Aug. 17, 1965 E. H. LAND 3,200,726

METHOD OF TREATING PHOTOGRAPHIC SHEET WITH A LIQUID

Filed Feb. 15, 1962 3 Sheets-Sheet 1

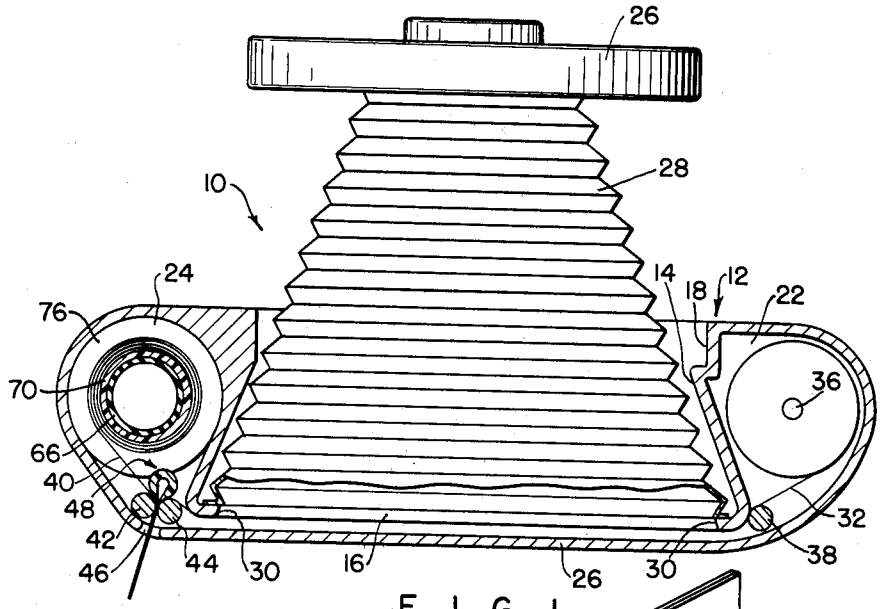


FIG. 1

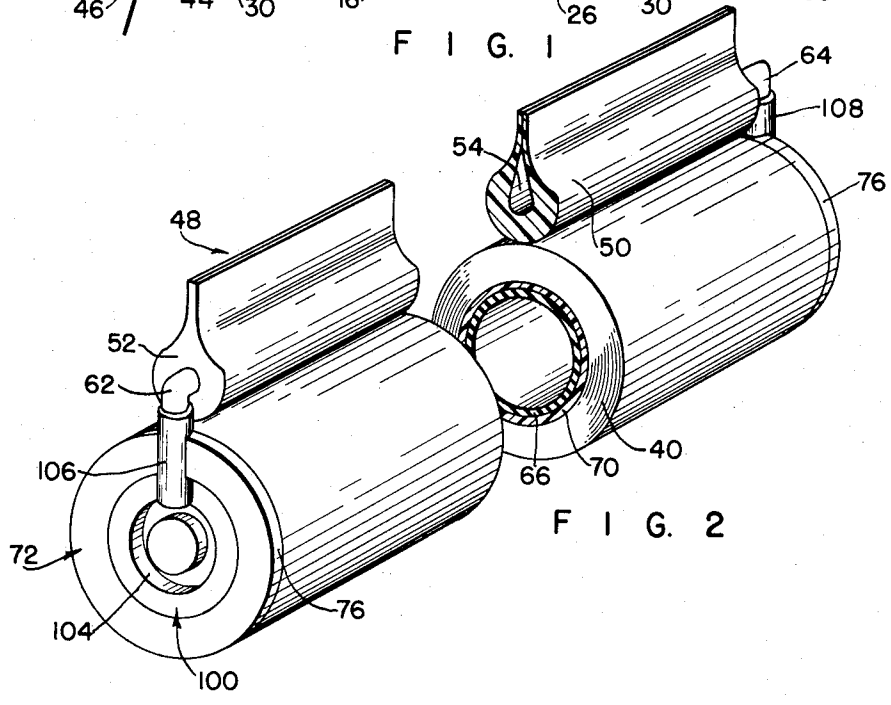


FIG. 2

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Filed Feb. 15, 1962 3 Sheets-Sheet 2

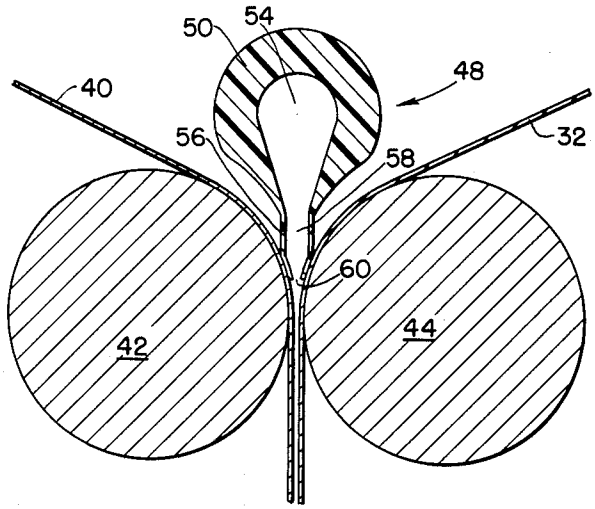


FIG. 3

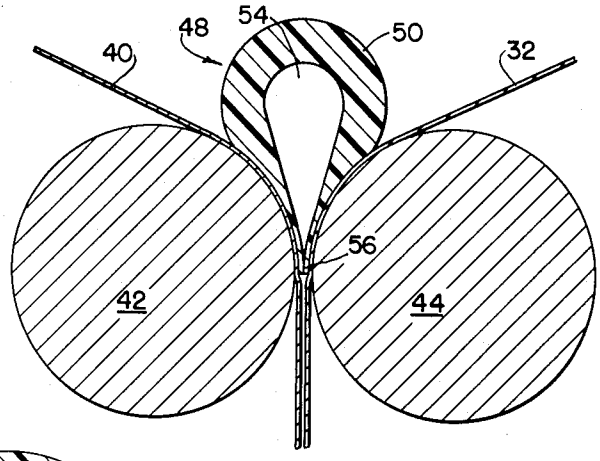


FIG. 4

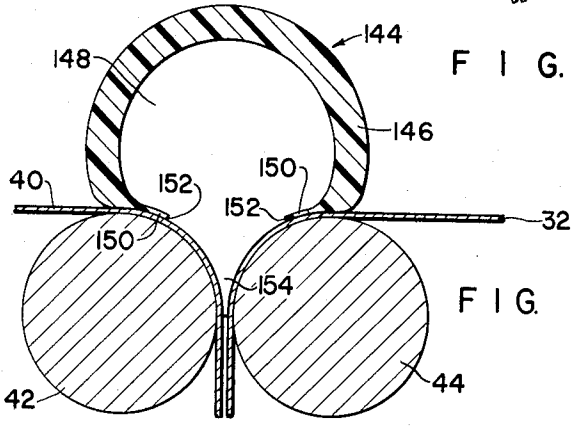


FIG. 7

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METHOD OF TREATING PHOTOGRAPHIC SHEET WITH A LIQUID

Filed Feb. 15, 1962 3 Sheets-Sheet 3

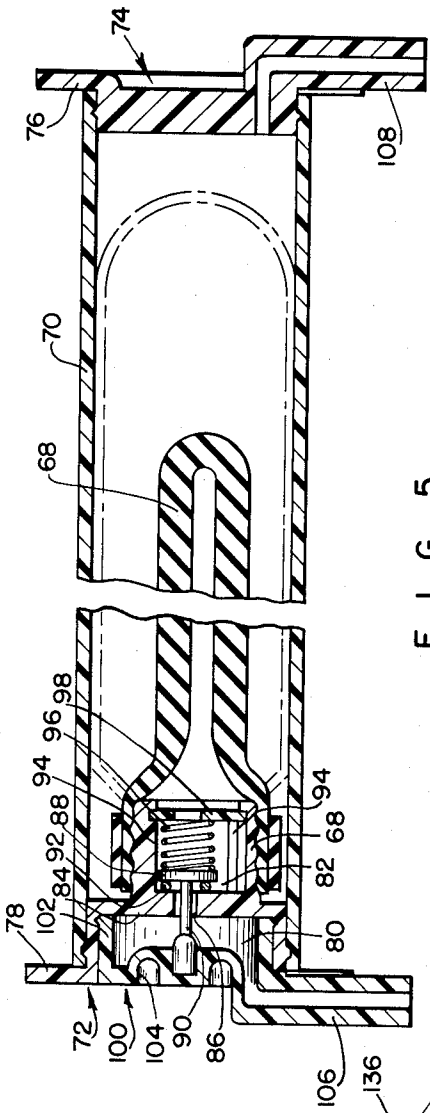


FIG. 5

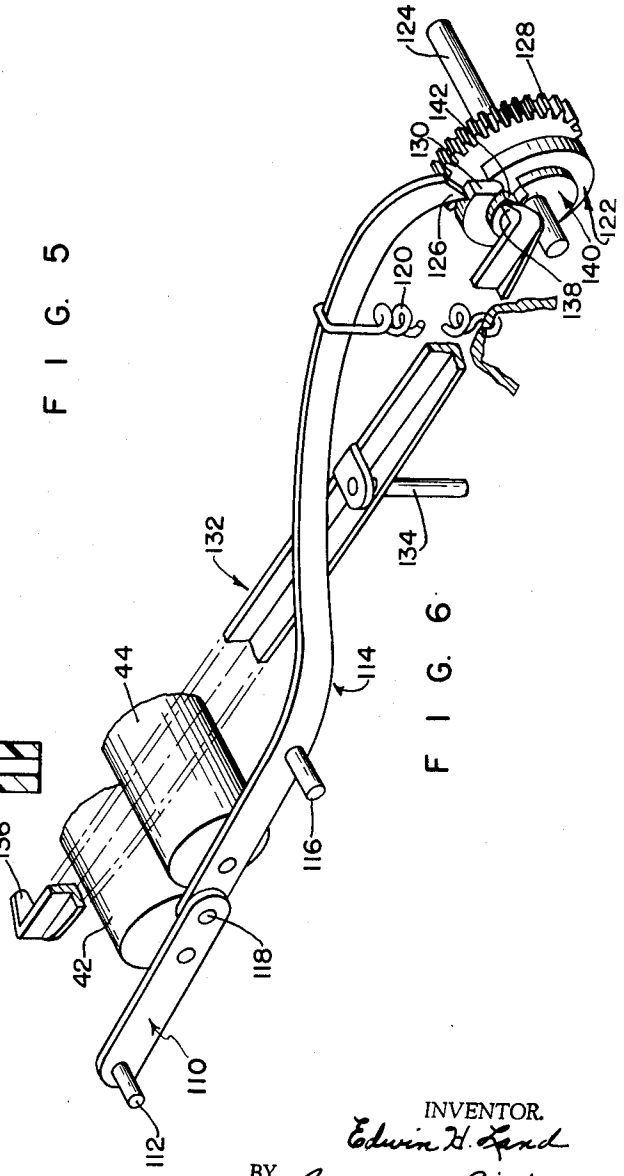


FIG. 6

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United States Patent Office 3,200,726 Patented Aug. 17, 1965

3,200,726

METHOD OF TREATING PHOTOGRAPHIC SHEET WITH A LIQUID

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Filed Feb. 15, 1962, Ser. No. 173,496
8 Claims. (Cl. 95—13)

This invention relates to photographic processes and particularly to a photographic process in which a sheet is treated with a liquid distributed in a layer on said sheet.

A number of photographic processes are performed by superposing a pair of sheets and distributing a processing liquid in a layer between the superposed sheets. Many of these processes employ a photographic image-recording sheet and are performed in photographic apparatus such as a camera in which the image-recording sheet is photographically exposed and processed to produce a visible image. The processing liquid may be distributed between the sheets by movement of the sheets along convergent paths into superposition between a pair of juxtaposed members while a fluid is introduced between the sheets through a suitable nozzle such as is disclosed in copending U.S. application Serial No. 159,234, filed December 14, 1961, in the name of Edwin H. Land, now Patent No. 3,142,243, issued July 28, 1964. The liquid is usually supplied to the nozzle under pressure and distributed by moving the sheets past the nozzle between the juxtaposed members. Movement of the sheets through the apparatus to effect exposure and processing of successive areas of the image-recording sheet is accomplished by engaging at least one of the sheets either manually or by some means (e.g. rolls) and drawing the sheets between the juxtaposed members (which may be driven rolls).

The invention has as an object, the provision of a novel and improved photographic process in which a pair of photographic sheets are advanced through photographic apparatus into superposition between a pair of juxtaposed members; a processing liquid is distributed between the superposed sheets, and the fluid is introduced between the sheets through a nozzle in such a way as to effect the movement of the sheets through the apparatus and between the juxtaposed members.

Other objects of the invention are: to provide a photographic process as described in which the energy required to perform the process, i.e., to move the sheets and distribute the fluid, is initially imparted to the fluid and is transferred thereby to the sheets; and to provide a photographic process as described in which the energy required to perform the process is imparted to the fluid by the container in which the fluid is supplied.

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

The invention accordingly comprises the process involving the several steps and the relation and order of one or more of such steps with respect to each of the others 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 a sectional view, of photographic apparatus in the form of a camera for practicing the method of the invention;

FIG. 2 is a perspective view, partially in section, illustrating components of the apparatus of FIGURE 1;

FIGS. 3 and 4 are somewhat schematic, sectional views

illustrating the operation of components of the apparatus of FIGURE 1;

FIG. 5 is a sectional view of a portion of the apparatus shown in FIG. 2;

FIG. 6 is a fragmentary perspective view of other components of the apparatus of FIGURE 1; and

FIG. 7 is a view similar to FIG. 3 of another embodiment of means for practicing the invention.

In photographic processes of the type with which the present invention is concerned, a photographically exposed, photosensitive image-recording sheet comprising, for example, a gelatino silver halide emulsion layer carried on a support, is guided into superposition with a second sheet including, for example, a layer for supporting a silver transfer image, between a pair of juxtaposed pressure-applying members. As the two sheets are moved along convergent paths into superposition at, and between, the juxtaposed members, a processed liquid capable, for example, of effecting a silver halide diffusion-transfer reversal process and including a silver halide developer and a silver halide solvent, is introduced through a nozzle between the sheet at the pressure-applying members which cooperate with the nozzle and sheets to distribute the liquid in a layer between the sheet. Apparatus for performing such processes may comprise, in addition to means for treating the image-recording sheet with the liquid, means for exposing the sheets; and heretofore it has been a practice to advance the sheets through the apparatus by engaging the sheets and drawing them between the juxtaposed pressure-applying members. Engagement and advancement of the sheets may be accomplished manually as in currently available hand held cameras of the type produced by Polaroid Corporation; or may be effected by mechanical means such as rollers which engage the sheets and are driven to advance the sheets through the apparatus. In apparatus and processes in which the liquid for treating a succession of exposed areas of the image-recording sheet is supplied from a single container and dispensed by a single nozzle, the apparatus includes, in addition to means for advancing the sheets, means for feeding the liquid to the nozzle under pressure, means for coordinating fluid feeding and sheet advancement, and means for controlling sheet advancement, i.e., indexing means, insuring exposure and processing of predetermined successive areas of the image-recording sheet.

The invention represents a novel and improved method of advancing the sheets through the apparatus in which the means for feeding the liquid to the nozzle under pressure, the nozzle and the liquid itself provide the means and the motive power for advancing the sheets, while control of sheet advancement (indexing) is effected by controlling the flow of the liquid to the sheets. In the copending U.S. application of Edwin H. Land, Serial No. 169,264, filed January 29, 1962 (now abandoned), it is proposed that the energy required to feed the liquid to the nozzle under pressure be stored and imparted to the liquid by the container in which the liquid is supplied. The container in this instance would comprises an elastomeric material in a stretched condition and makes possible the concept envisioned by the present invention of apparatus such as a camera, the operation of which is substantially automatic and which is powered by a container of processing liquid supplied with the sheet materials employed in the camera.

Reference is now made to FIGURE 1 of the drawings in which is shown photographic apparatus in the form of a small, compact, handheld camera **10** of a type in which the method of the invention is practiced. Camera **10** comprises a housing including a forward wall **12**, having a recessed or re-entrant section **14**, extending rearwardly to an inner forward wall **16**, side walls **18**, and a rear wall **20**. The walls of the housing cooper-

ate to provide chambers designated 22 and 24 at opposite ends of the housing, and an exposure chamber located between inner forward wall 16 and rear wall 20. Camera 10 includes a conventional lens and shutter assembly designated 26, coupled to the camera by a bellows 28 joined to assembly 26 and to inner forward wall 16, around the edges of an exposure aperture 30, provided in inner forward wall 16 for transmitting light from the lens to a photographic image-recording sheet positioned within the exposure chamber between inner forward wall 16 and rear wall 20. The bellows and the camera housing are preferably constructed so that the shutter assembly can be displaced from the extended operative position shown in FIGURE 1 to a folded or closed position at which the bellows is collapsed within the recess described, and the shutter assembly is also dispensed within the recess.

The photosensitive image-recording sheet herein designated 32 is preferably supplied in a coiled condition on a spool 36 which is mounted for rotation within chamber 22. The image-recording sheet extends from chamber 22 at one end of inner forward wall 16, between the latter and the rear wall 20, across exposure aperture 30 and the rear surface of wall 16 to chamber 24 at the opposite end of the camera housing. The rear or inner surface of wall 16 is preferably located at the focal surface of the lens of assembly 26 and a guide and indexing roll 38 is provided within chamber 22 near the entrance to the exposure chamber for holding sheet 32 in position for exposure against the rear surface of wall 16 and performing other functions which will be described hereinafter.

As previously indicated, the photosensitive image-recording sheet is treated, following exposure, with a liquid distributed between the image-recording sheet and a second sheet superposed therewith. A supply of this second sheet, designated 40, is provided within chamber 24 together with means in the form of a pair of juxtaposed members for superposing the photosensitive and second sheets and aiding in the distribution of a processing liquid in a layer between the sheets. In the form shown, the juxtaposed members comprise a pair of pressure-applying rolls 42 and 44, mounted in juxtaposition within chamber 24, adjacent an end of wall 16 near the entrance to the exposure chamber between wall 16 and rear wall 20. Image-recording sheet 32 is guided from spool 36 within chamber 22, between roll 38 and an end portion of inner forward wall 16, through the exposure chamber across exposure aperture 30, and around pressure-applying roll 44 between rolls 42 and 44 toward the rear of the camera. Second sheet 40 extends within chamber 24 into superposition with image-recording sheet 32 at the bite of rolls 42 and 44 and extends in superposition with the image-recording sheet between the pressure-applying rolls. An exit passage 46 is provided in rear wall 20 in alignment with the gap between rolls 42 and 44 to permit movement of sheets 32 and 40 from the housing. The sheets, as shown, are guided along convergent paths into superposition at the bite of the pressure-applying rolls, and it is between the convergent portions of the sheets at the bite of the rolls that the fluid-processing liquid is dispensed.

The sheets and processing liquid may be provided as part of a product shown in FIGS. 2 and 5 of the drawings as comprising, in addition to image-recording sheet 32, spool 36 and second sheet 40, means in the form of a nozzle 48 for dispensing a processing liquid as a layer between the photosensitive and second sheets at the bite of the pressure-applying rolls, and means for holding a supply of the processing liquid, delivering the liquid to the nozzle under pressure and supporting the nozzle in proper position to perform its liquid-dispensing function. Nozzle 48 is preferably formed of a material which is impervious to the liquid and to air and has some flexibility and resiliency. Various organic plastics and rubber are suited for this purpose and include, for example, high density polyethylene, polypropylene, polyvinylidene chloride and polyethylene terephthalate resins. The nozzle, shown in detail in FIGS. 3 and 4, includes an elongated generally cylindrical body section 50 having end walls 52 cooperating with the body to provide an elongated chamber 54 within the body section and extending from end to end thereof. The body section is substantially rigid and is provided along one side with a pair of thin flexible lips 56 extending substantially from end to end of the body section. End walls 52 include tapered portions cooperating with lips 56, which converge toward one another, to define a tapered passage 58 between the lips coupled with chamber 54 and terminating at the edges of the lips in a very narrow elongated discharge mouth 60 through which a liquid introduced into chamber 54 is dispensed. The material comprising lips 56 and end walls 52, and the construction of the lips and the tapered portions of the end walls, are such that mouth 60 can be sealed by the application of compressive pressure to the edge portions of the lips. For details and a further description of nozzles similar to nozzle 48 and adapted to incorporation in a structure for practicing the method of the invention, reference may be had to the aforementioned U.S. Patent No. 3,142,243.

In the form of product designed for performing the method of the invention and shown in the drawings, the processing liquid is supplied and stored under pressure in a container designated 66 comprising an elongated and generally cylindrical tube open at one end, closed at its other end, and having, in its unextended condition, an inside diameter comparable to its wall thickness and equal to a fraction of its outside diameter. Container 66 is formed of an elastomeric material such as natural rubber (polyisoprene) or synthetic rubber (synthetic isoprene) and filled with the processing liquid under pressure so that the liquid maintains the container in a stretched and expanded condition while the elasticity of the material comprising the container causes pressure to be exerted on the liquid. The container may be filled, and designed and constructed in such a way as to dispense the liquid at a substantially constant and predetermined pressure. For a more complete description of the container, its manner of assembly, and filling, and its function and operation, reference may be had to the aforesaid copending U.S. Application Serial No. 169,264.

Container 66, in its fully expanded condition, is shown with its open end engaged around tube 68 and enclosed within a cylindrical tube 70 which serves to confine the container and protect the container from damage. Tube 70 also functions as a support around which second sheet 40 is coiled; and as means for retaining second sheet 40 in a coiled condition on tube 70, there are provided enclosures 72 and 74 engaged in opposite ends of tube 70 and each having a flange 76 the diameter of which is greater than the diameter of tube 70 and cooperates with the tube to define a spool on which the second sheet is coiled. Closure 74 of tube 70 may be provided with an air vent (not shown), formed to permit the expansion and contraction of container 66 within the chamber defined by tube 70 and closures 72 and 74.

Closure 72 is in the form of a plug incorporating tube 68 and a valve for regulating the flow of fluid from the container, the latter being retained on tube 68 by a ring 78. The outer end of closure 72 is provided with an enlarged recess 80, separated from a recess 82 defined by tube 68, by a dividing wall 84, and connected with recess 82 by way of a relatively small bore 86 through wall 84. Recesses 80 and 82 and bore 86 are substantially cylindrical and disposed coaxially, and closure 72 is designed to be formed as a single element of an organic plastic material such as employed to form nozzle 48. The

valve comprises a valve member 88 to which is attached a valve stem 90 extending from recess 82 through bore 86 into recess 80 and having a shape and dimension which permit the flow of liquid through bore 86 around the valve stem. An O-ring 92 is provided as a seal between valve member 88 and the surface of wall 84 at the periphery of bore 86; and inwardly projecting axial ribs 94 are provided on the inner surface of tube 68 for guiding the valve member for axial movement within recess 82 while permitting flow of the liquid around the valve member. Valve member 88 is biased into the closed position shown in FIG. 5 by a coil spring 96, retained in recess 82 by a retaining washer 98, engaged in a circumferential recess in the inner surface of tube 68. As a means for displacing the valve member to an open position and conducting the liquid from recess 80 to the nozzle, there is provided a cap 100 having a skirt 102 engaged within recess 80 and an end wall 104 including annular flexible section and a tube 106 connecting with recess 80. The end of valve stem 90 is enlarged and is engaged within recess at the center of end wall 104, while the annular flexible section permits the valve stem to be displaced inwardly by pressure on end wall 104 to open the valve and allow the liquid to flow from recess 82 through bore 86 into recess 80.

Nozzle 48 is provided at one end with an L-shaped tubular conduit 62 communicating with chamber 54 for conducting the liquid into the chamber and for supporting one end of the nozzle. A similar tube or a solid rod 64 is provided at the opposite end of nozzle 48 projecting from end wall 52 for supporting the opposite end of the nozzle. Conduit 62 is engaged in tube 106 while rod 64 is engaged in a tube 108 extending from closure 74 so that tubes 106 and 108 cooperate with conduit 62 and rod 64 for mounting and supporting the nozzle in position for dispensing the fluid contents of container 66 between the sheets at the bite of the pressure-applying rolls.

Nozzle 48 is mounted for operation with lips 56 extending toward the bite of the rolls between convergent portions of sheets 32 and 40 with the outer surfaces of at least the edge portions of the lips located in face to face contact with the facing surfaces of the sheets. Rolls 42 and 44 are movable between an operative, liquid-spreading position shown in FIG. 3, and an inoperative, nozzle-sealing position shown in FIG. 4. In the operative, liquid-spreading position of the rolls, the maximum width of the gap between the rolls at the narrowest portion of the gap is fixed and is approximately equal to the combined thicknesses of the two sheets and the layer of liquid to be distributed between the sheets. Lips 56 extend between the convergent portions of the sheets to a position just short of the narrowest portion of the gap so that the width of mouth 60 is substantially equal to the thickness of the layer of liquid. The length of the mouth, i.e., the distance between end walls 52, is preferably equal to the width of the area of the photosensitive sheet to be treated with the liquid.

The image-recording and second sheets are guided, as shown, around and between portions of pressure-applying rolls 42 and 44 through a gap between the rolls, and movement of the sheets through the apparatus into superposition between the rolls is accomplished by introducing the processing liquid through the nozzle between the sheets under sufficient pressure to cause the advancement of the sheets. In the operation of camera 10, an area of image-recording sheet 32 positioned across aperture 30 is exposed; and this area is then advanced into superposition with a corresponding areas of second sheet 40 between pressure-applying rolls 42 and 44 while the processing liquid is distributed from nozzle 48 through mouth 60 in a thin layer between the sheets to form a sandwich. Advancement of the sheets through the apparatus is continued until the exposed area has been advanced entirely between the pressure-applying rolls and preferably from the camera and is then discontinued to permit the next succeeding area of the photosensitive sheet to be exposed through aperture 30. The portion of the sandwich comprising the previously exposed area of the image-recording sheet may be severed from the remainder of the sandwich extending between rolls 42 and 44, preferably as close as possible to the rolls in order to conserve sheet materials.

The pressure on the liquid, in addition to advancing the sheets, obviously presses the lips outwardly against the sheets thereby effectively preventing entrapment of air between the lips and the sheets and escape of the processing liquid. The liquid, as previously indicated, is dispensed from mouth 60 substantially in the form of a layer which is immediately engaged between the opposed surfaces of the sheet and causes the movement of the sheets by pressing against the layer of fluid engaged between the sheets. In order to facilitate movement of the sheets by the liquid, the latter is preferably quite viscous, having a viscosity at 24° centigrade in excess of 1,000 centipoises and ranging from 1,000 to 200,000 centipoises. The viscosity-causing ingredient may comprise, for example, sodium carboxymethyl cellulose which, as components (e.g., water) of the liquid are absorbed by the sheets, also functions in the nature of an adhesive for maintaining the integrity of the sandwich comprising the two sheets and layer of liquid and providing means against which the liquid dispensed from the nozzle can exert pressure for moving the sheets. For the details and formulations of processing liquids suitable for use in the method of the invention and particularly for effecting silver halide-diffusion transfer reversal 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 a camera of the construction illustrated, when the camera is not in use for treating an exposed area of the image-recording sheet with the liquid and the sheets are not being moved between the pressure-applying rolls, the rolls are moved to their inoperative, nozzle-sealing position at which the rolls compress the lips of the container toward one another so as to seal mouth 60. In this sealing action the rolls, as illustrated in FIG. 4, are displaced from the operative position of FIG. 3 in a direction opposite to the direction of movement of the sheets between the rolls so that the edge portions of lips 56 are located within the bite of the rolls at the narrowest portion of the gap. As the rolls are displaced from operative to inoperative position in a direction opposite to the direction of movement of the sheets and the flow of liquid and toward the nozzle, the lips remain substantially stationary supported by body section 50 of the nozzle; and the rolls may be displaced apart slightly so as to accommodate the combined thickness of the lips between the sheets as this thickness may be greater than the thickness of the layer of fluid and the gap between the sheets.

Camera 10 is operated to advance the sheets and treat an exposed area of the image-recording sheet with a liquid by opening valve 88 and simultaneously moving the pressure-applying rolls into operative, fluid-spreading position. This opening of the valve and movement of the rolls need be the only operation, except for tripping the shutter, that the operator must perform, the processing being otherwise automatic with the apparatus being operated by the pressure on the fluid exerted thereon by the container. The camera includes a mechanism which may be actuated manually to open the valve and move the pressure-applying rolls into operative, fluid-spreading position, and which is thereafter operated in response to movement of the sheets through the apparatus for closing the valve and moving the pressure-applying rolls into inoperative, nozzle-sealing position and thereby arresting the movement of the sheets when a predetermined exposed area of the photosensitive sheet has been treated with the processing fluid. This mechanism includes means for mounting the rolls comprising a pair of arms

110 each mounted at one end on a pivot 112 secured to the camera housing, with roll 42 mounted for rotation at its ends on arms 110 intermediate their ends. Roll 44 is mounted at its ends near the free ends on a pair of levers 114 which are mounted for pivotal movement intermediate their ends on pivots 116 having a common axis and secured to the camera housing. The free end of each of arms 110 is pivotally connected at a pivot 118 to the free end of one of levers 114 at a position intermediate rolls 42 and 44. In the operative, fluid-spreading position of rolls 42 and 44, the axes of the rolls and pivots 112, 116, and 118 lie substantially in a plane with the axis of pivots 118 being located equidistant from the axes of pivots 112 and 116 and the axes of rolls 42 and 44. This arrangement insures that any movement imparted to roll 44 by levers 114 will be imparted to roll 42 so that the latter will describe the same movement as roll 44 simultaneously with the movement of roll 44. A spring 120 is provided coupled between each of levers 114 and the camera housing for biasing each lever (in a clockwise direction viewing FIG. 6) so as to bias rolls 42 and 44 for movement into inoperative nozzle-sealing position.

Means are provided for retaining the pressure-applying rolls in operative, fluid-spreading position and in the form shown comprise a pair of cams 122 mounted on a shaft 124 and each located in engagement with an end section 126 of one of levers 114, which end section acts as a cam follower. Each of cams 122 is designed to coact with a lever 114 so as to pivot the lever in such a way as to position rolls 42 and 44 in the operative position shown in FIG. 6. The mechanism for moving the rolls and actuating the valve is operated in response to movement of the sheets through the apparatus and derives its motive power from roll 38 which is located in frictional engagement with the image-recording sheet so as to be rotated thereby during movement of the sheet through the apparatus. Roll 38 is provided with a gear (not shown) which is meshed with a gear 128 keyed to shaft 124. The ratio of the numbers of teeth on the two gears is such that gear 128 is rotated through one revolution (360°) in response to movement of an exposed area of the image-recording sheet from exposure position, between the pressure-applying rolls and from the camera. Cams 122 are coupled with gear 128 through shaft 124, each of cams 122 being mounted on shaft 124 for limited movement with respect to the shaft through a conventional spring device which permits shaft 124 to rotate through a few degrees while cams 122 are held against rotation (in a clockwise direction viewing in FIG. 6); and when cam 122 is released for rotation, the spring will cause the cam to rotate so as to catch up to the shaft. Each of cams 122 is designed to function as a sheet-arresting mechanism, that is, to permit the rolls to move into inoperative nozzle-sealing position each time a predetermined length of the image-recording sheet has moved through the apparatus. For this purpose, cam 122 is provided with an abrupt recess 130 into which end section 126 of lever 114 moves under the bias of spring 120 when recess 130 comes into alignment with the end section of the lever. This immediately stops the rotation of the cam which in turn arrests the rotation of shaft 124 and roll 38 at the end of a few more degrees of a revolution thereof and permits the rolls to move into inoperative position under the bias of springs 120.

The mechanism also includes means for opening valve 88 at the commencement of the processing cycle and close the valve simultaneously with the movement of the pressure-applying rolls into inoperative position at the end of a process cycle. This last-mentioned means includes a lever 132 pivotally mounted intermediate its ends on a pivot 134 mounted in fixed position on the camera housing. One end, designated 136, of lever 132 is designed to engage the center of end wall 104 for displacing the end wall and valve stem so as to open valve 88. The opposite end of lever 132 is in the form of a cam follower 138 positioned in engagement with a cam 140 secured to and comprising a part of cam 122. Cam 140 is designed to hold lever 132 pivoted in such a position as to hold valve 88 open, and includes a recess 142, aligned with recess 130, into which cam follower 138 may project permitting lever 132 to pivot in such a way as to allow valve 88 to close.

An operating or sheet-advancing cycle of the apparatus is commenced (and terminated) with end section 126 of each of levers 114 engaged in a recess 130 of a can 122 and with cam follower 138 engaged in recess 142 of cam 140. The camera includes a manually operated device for pivoting levers 114 and 132 so as to disengage the ends of the levers from the recess in the cams and simultaneously open valve 88 and move rolls 42 and 44 into operative, fluid-spreading position. This manually operated means may also be coupled with the shutter so that only one element need be actuated by the operator to both make an exposure and process the exposed area of the image-recording sheet. Upon disengagement of end section 126 from recess 130 and cam follower 138 from recess 142, the cams immediately rotate in a clockwise direction under the bias of the spring connecting the cams with shaft 124 thereby moving the recesses out of alignment with end sections 126 and cam follower 138, so that the end sections and cam followers cannot return to engagement in the recesses until the cams have completed a full revolution. The device (not shown) for pivoting levers 114 and 132 is designed to momentarily engage and pivot the levers so that the levers are free to return to their positions prior to pivotal movement, which return movement is prevented by the cams.

The form of liquid-dispensing nozzle shown and described herein is designed for intermittent operation in which the lips of the nozzle are pressed together to seal the nozzle when it is not in use. Because of the type of operation for which the nozzle is intended, the area of contact between the liquid within the nozzle and the convergent portions of the sheets between the pressure-applying members is minimized and this restricts, to some extent, the force which can be applied to the sheets by the liquid tending to move the sheets through the apparatus. The pressure exerted by the liquid within the nozzle on the convergent portions of the sheets located between the pressure-applying members can be resolved into components normal to the surfaces of the sheets and parallel with the surfaces of the sheets, with the latter components tending to move the sheets between the pressure-applying members. The total force exerted on the sheets and tending to advance the sheets is a function of the area of the convergent portions of the sheets in contact with the liquid and, as already noted, the viscosity of the liquid.

Reference is now made to FIG. 7 of the drawings in which there is illustrated a nozzle designed for continuous, rather than intermittent, fluid distributing operation and constructed to provide for a maximum area of contact between the liquid under pressure in the nozzle and the convergent portions of the sheets. This form of nozzle designated 144, comprises a body 146 providing a chamber 148 into which the liquid is introduced under pressure. Body 146 includes a pair of flexible lips 150 which are positioned against the surfaces of sheets 32 and 40 extending around and between pressure-applying rolls 42 and 44. Lips 150 extend only slightly into the convergent passage between the rolls and define a relatively wide mouth 152 through which the liquid from chamber 148 is dispensed between convergent portions of the sheets 32 and 40 located within the bite of the rolls. The rolls themselves, being part of an apparatus designed for continuous operation, can be fixed against movement with respect to one another and the nozzle while lips 150 of the nozzle are pro-

vided for the purpose of forming a liquid and air-tight seal between the nozzle and the sheets and do not function to seal the nozzle. The nozzle also includes end walls **154** which extend beyond the longitudinal edges of the lips into the bite of the rolls for preventing escape of the liquid from between the sheets at their lateral edges.

It is apparent that the pressure exerted on the liquid is required to do the work involved in feeding the liquid to the nozzle and advancing the sheet; and that the work involved in advancing the sheet is expended primarily in overcoming friction between the sheets and the apparatus and between components of the apparatus which are moved by the sheets. The energy expended feeding the liquid, from the container in which it is stored, to the nozzle is a function of the viscosity of the liquid and can be minimized by employing a liquid having the lowest possible viscosity. Of course, the friction between the sheets and apparatus and between components of the apparatus should be reduced as much as possible in order to minimize the energy required to be imparted to the liquid as compressive pressure. It is contemplated that in some embodiments of the apparatus, the frictional forces may be so great that they cannot be entirely overcome by pressure on the fluid alone, and it may be necessary to provide mechanical means for assisting the fluid to advance the sheets. For example, a motor of some type (e.g., a spring motor) might be provided for continuously applying torque to the pressure-applying rolls, which torque is insufficient in itself to advance the sheets, but which assists in overcoming the frictional forces resisting sheet movement. In such an embodiment, sheet movement would be effected and controlled by a flow of the processing liquid in the manner described, with the motor, in effect, merely reducing frictional resistance to sheet movement.

The invention contemplates additional forms of juxtaposed pressure-applying members as well as modified types of nozzles and other means for feeding the liquid to the nozzle under pressure. Many of these additional types of pressure-applying members are shown and described in the aforementioned U.S. Patent No. 3,142,243 and include, for example, juxtaposed members which do not rotate, but may be fixed with respect to one another and/or moved with respect to one another in different manners between liquid-spreading and nozzle-sealing positions. The nozzles hereto incorporating flexible lips may take a number of different forms which adapt them to use with the particular type of pressure-applying members being employed. As for feeding the liquid to the nozzle under pressure, this may be accomplished in a number of different ways including, for example, compressing a flexible liquid container, employing gas pressure to empty the container, and pumping the liquid from the container to the nozzle. In each embodiment, however, sheet movement is effected by the liquid itself and is controlled by the pressure on the liquid at the nozzle which, in turn, is controlled by a valve or the means for pressurizing the liquid.

Since certain changes may be made in the above processes 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 the treatment of a photographic sheet with a liquid distributed in a layer in contact with said sheet, the method comprising:

guiding said photographic sheet and a second sheet along convergent paths into superposition with one another between a pair of members having opposed surfaces defining said paths and supporting superposed portions of said sheets against movement apart from one another with said superposed portions disposed a predetermined distance apart;

supporting a nozzle, having a discharge mouth bounded by a pair of lips which are at least equal in length to the width of the area of said sheets to be treated, between said convergent portions of said sheets and holding said lips in substantially liquid-tight contact with said convergent portions of said sheets; and

introducing a viscous photographic processing liquid through said nozzle between said lips into contact with the adjacent surfaces of said sheets, said liquid being introduced under pressure sufficient to cause the movement of said sheets along said convergent paths past said lips into superposition between said members in the direction of flow of said liquid between said lips.

2. A method of photography as defined in claim **1** in which said liquid is contained under pressure in an extended elastic container coupled with said nozzle, a force is applied to said sheets tending, but insufficient by itself, to move said sheets in the direction of flow of said liquid from said mouth, and movement of said sheets is commenced and arrested, respectively, by commencing and arresting the flow of said liquid from said container to said nozzle.

3. The method of producing a visible photographic image comprising:

positioning a photographic image-recording sheet within photographic apparatus with a first portion of said sheet located in position for exposure and another portion of said sheet located between a pair of members having opposed surfaces converging to a gap of a predetermined width;

supporting said other portion of said image-recording sheet against one of said surfaces;

supporting a portion of a second sheet against the other of said surfaces;

positioning a nozzle, having a discharge mouth bounded by a pair of lips which are at least equal in length to the width of said first portion of said image-recording sheet to be exposed, between convergent portions of said sheets between said members, and holding said lips in substantially liquid-tight contact with the opposed surfaces of said convergent portions of said sheets supported on said surfaces of said members;

exposing said first portion of said image-recording sheet to actinic light;

introducing a viscous photographic liquid, including reagents capable of reacting with said image-recording sheet following exposure thereof to produce a visible image in said sheet, through said nozzle between said lips into contact with said opposed surfaces of said sheets;

exerting pressure on said liquid within said nozzle sufficient to cause the movment of said sheets through said apparatus past said lips between said members in the direction of flow said liquid between said lips;

continuing to introduce said liquid under pressure through said nozzle into contact with said sheets until said first portion of said image-recording sheet has been advanced into superposition with a portion of said second sheet and has moved through said gap; and

reducing the pressure exerted on said fluid within said nozzle after said first portion of said sheet has passed through said gap between said members.

4. A method of photography as defined in claim **3** in which said lips are pressed against one another simultaneously with the reduction of pressure on said liquid to close said mouth and prevent the flow of said liquid from said mouth.

5. A method of photography as defined in claim 4 in which said lips are pressed against one another by moving at least one of said members relative to said nozzle.

6. In photography, the method of advancing a pair of sheets into superposition and treating said sheets with a liquid distributed in a layer therebetween, said method comprising:

guiding said sheets along convergent paths into superposition with one another between a pair of members, one of which is a roll mounted for rotation, providing convergent support surfaces;

supporting convergent and contiguous superposed portions of said sheets between said surfaces against movement apart from one another with said superposed portions disposed a predetermined distance apart;

locating a nozzle, having a discharge mouth bounded by lips which are at least equal in length to the width of the area of said sheets to be treated, between said convergent portions of said sheets and holding said lips in substantially liquid-tight contact with said sheets;

introducing a viscous photographic processing liquid through said nozzle between said lips into contact with adjacent surfaces of said sheets under pressure sufficient to cause the movement of said sheets along said convergent paths past said lips and into superposition in the direction of flow of said liquid between said lips; and

applying torque to said roll tending to move said sheets in the direction of flow of said liquid between said lips, said torque being insufficient by itself to cause movement of said sheets relative to and between said members.

7. A method of photography as defined in claim 1 in which said liquid is contained under pressure in an extended elastic container coupled with said nozzle, a force is applied to said sheet by moving one of said members in engagement with one of said sheets, said force tending but being insufficient by itself to move said sheets in the direction of flow of said liquid from said mouth.

8. In the treatment of a photographic sheet with a liquid distributed in a layer in contact with said sheet, the method comprising:

guiding said photographic sheet and a second sheet along convergent paths into superposition with one another between a pair of members having opposed surfaces defining said paths and supporting superposed portions of said sheets against movement apart from one another with said superposed portions disposed a predetermined distance apart;

supporting a nozzle, having a discharge mouth bounded by a pair of lips which are at least equal in length to the width of the area of said sheets to be treated, between said convergent portions of said sheets and holding said lips in substantially liquid-tight contact with said convergent portions of said sheets;

introducing a photographic processing liquid through said nozzle between said lips into contact with the adjacent surfaces of said sheets, said liquid being introduced under pressure sufficient to cause the movement of said sheets along said convergent paths past said lips into superposition between said members in the direction of flow of said liquid between said lips;

said liquid being fed to said nozzle under pressure and movement of said sheets being arrested by reducing the pressure on said liquid within said nozzle; and

simultaneously with the reduction of pressure on said liquid within said nozzle, pressing said lips against one another to close said mouth and prevent flow of said liquid from said mouth.

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