

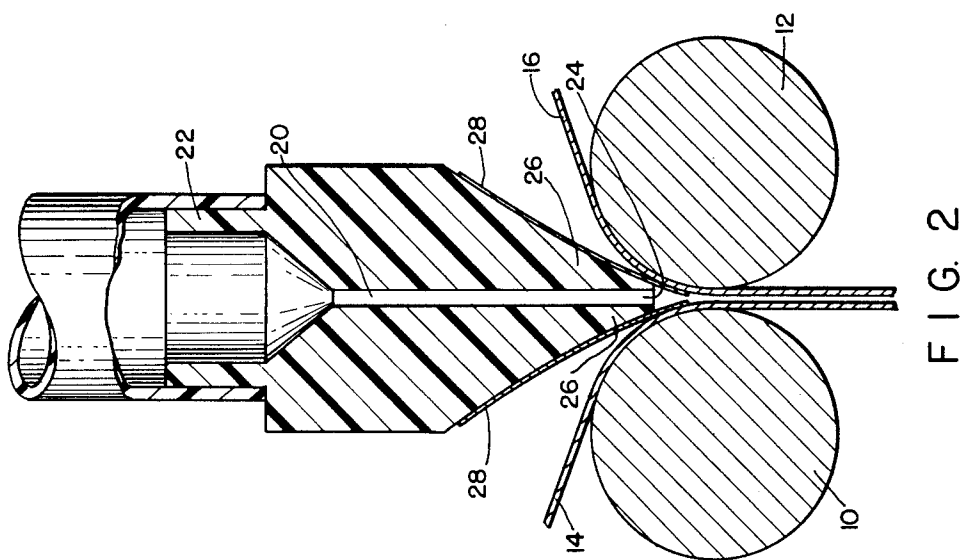
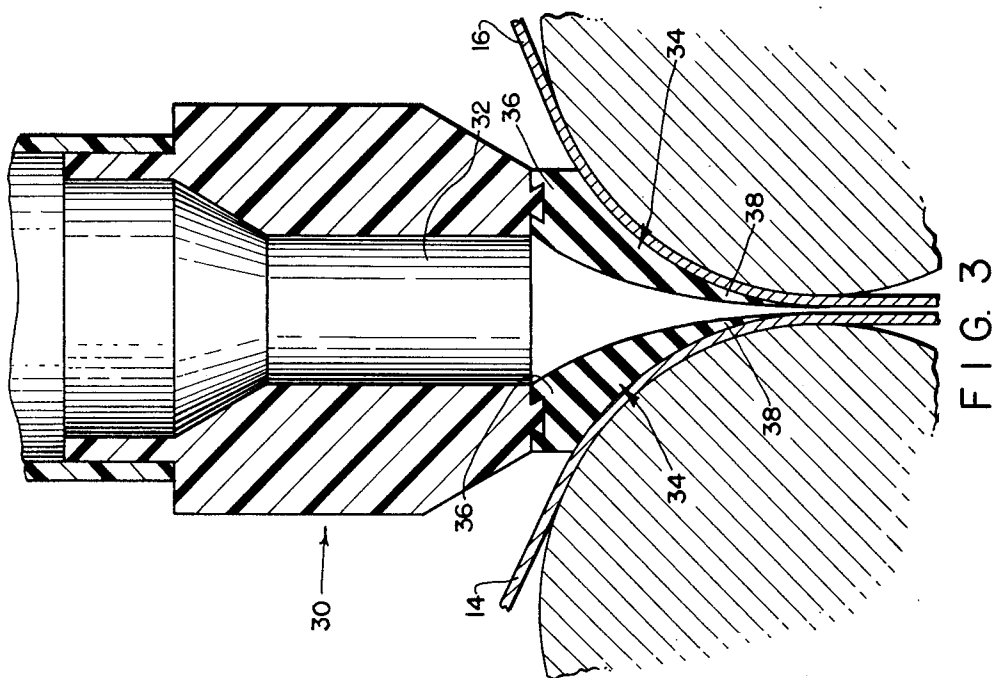
July 28, 1964

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DISPENSING NOZZLE STRUCTURE FOR PHOTOGRAPHIC
PROCESSING APPARATUS

3,142,242

Filed Dec. 14, 1961

2 Sheets-Sheet 2



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3,142,242

DISPENSING NOZZLE STRUCTURE FOR PHOTOGRAPHIC PROCESSING APPARATUS

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Filed Dec. 14, 1961, Ser. No. 159,227

16 Claims. (Cl. 95—89)

This invention relates to photographic processing apparatus and particularly to apparatus for processing a photographic image-recording sheet by distributing a processing fluid in a thin layer in contact with said sheet and another sheet superposed therewith.

A number of different forms of devices have been proposed for superposing a pair of photographic sheets and distributing a processing fluid in a layer between the sheets. Such devices generally include a pair of juxtaposed pressure-applying members between which the sheets are advanced into superposition and means for supplying the processing fluid to a space between the sheets for spreading in a layer therebetween during movement of the sheets in superposition relative to and between the pressure-applying members. Devices of this type are particularly designed to produce a photographic transfer print directly from an exposed image-recording sheet material, by processes of the type disclosed in 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 these processes, termed silver halide diffusion-transfer reversal processes, an exposed photosensitive image-recording sheet, preferably including as the photosensitive material thereof a gelatino silver halide emulsion, is superposed with a second sheet which functions as a support for an image-receptive layer in which a visible print of a latent image in the photosensitive material is produced. A fluid processing composition is distributed in a thin layer between the superposed sheets to form a sandwich in which the latent image in the photosensitive material is developed and a positive transfer print is produced in a layer (which may comprise the fluid) supported preferably on the second sheet. The processing fluid may contain, for example, an aqueous alkaline solution of a silver halide developer such as hydroquinone, and a silver halide solvent such as sodium thiosulphate. This processing fluid, when distributed in contact with the silver halide emulsion, causes the exposed silver halide to be reduced to silver and forms a water-soluble complex silver salt from unreduced silver halide of the photosensitive sheet, the complex silver salt being diffusible through the layer of fluid to an image-receptive layer where it is reduced to silver to form a positive print.

In silver halide diffusion-transfer reversal processes of the type described, reduction of exposed silver halide and formation and diffusion of a soluble silver complex commences immediately as the processing fluid contacts the exposed silver halide emulsion and is absorbed thereby, and proceeds at a rate dependent upon the physical and reaction characteristics of the particular ingredients of the processing fluid and emulsion. When processes in which a positive transfer image is formed on or in a layer carried by the second sheet, it is important that the two sheets be properly superpositioned before image formation has advanced to any appreciable extent or impairment of the transfer image may result. Apparatus designed heretofore for performing processes of this type generally includes a pair of pressure-applying members defining a convergent gap through which the two sheets are moved along convergent paths into superposition and means for supplying the processing fluid to the convergent space between the sheets. Frequently in apparatus of this type, the fluid is allowed to contact areas of the

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photosensitive material at a location spaced from the location at which these same areas of the photosensitive material are superposed with the second sheet. This condition is permissible as long as the sheets are advanced at comparatively rapid linear rates, e.g., several inches to several feet per second, such that the time lapse between fluid contact and superpositioning is so short that the reaction does not progress to any appreciable extent. However, conditions which may be permissible at comparatively rapid sheet advancement rates often cannot be tolerated at comparatively slow sheet advancement rates such as, for example, one or two inches per minute.

Accordingly, objects of the invention are: to provide novel and improved photographic apparatus for treating an exposed photosensitive image-recording sheet with a fluid applied to the sheet as a layer sandwiched between the image-recording sheet and other sheet in such a manner as to permit advancement of the sheets at a relatively slow linear rate; and to provide photographic processing apparatus as described for distributing a fluid processing composition as a layer between a photosensitive sheet and a second sheet superposed therewith, in which the processing fluid is prevented from contacting the photosensitive sheet until the photosensitive and second sheets are superposed substantially in the relative positions required for proper formation of a positive image by diffusion transfer reversal.

Another object of the invention is to provide photographic processing apparatus as described comprising a nozzle including a pair of juxtaposed thin, flexible lips adapted to extend well into a convergent space between the superposed sheets to a position at or closely adjacent the position at which adjacent areas of the sheets are properly located in superposition, for delaying contact between said fluid and the photosensitive image-recording sheet.

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

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

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

FIGURE 1 is a perspective view, partially in section with parts broken away, illustrating photographic processing apparatus embodying the invention;

FIG. 2 is a fragmentary, sectional view of the apparatus of FIGURE 1, the section being taken substantially midway between the sides of the apparatus; and

FIG. 3 is a view similar to FIG. 2 of another embodiment of the apparatus of the invention.

The processing apparatus of the invention is adapted for use independently of other apparatus for the purpose of treating exposed photosensitive image-recording sheet materials to produce positive prints; or it may be incorporated in the structure of a number of different types of photographic apparatus such as cameras and document copiers which include means for photoexposing the image-recording sheet. The apparatus is particularly useful for processing the image-recording sheet as the latter is being moved continuously through the apparatus at a relatively slow rate, i.e., at a rate such that prior art processing equipment of this type is unsuitable because it would permit the reactions between the photosensitive material and the processing fluid to advance to too great an extent prior to proper superpositioning of the sheets. The invention overcomes this problem with a construction which provides for the introduction of a processing fluid into a

convergent space between the sheets while permitting the fluid to contact the sheets substantially only in areas thereof which have been, or are very close to being properly superposed; i.e., spaced from one another by a distance approximately equal to the desired thickness of the layer of processing fluid.

Reference is now made to FIGS. 1 and 2 of the drawings in which is illustrated photographic apparatus embodying the invention and generally comprising a pair of pressure-applying members for superposing a pair of sheets and means for supplying and dispensing a processing fluid for distribution between the sheets. The pressure-applying members are shown in the form of a pair of rigid, cylindrical rolls 10 and 12, positioned adjacent one another with their axes substantially parallel so as to define a convergent passage. The pressure-applying members, while being illustrated as rolls, may take other forms including bars which are fixed with respect to one another and include convergent surfaces defining a convergent passage. Rolls 10 and 12 are preferably mounted for rotation about their axes by suitable means (not shown) and may be retained in fixed position with respect to one another so that the width of the passage defined by the closest portions of the peripheral surfaces of the rolls is fixed, or in an alternative form, may be movable toward and apart from one another but with the maximum separation being limited so that the maximum width of the passage, at any point, is fixed.

A pair of sheets, including a photosensitive image-recording sheet 14 and a second or image-receiving sheet 16, are guided between rolls along convergent paths into superposition with one another within the convergent passage defined by the rolls. The photosensitive sheet may comprise a layer of a photosensitive material such as a gelatino silver halide emulsion carried on a suitable thin flexible support formed of any of the materials generally used in photography including for example paper, organic plastics, foils, and the like. The second sheet also comprises a thin flexible material of the type generally used in photographic processes. The two sheets are guided around portions of the surfaces of the juxtaposed rolls into the convergent gap between the rolls so as to define a convergent space into which a processing fluid is introduced for spreading in a layer between the sheets during movement of the sheets relative to and between the pressure-applying rolls. Movement of the sheets between the pressure-applying rolls can be effected, either by pulling on the sheets, or by rotating the rolls themselves.

The means for supplying and dispensing the processing fluid between the sheets comprise a nozzle 18 approximately equal in width to the width of the sheets between which the fluid is to be distributed. The nozzle includes a triangular shaped, divergent passage 20, diverging from a conduit 22, located at one end of the nozzle and through which fluid is introduced into the nozzle, to a discharge mouth 24 at the opposite end of the nozzle, the discharge mouth extending from side to side of the nozzle and being approximately equal in length to the width of the area of the photosensitive sheet to be treated with the processing fluid. Edge sections 26 of the nozzle, located adjacent and defining opposite sides of the discharge mouth are tapered so as to permit the nozzle to extend into the convergent space between sheets 14 and 16. In the form shown, edge sections 26 are provided with concave, cylindrically curved outer surfaces and the nozzle is positioned with the end edges of these sections of the nozzle extending to positions closely adjacent but out of contact with the photosensitive and second sheets. The nozzle is thus positioned so that discharge mouth 24 is located substantially as close as possible to the narrowest portions of the gap between rolls 10 and 12.

In accordance with the invention, a pair of thin flexible lips 28 are attached to opposite sides of the nozzle at the curved surfaces of edge sections 26 so as to extend beyond the end of the nozzle and discharge mouth 24, into the convergent passage between the rolls. Lips 28 are posi-

tioned in face to face contact with the opposed surfaces of portions of sheets 14 and 16 located within the convergent passage between the rolls and cooperate with the nozzle to define a space into which the processing fluid is introduced and from which the processing fluid is distributed as a layer between the superposed sheets. Lips 28 are preferably quite thin, being on the order of the thickness of the layer of processing fluid or the thickness of one of the sheets; and materials preferred for use as lips 28 include organic plastics which are strong, flexible, water impermeable and inert to the reagents of the processing fluid. Materials suggested for this purpose include high density polyethylene, polypropylene, polyvinylidene chloride and polyethylene terephthalate resin. As an example of the thickness of the lips, the photosensitive and second sheets each may have a thickness on the order of three thousandths of an inch and may range from 1 to 10 thousandths, while the layer of processing fluid spread between the sheets may range from 1 to 10 thousandths of an inch; and each of lips 28 may be thinner than either of these sheets, for example, five ten-thousandths of an inch in thickness. The thinnest possible lips are preferred for reasons appearing hereinafter.

The processing fluid which the apparatus is designed to dispense and distribute between the sheets 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 fluid is provided in a suitable container (not shown) coupled with the nozzle by a conduit and is maintained under pressure sufficient to cause the fluid to flow from the container through the conduit and nozzle into the convergent space between lips 28. In the operation of the device, the fluid is distributed in a layer between the sheets at substantially the same rate that it is fed into the convergent space between the sheets. Movement of the sheets past the end edges of lips 28 causes the fluid to be drawn from between the lips because of the viscosity of the fluid, its surface tension and its tendency to adhere to the sheets, and to be withdrawn by the sheets from between the edges of lips 28. In preferred operation of the device, fluid pressure is just sufficient to cause the fluid to reach the space between lips 28 permitting spreading of the fluid to be accomplished by movement of the sheets, so that the quantity of fluid distributed between the sheets, i.e., metering of the fluid, is substantially automatic.

The purpose of the lips, as previously indicated, is to prevent the fluid from contacting the photosensitive sheet until the last possible moment. In other words, the fluid is prevented from contacting the photosensitive sheets until the latter is superposed or almost superposed with the second sheet with a gap between the sheets approximately equal to the desired thickness of the layer of processing fluid, so that diffusible image-forming substances such as soluble silver complexes formed almost immediately as the fluid contacts the photosensitive material, are provided with a properly positioned fluid confining surface for supporting an image-receptive layer to which the image-forming substances are transferred to produce an image. Image formation is also dependent upon the thickness of the layer of fluid distributed between the sheets because the fluid must be provided in sufficient quantity to effect the desired processing while diffusion transfer and image resolution are functionally related to the layer thickness. The thickness of the layer of fluid spread between the superposed sheets can be determined in various ways, preferably by the spacing of the pressure-applying members at the narrowest portion of the gap between the members; and specifically, by making the minimum spacing between the pressure-applying members approximately equal to the combined thickness of the sheet materials located between the pressure-applying members at the narrowest portion of the gap and the thickness of the layer of processing fluid.

The extent to which lips 28 project into the convergent

gap between the pressure-applying members is dependent upon the particular manner in which the thickness of the layer of fluid is to be controlled. In one embodiment, the end edges of the lips may extend between the sheets into the gap to the narrowest portion of the gap which, in case of cylindrical rolls, is a plane through the axes of the rolls. In this embodiment the width of the gap would be approximately equal to the combined thicknesses of sheets 14 and 16, lips 28 and the layer of fluid. In an alternative embodiment, the end edges of the lips extend to a position short of the narrowest portion of the gap so that the lips are not a factor in determining the spacing between the sheets within which the fluid is distributed as a layer. In this latter embodiment, the gap between the end edges of the lips, i.e., the width of the mouth defined by the lips, is preferably equal to the thickness of the layer of fluid being spread; while the distance between the end edges of the lips and the narrowest part of the gap is maintained at a minimum. It is for these reasons that lips 28 should be as thin as possible in order that they may extend as far as possible into the gap while being spaced a minimum distance apart. The processing fluid within the convergent cavity defined by the lips in the end of the nozzle, due to its motion in the direction of movement of sheets, exerts outward pressure against the lips thereby pressing the lips against the sheets and forming a seal between the lips and sheets preventing leakage of the fluid and/or in entrapment of air between the sheets. The converging cavity defined by the lips and nozzle, in the form shown, is open at opposite ends. Nevertheless, leakage of the fluid from the open ends of the cavity presents no problem since the openings are relatively small, the flow of fluid is continuous in the direction of the movement of the sheets and the fluid is drawn from the cavity as a layer between the sheets at the same rate that it is fed into the cavity from the mouth of the nozzle. Oxidation of the fluid similarly presents no problem since a relatively small area of the fluid is in contact with the air and even this minute amount of fluid is constantly changing. However, the apparatus shown is designed primarily for continuous use, that is, continuous sheet movement and fluid feeding; and requires modification if it is to be employed intermittently, that is, with intermittent sheet movement. Such modification involves the provision of means such as end walls for closing the ends of the convergent cavity defined by the lips. The use of a device of this type in intermittent processes not only offers the advantages associated with continuous processing, but the additional advantage of limiting the areas of the sheets in contact with the fluid during the periods when the sheets are not in motion. Thus a saving in the sheet materials can be effected and the sheets are not given the opportunity to absorb so much of the fluid as to be weakened and subject to tearing when drawn between the pressure-applying members.

Another embodiment of apparatus incorporating the invention is shown in FIG. 3 of the drawings. This embodiment includes a nozzle 30 having a discharge mouth 32 and differs from the aforementioned embodiment in the construction of the lips. In the embodiment of FIG. 3, each of the lips, designated 34, comprises a very flexible material and tapers from a relatively thick base section 36 at which it is secured to the nozzle adjacent one side of discharge mouth 32, to a thin edge section 38 extending well into the convergent gap between sheets 14 and 16. The edge sections preferably taper to a knife or feather edge and include outer surfaces conforming to the curvature of the sheets in the region of the convergent gap between the pressure-applying rolls. Lips 34 may be formed, by molding processes, of rubber and rubberlike organic plastic materials, and when tapered to a feather or knife edge, may extend almost to the narrowest portion of the gap without influencing the thickness of the layer of fluid or the spacing between the superposed sheets.

Since certain changes may be made in the above appara-

tus 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. Photographic processing apparatus comprising, in combination:

means providing a passage having walls converging to a gap of predetermined width for guiding a pair of photographic sheets into superposition during movement of said sheets through said passage;

a fluid dispensing nozzle for supplying photographic processing fluid to a convergent space between portions of said sheets in the region thereof at which said sheets converge between said walls;

said nozzle including an elongated discharge mouth bounded on opposite sides by a pair of lips including at least end edge portions which are thin and flexible and are separated by a distance not exceeding the distance between said sheets at said gap;

means for positioning said nozzle with said lips extending into said passage within said convergent space between said sheets and with the outer surfaces of said lips in contact with said portions of said sheets; and

means for supplying said processing fluid to said nozzle under pressure sufficient to cause said fluid to flow between said lips through said discharge mouth.

2. The photographic apparatus of claim 1 wherein said lips extend into said passage, with their outer surfaces substantially parallel with said walls to a position wherein the end edges of said lips are located within said gap.

3. The photographic apparatus of claim 1 wherein said nozzle comprises a rigid section having a fluid conducting passage coupled with said discharge mouth and terminating at a position spaced from said gap, and said flexible lips extend from said rigid section toward said gap and provide said discharge mouth.

4. The photographic apparatus of claim 3 wherein said lips comprise sheets of thin, flexible, fluid-impermeable material attached to said rigid section of said nozzle.

5. The photographic apparatus of claim 1 wherein the thicknesses of at least said edge portions of said lips is on the order of the thickness of said sheets.

6. The photographic apparatus of claim 1 wherein each of said walls is convexly curved toward the other of said walls.

7. Photographic processing apparatus for treating a photosensitive image-recording sheet by superposing said sheet with a second sheet and distributing a processing fluid in a layer of predetermined thickness between said sheets to form a sandwich, said apparatus comprising, in combination:

means providing a passage having walls converging to a gap of predetermined minimum width for guiding said sheets into superposition and distributing said processing fluid in a layer between said sheets during movement thereof through said passage;

a fluid dispensing nozzle for supplying said fluid to a convergent space between portions of said sheets in the region thereof at which said sheets converge between said walls;

said nozzle including a pair of juxtaposed lips disposed on opposite sides of an elongated discharge mouth and being positioned with said lips extending into said passage to positions adjacent said walls;

at least the end edge portions of said lips being thin and flexible;

means for positioning said nozzle with said lips within said convergent space between said sheets, with the outer surfaces of said lips in face-to-face contact with said portions of said sheets and the inner surfaces of said lips spaced from one another by a dis-

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tance not exceeding the thickness of said layer of fluid; and

means for supplying said processing fluid to said nozzle under pressure sufficient to cause said fluid to flow between said lips.

8. The photographic apparatus of claim 7 wherein said minimum width of said passage at said gap is approximately equal to the combined thicknesses of said sandwich and said end edge portions of said lips.

9. The photographic apparatus of claim 7 wherein the thickness of at least the end edge portion of each of said lips is on the order of the thickness of said layer of fluid being distributed between said sheets.

10. The photographic apparatus of claim 7 wherein said nozzle comprises a rigid section terminating at a position spaced from said gap and from said walls, and said lips extend from said rigid section toward said gap.

11. The photographic apparatus of claim 10 wherein the edges of said lips extend into said gap to the narrowest portion thereof.

12. The photographic apparatus of claim 7 wherein each of said walls is convexly curved toward the other of said walls.

13. The photographic apparatus of claim 7 wherein said minimum width of said gap is approximately equal to the combined thicknesses of said sandwich and said end edge portions of said lips are spaced from one another by a distance at least equal to the thickness of said layer of fluid being distributed between said sheets.

14. Photographic processing apparatus for treating a photosensitive image-recording sheet by superposing said sheet with a second sheet and distributing a processing fluid in a layer of predetermined thickness between said sheets to form a sandwich, said apparatus comprising, in combination:

means providing a passage having opposed walls converging to a gap of predetermined minimum width for guiding said sheets into superposition and distributing said processing fluid in a layer between said sheets during movement thereof through said passage;

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a fluid dispensing nozzle for supplying said fluid to a convergent space between portions of said sheets in the region thereof at which said sheets converge between said walls;

said nozzle including a substantially rigid section having an opening therethrough, and a pair of relatively flexible undersupported lips extending from said rigid section and defining an elongated opening at the end edges of said lips;

means for positioning said nozzle with said rigid section spaced from said walls sufficiently to permit movement of said sheets between said rigid section and said walls without contacting said rigid section, with said lips extending toward said gap with the outer surface of said lips in contact with said portions of said sheets and with the inner surface of said lips spaced from one another by a distance not exceeding the distance between said sheets at said gap; and

means for supplying said processing fluid to said nozzle under pressure sufficient to cause said fluid to flow through said opening between said lips.

15. The photographic apparatus of claim 14 in which each of said lips tapers from a maximum thickness at said rigid section to an edge portion extending into said gap, said end edge portions of said lips are located in juxtaposition within said gap in contact with said sheets, and said end edge portion of each of said lips has a thickness on the order of the thickness of said layer of processing fluid.

16. The photographic apparatus of claim 14 in which said rigid section of said nozzle is tapered and extends into said passage, and said lips comprise a pair of flexible sheets secured to opposite sides of said tapered portion of said rigid section and extending into said passage beyond the end of said tapered portion.

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