 66 (which remains open) while wiping the liquid from the exterior of the container so that the opportunity for contamination of guide bar 36 and drive roll 40 is further reduced. In this last-mentioned embodiment, the flange 48 on the side of guide bar 36 closest rolls 22 is preferably omitted since it might otherwise come into contact with the liquid.

The system previously described for moving the container and compressing it to dispense its viscous fluid contents is designed to function even though contaminated with the liquid. In accordance with the invention, another system is provided for moving successive sections of container 30 across the sheets and dispensing liquid 32 from the sections without becoming contaminated with the liquid. This system is shown in FIGS. 9 through 11 as comprising guide roll 34 adjacent one edge of sheet 12; a guide roll 68 mounted adjacent the opposite edge of the sheet for cooperating with guide roll 34 to support a section of container 30 adjacent and transversely of sheet 12; and first and second pressure rolls 70 and 72 mounted on the ends of a crank 74 pivotable to urge rolls 70 and 72 alternatively into engagement with container 30 to compress the container against guide roll 68. Guide roll 68 and pressure rolls 70 and 72 are preferably mounted for rotation about vertical axes rather than a horizontal axis as is guide roll 34 because guide rolls 68 and the pressure rolls are employed to squeeze the processing liquid from the container and this arrangement helps to prevent guide rolls 68 and the pressure rolls from becoming contaminated with the liquid. The construction of the pressure rolls and the crank on which they are mounted is such that one of the pressure rolls engages and compresses the container against guide roll 68 while the other pressure roll is spaced from the guide roll so as not to apply pressure to the container.

Guide roll 68, in addition to functioning as one of a pair of pressure-applying members for compressing the container to dispense its liquid contents, also functions as means for moving the container across sheet 12. Guide roll 68 is rotated to advance the container and since engagement of the container and guide roll is frictional, additional care is required to prevent guide roll 68 from contacting the processing liquid. This is accomplished with the construction shown by advancing and squeezing the container in such a way that the container is not compressed in the region of opening 66 and any liquid adhering to the outside of the container in the region of the opening is wiped from the container by commencing the advancement of sheet 12 while the container is still moving across the sheet.

In the operation of the apparatus, pressure roll 70 engages and compresses the container against guide roll 68 and extrudes liquid 32 from container 30 through opening 66 as the container is moved across the sheet (see FIG. 9). As the opening in the container approaches the edge of sheet 12 and guide roll 68 (see FIG. 10), crank 74 is pivoted in a counterclockwise direction relieving the pressure on the container exerted by roll 70 and causing roll 72 to exert pressure on the container. When the pressure on the container exerted by roll 70 is relieved the container, because of its resilience, returns to its normal expanded configuration causing the end of the liquid within the section of the container between guide roll 68 and opening 66 to withdraw from the opening toward the guide roll while the opening remains open allowing air to enter. At about this same moment a third pressure roll 76 is moved toward guide roll 34 to compress a section of the container against guide roll 34

and squeeze a small amount of the liquid located in the section of the container between guide roll 34 and opening 66 from the opening, and movement of sheet 12 is commenced to remove this last-mentioned small amount of liquid from the container as well as to wipe from the container any remaining liquid extruded from the section of the container adjacent guide roll 68. Movement of the container is continued and the pressure exerted by third pressure roll 76 is immediately relieved permitting the container in the region of guide roll 34 and pressure roll 76 to expand and cause the liquid within the container between opening 66 (to the left thereof) and guide roll 34 to withdraw from the opening so that the ends of the two masses of liquid within the container adjacent opposite ends of opening 66 are spaced from the opening as the opening is moved between guide roll 68 and pressure roll 70 (see FIG. 11). After the opening has moved between guide roll 68 and pressure roll 70, crank 74 is pivoted in a clockwise direction to relieve the pressure exerted by second pressure roll 72 and pinch the container between the first pressure roll and the guide roll. Movement of the container is then arrested with the container retained in a closed condition by first pressure roll 70 and guide roll 68 with a small amount of liquid remaining within the container between the opening and second pressure roll 72 rather than have the liquid extruded from the container and risk the possibility that it may contaminate guide roll 68.

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. In photographic apparatus for treating successive exposed areas of a photographic image-recording sheet with a viscous liquid dispensed from successive sections of an elongated tube filled with said liquid, including means for moving said sections of said tube lengthwise relative to and across said sheet and means for forming an opening in said tube at the trailing end of each of said sections through which said liquid is dispensed from said each section onto said sheet, in combination:

a pair of guide members positioned for engaging said tube adjacent the ends of each of said sections and supporting said sections adjacent said sheet; and compression means including one of said guide members for compressing said tube to discharge said liquid from each of said sections through an opening at the trailing end of said each section during movement of said each section toward said guide member, said compression means including means

for alternately compressing spaced portions of said tube against said one guide member.

2. The photographic apparatus of claim 1 in which said one guide member comprises a roll mounted for rotation and said drive means include means for rotating said roll in engagement with said tube for moving said tube lengthwise across said sheet toward said one guide member.

3. The photographic apparatus of claim 1 in which said compression means include a pair of pressure members mounted on a pivotal member for movement alternately toward said one guide member.

4. The photographic apparatus of claim 3 in which said guide members are mounted for supporting an end of said section of said tube in a generally horizontal position, and said pressure members are mounted for movement in a generally horizontal plane toward and away from said one guide member.

5. The photographic apparatus of claim 3 including means for urging said pressure member closest said opening against said tube and said one guide member until said opening is moved to a position closely adjacent said one guide member, then withdrawing the first-mentioned pressure member from engagement with said tube while moving said other pressure member into compressive engagement with said tube, retaining said other pressure member in compressive engagement with said tube until said opening is moved to a position intermediate said pressure members and then moving said first-mentioned pressure member into engagement with said tube.

6. The photographic apparatus of claim 5 in which said compression means include a third pressure member positioned for pressing said tube against the other of said guide members and including means for causing said third pressure member to compress said tube as said opening therein approaches said one guide member immediately prior to movement of said first pressure member from engagement with said tube.

7. The photographic apparatus of claim 6 in which the last-mentioned means include means for holding said sheet stationary during the major portion of said movement of said section of said tube across said sheet and commencing movement of said sheet relative to said tube simultaneously with movement of said third pressure member into compressive engagement with said tube.

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JOHN M. HORAN, *Primary Examiner*.