March 22, 1966 O. E. WOLFF 3,241,468

PHOTOGRAPHIC APPARATUS

Filed Aug. 5, 1963

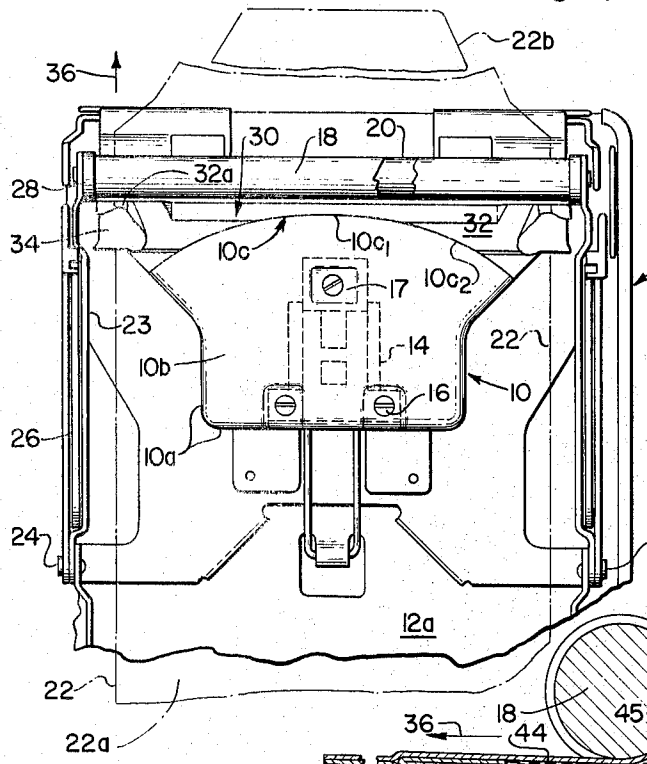


FIG. 1

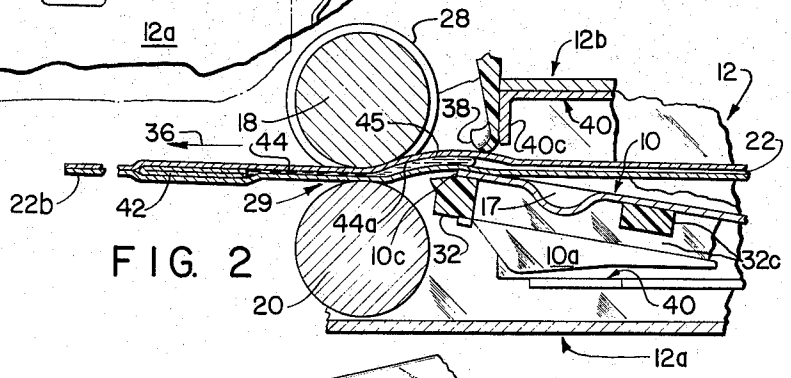


FIG. 2

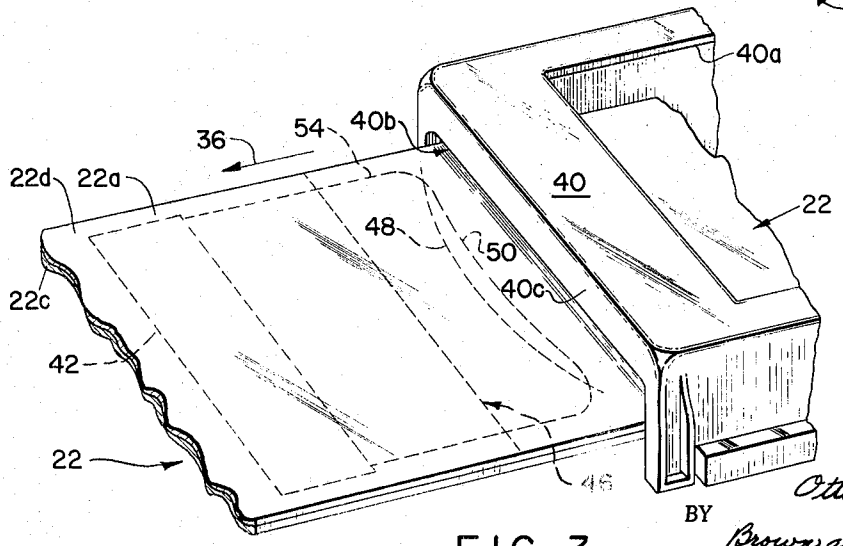


FIG. 3

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PHOTOGRAPHIC APPARATUS

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This invention relates to apparatus for processing a multilayer photographic film unit or assembly and especially to novel apparatus for providing an improved spreading of a processing liquid between a pair of layers of the film assembly.

The apparatus of the present invention is adapted to use in conjunction with a diffusion transfer process of forming photographic images in which, for example, a multilayer film assembly comprising at least one photosensitive emulsion and a releasably contained processing liquid, including a silver halide developer and a silver halide solvent, is subjected to progressive compression, e.g., moved between compressive means, after it has been photographically exposed. The apparatus is preferably of a type adapted to incorporation with a so-called self-processing camera. In a method such as that contemplated herein, a preferably viscous processing liquid is released from container means of the film assembly, e.g., a compressible and fracturable container, and is spread between and imbibed into appropriate layers of the film. During the formation of an essentially black-and-white image, reagents of the processing liquid reduce exposed silver halide to silver and react with unreduced silver halide to form a soluble silver complex which is transferred and which, in turn, is reduced to silver at a given surface location to provide the image. Certain modifications of the foregoing diffusion transfer process, known to the art, occur in conjunction with the production of full-color images, but will not be described herein, in detail, as the actual image formation forms no part of the present invention. Diffusion transfer processes of the type contemplated herein are disclosed, for example, in U.S. Patents Nos. 2,543,181, 2,662,822 and 2,774,668. Film structures of a generally related type are described in U.S. Patents 2,946,270, 2,991,702 and 2,991,703 and in the copending U.S. patent application of Rogers B. Downey, Serial No. 268,882, now Patent No. 3,165,039.

Control of the processing liquid spreading operation may, in general, be considered somewhat more critical in the processing of color film than in that of black-and-white film. For example, with color film, blemishes in the final image which were due to inadequate spreading might involve color differences as well as density differences and, accordingly, be more noticeable. In any event, where, as may be generally assumed, the liquid spreading means is intended for use with both black-and-white and color film it must, of course, perform satisfactorily for each and accommodate to such factors as differences in the amount of contained processing liquid, differences of film thickness, etc. A correct spreading of the processing liquid may generally be taken as that which produces a layer thereof of proper and even thickness throughout the image area, without entailing any excessive accumulation of the liquid outside of the image area.

A method of obtaining a suitable spreading of the processing liquid in a film unit of the character described, employing means supplementary to the principal compressive means for the purpose, has, for example, been presented in considerable detail in U.S. Patent 2,991,703 and to some extent in the copending U.S. patent application Serial No. 268,882, above mentioned. The present invention takes what may be considered as a somewhat related approach to the problem but employs improved

means for obtaining a controlled flow of the processing liquid.

In view of the foregoing considerations, a principal object of the invention is to provide a device for obtaining a consistently even and complete spreading of a processing liquid throughout given areas of a multilayer film assembly. Other objects are to provide apparatus of the character described which is adapted to use in conjunction with, or supplementary to, a principal compression-applying means for the film assembly; to provide a device for use with the principal compression-applying means which produces a restricting force counteracting a misdirectional flow of the processing liquid initiated by the principal compression-applying means in conjunction with means compressing longitudinal margins of the film assembly; to provide a processing-liquid flow-control device which is positionable in close proximity to the principal compression-applying means thus reducing the pressure necessary of application by the flow-control device; to provide apparatus of the character described embodying a relatively simple and inexpensive structure for applying a secondary pressure to the film assembly; to provide apparatus, as described, which is suitable for incorporation with a camera; to provide liquid-spreading apparatus which contributes, through maximum distribution in the image area, to avoidance of an undue excess of processing liquid outside of the image area of the film assembly; and to provide apparatus of the aforesaid category which is adapted to accommodate film materials of relatively different physical characteristics such as may exist between black-and-white and color film materials.

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 drawing wherein:

FIGURE 1 is a diagrammatic plan view of the liquid-spreading device of the invention;

FIG. 2 is a diagrammatic side elevation view, partly in section, of the liquid-spreading device in relation to compression-applying means; and

FIG. 3 is a diagrammatic perspective view of film and container components of a film pack, illustrating the operation of the spreading means of the invention.

In FIGURE 1 the flow-control or liquid-restricting device **10** of the invention, for controlling spreading of a processing liquid between given layers of a film assembly, is shown in conjunction with elements of a so-called self-processing camera **12**. The element **10** is of a generally plate-like form with rounded edges at **10***a*. It includes a major planar surface **10***b* terminating in a curved, flared, film-bearing edge portion at **10***c*, the curve and location of the latter having special significance with respect to an applied pressure and to the liquid-spreading or flow-control operation, as will be explained hereinafter. The element **10** is releasably attached to an underlying mounting-block **14** of the camera by three screws **16** inserted through perforated recessed portions **17**. Cooperating elements of the camera, which may be considered as located in the camera back **12***a*, as opposed to the camera front **12***b* in which means for exposing the film are contained, include a pair of rotatably mounted pressure rolls **18** and **20** which are the principal compressive means employed for fracturing the liquid container of the film assembly and for

releasing and spreading the processing liquid between inner surfaces of the assembly. The general contour of a film unit positioned for treatment by the flow-control device **10** and the pressure rolls **18** and **20** is indicated by the broken line **22**. Two elongated arms **23**, mounting the foremost pressure roll **18**, are pivotally attached to fixed portions of the camera back at **24**. Pressure roll **18** is biased toward roll **20** by a pair of "U"-shaped springs **26**. Roll **18** includes a peripheral flange **28** at each of its extremities for limiting its proximity to roll **20** and thereby providing a minimum spacing or slot **29** between the working surfaces of the two rolls. While the aforesaid mounting of the pressure rolls is of a preferred type, the flow-control device of the invention is, in no sense, limited to use with pressure rolls thus mounted.

An elongated, transversely-disposed element **30** is positioned closely adjacent to the pressure rolls **18** and **20** and comprises a multi-faced bar component **32** intermediate of a pair of spring-clip members **34**. The latter bear against raised portions **32***a* of the bar extremities. Element **30** is mounted on the block **14** by an appendage **32***c* and by other mechanism (not shown) in a manner which permits it to undergo substantially free movement in a plurality of directions. The longitudinal marginal areas **22***a* of a film assembly pass slidably between the clips **34** and underlying surface portions **32***a* of the bar and are compressed thereby during movement of the film unit in a direction toward the pressure rolls **18** and **20**. The element **30** thus serves to seal the film unit margins or edges against escape of the released processing liquid during the spreading operation. However, in so doing it tends to cause an unwanted concentration of the liquid centrally of the film unit. Element **30**, although capable of the aforesaid free movement, is biased to a centered position and thereby also contributes somewhat to proper guidance of the film unit during its movement toward the pressure rolls and thence to a location external of the camera.

To accomplish its processing, generally assuming a photo-sensitive emulsion thereof to have been photographically exposed, the film unit **22** is drawn, manually, by a leader **22***b* in the direction of the arrow **36**, its margins passing between the clip members **34** and bar portions **32***a* and its entire area passing between the pressure rolls **18** and **20**.

In FIG. 2, operation of the flow-control plate **10**, in cooperation with the pressure rolls **18** and **20**, with a projecting guide or bearing member **38** of the camera, and with the bar element **32**, is illustrated in a side elevational view. A film assembly **22** is undergoing movement in the direction of the arrow **36**. The film assembly is shown as partially removed from a container element **40** of the film pack which is releasably mounted in the camera front **12***b*. An exhausted liquid container of the film assembly is shown at **42**, its contents **44**, namely, a processing liquid, having been ejected during passage between, and by compression applied by, the pressure rolls **18** and **20**. The especially contoured bearing surface or edge **10***c* is shown in contact with a surface of the film assembly **22**.

When the processing liquid **44** is released from the container **42** by passage of the latter between the pressure rolls **18** and **20**, it is emitted with considerable force between unbonded facing layers of the film assembly in a direction opposite to the direction of film assembly advancement. Assuming the pressure-applying means to be of a form wherein its members are spaced apart equidistantly throughout their length during compression of the film assembly, as in the instance of rolls **18** and **20**, and by reason of the marginal compressing action of components **32***a* and **34** of element **30**, which oppose lateral flow, the viscous processing liquid would tend, if uncontrolled, to concentrate in the center area of the film assembly and to assume the appearance of a longitudinally-extending, tapering ribbon or tongue. This tendency would be accentuated if the layers between which the liquid is released were not held against undue separation under the force exerted by the liquid at their central areas. Accordingly, the layer of spread liquid might well fail to reach the transverse limits of the image area. If this were to occur, an incomplete image would, of course, be formed. Or, the spread processing liquid might cover the image area but be considerably thicker in central portions than toward the lateral margins thus causing, for example, abnormal densities or other undesirable effects. Various additional faults in the image such as streaks, bubbles and the like could also be attributable to an uneven distribution or misdirection of flow of the processing liquid throughout the facing areas of its negative and positive components.

The flow-control plate **10** of the present invention, lying athwart the film assembly, exerts a supplementary pressure, along a transverse curved line, on the film assembly which operates against separation of the film assembly layers **22***c* and **22***d*, thereby modifying the shape of a pool of the released liquid **44***a* in the cavity **45** so that it becomes less concentrated at the center of the film assembly. In holding the layers against separation, the plate also facilitates a greater length of the pool, taken longitudinally of the film assembly. Owing to the heightened compression of the processing liquid close to the bite of the pressure rolls **18** and **20**, a considerable turbulence of the liquid is generated in this area, producing bubbles therein. The aforementioned greater length of the pool of liquid tends to dissipate these bubbles prior to completion of the spreading process, thus preventing impairment of the image. Through its location close to the bite of the pressure rolls **18** and **20**, less pressure is required of the edge **10***c* than would be the case if it were more remotely located. The projecting element **38**, adjacent to that side of the film unit which is opposite to that in contact with the plate edge **10***c*, cooperates in the restrictive process by guiding the film assembly toward the aforesaid edge **10***c* and supporting it against pressure exerted by the latter. Moreover, through the special contour of the bearing edge or surface **10***c*, the restrictive force is applied along a curve which may be said to be generally complementary to that of the aforesaid taper of the processing liquid. The accumulation of compressed processing liquid **44***a* in the cavity **45**, when taken with the curve of bearing edge **10***c*, which restricts its flow along a curve of one radius in central areas **10***c* and along a curve of a different radius adjacent to marginal areas $10c_2$ at each side of the central area, and when taken with the forces of viscosity involved with respect to processing liquids of the type contemplated, provides a flow pattern wherein the processing liquid is distributed substantially evenly and linearly across the image area.

In FIG. 3 the aforesaid operation and forces applied by apparatus of the invention which underlie the processing liquid distribution are further illustrated. It is to be assumed that the enclosing container **40** of the film pack, comprising the exposure aperture **40***a* and the film withdrawal aperture **40***b*, is mounted in the camera as indicated in FIG. 2, a film assembly **22** comprising an image-receiving layer **22***c* and a photosensitive layer **22***d* being shown as undergoing withdrawal in the direction of the arrow **36** from the film-pack container **40**. A compressed and exhausted liquid container is shown at **42**. The dotted line **46** illustrates the location of the bite of the pressure rolls **18** and **20**. The curved dotted line **48** represents the line of restraining force exerted on the film assembly by the curved bearing edge **10***c* of element **10**. The dotted line **50** indicates the contour of the processing liquid after its subjection to the line of restraining force **48**, with particular emphasis on the full coverage of the liquid transversely of the film assembly which has been obtained thereby.

While the following data are not, in any sense, to be taken as restrictive of the scope of the invention, they have been found to be satisfactorily applicable with re-

spect to film assemblies of types having the designation type 107 and type 108, sold by Polaroid Corporation, Cambridge, Massachusetts, U.S.A. By "satisfactory" is meant a reduction in incomplete spreading of a processing liquid, where plate member **10** was not employed, from 45 percent to less than 3 percent. The bearing edge **10***c* may suitably be located between .002" below and .015" above the "bite line" of pressure rolls **18** and **20**, this line being tangent to the periphery of pressure roll **18** and disposed at 90° to a plane including the axes of both pressure rolls **18** and **20**. The plate element **10** may suitably be inclined at an angle of approximately 8° 15" relative to the aforesaid bite line, the angle being exaggerated in the drawing. As previously indicated, variation of the angle of inclination of the plate element **10** alters the plane in which the curved surface **10***c* lies and varies the portions which bear most firmly against the film unit. Assuming no inclination at all, which, also, would be a possible arrangement, the curve would lie in a plane substantially parallel to the film unit and all portions of the edge **10***c* would bear against the film unit substantially equally. The curved edge **10***c* of varying radius is approximately $\frac{9}{32}$ inch from the bite of the pressure rolls at its nearest point. Variation of this spacing effectively alters the relation of the edge **10***c* to the bite line. The curve of edge **10***c* having, for example, a radius of 5 inches in mid-portions and a radius of 1.5 inches in portions to each side thereof, has been chosen as particularly effective with respect to given film assemblies, above-mentioned, in which is contained a processing liquid in given amounts, e.g., approximately 1.33 grams for a color film and .78 gram for a black-and-white film, the liquid having, for example, a viscosity of 30,000 to 100,000 centipoises for the color film and a viscosity of 60,000 to 200,000 centipoises for the black-and-white film.

A modification of the apparatus shown would permit the element **38** to be supplanted, in its function of supporting the film assembly against the pressure applied by the edge **10***c*, by an appropriate extension of the depending member **40***c* of the film pack container. Assuming the layer or layers of a film assembly to be sufficiently rigid, the need for a supporting members at the face of the film opposite to the face in contact with the edge **10***c* might be obviated entirely. The invention is not limited to the particular principal compression-applying means **18** and **20** or the marginal compressing means **30** shown, it being obvious that modified elements could be employed for the purpose in conjunction with the flow-control device of the invention.

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 drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Photographic apparatus for controlling the distribution of a processing liquid between layers of a multilayer film assembly when released and undergoing said distribution in response to longitudinal advancement of the film assembly in a given plane between the bite of compression-applying means, said apparatus comprising a pressure-applying member positioned adjacent to said compression-applying means so as to be substantially athwart and bear against said film assembly, said member terminating at a portion thereof nearest said bite in an edge of predetermined curvature, said curved edge being curved in a direction opposite to that of said film-assembly advancement and lying in a plane disposed within a range of from 0° to an acute angle, inclusive, relative to said plane of film-assembly advancement, whereby a transverse area of said film assembly is subjected at different longitudinal portion to a bearing force differentially applied in time just prior to the entrance of said area into said bite of the compression-applying means, a central portion being first subjected thereto followed continuously by portions located transversely thereof, said member thereby providing a continuous flow of said processing liquid in substantially transverse directions toward the sides of said film assembly.

2. Photographic apparatus, as defined in claim **1**, wherein the curvature of said edge is of a varying radius.

3. Photographic apparatus, as defined in claim **2**, wherein said curve is of a greater radius in central portions than in portions at each side thereof.

4. Photographic apparatus for controlling the distribution of a processing liquid between layers of a multilayer film assembly when released and undergoing said distribution in response to longitudinal advancement of the film assembly between the bite of a pair of pressure rolls, said apparatus comprising a generally plate-like member positioned adjacent to said pressure rolls so as to be substantially athwart said film assembly and inclined at an acute angle with respect to a plane normal to a second plane which includes the axes of both said pressure rolls, said plate-like member terminating at a portion thereof nearest said bite of the pressure rolls in an edge of predetermined curvature, the aforesaid inclination of said member providing said edge lying in a plane which is acutely angularly disposed relative to that of said film assembly, whereby central portions of said edge bear against said film assembly with a greater force than portions thereof at each side of said central portions and a transverse area of said film assembly is subjected to a differential bearing force just prior to the entrance of said area into said bite of the pressure rolls, said plate-like member thereby providing a flow of said processing liquid in substantially transverse directions toward the sides of said film assembly.

5. Photographic apparatus, as defined in claim **1**, wherein said compression-applying means is a pair of pressure rolls, said longitudinal movement of said film assembly is substantially in a plane normal to a plane which includes the axes of both said pressure rolls, and said edge of predetermined curvature is so positioned with respect to said bite of the compression-applying means and relative to the plane of said film assembly as to apply a bearing force to the latter restricting separation of said layers of the film assembly and thereby facilitating a lateral flow of said processing liquid.

6. Photographic apparatus, as defined in claim **4**, wherein said compression-applying means and said plate-like member are incorporated with a camera.

7. For use in a camera, including a pair of pressure rolls between the bite of which a plurality of film assemblies of a film pack, each containing a releasable processing liquid, are adapted to be successively advanced and compressed after their photographic exposure to release and spread the processing liquid between inner surfaces thereof and including a marginal compression-applying means for engaging the longitudinal margins of each said film assembly during its advancement to compress said margins and prevent escape of the released liquid, apparatus for influencing a generally lateral flow of said processing liquid toward said margins thereby opposing the effect of said marginal compression-applying means in concentrating said liquid in central areas of said inner surfaces of said film assembly, said apparatus comprising a generally planar, plate-like member positioned closely adjacent to said pressure rolls so as to be substantially superimposed with a transverse area of each film assembly and inclined at an acute angle with respect to a plane normal to a second plane which includes the axes of both said pressure rolls, said plate-like member terminating at a portion thereof nearest said bite of the pressure rolls in an edge of predetermined curvature for bearing against one face of said film assembly, the aforesaid inclination of said member providing said edge lying in a plane which is acutely angularly disposed relative to that

of said film assembly, whereby central portions of said edge bear against said film assembly with a greater force than portions thereof at each side of said central portions and a transverse area of said film assembly is subjected to a differential bearing force along a transverse, curved linear area thereof just prior to the entrance of said linear area into said bite of the pressure rolls, said plate-like member thereby providing said lateral flow of said processing liquid.

8. For use in a camera including a pair of pressure rolls between the bite of which a plurality of film assemblies of a film pack, each containing a releasable processing liquid, are adapted to be successively advanced and compressed after their photographic exposure to release and spread the processing liquid between inner surfaces thereof and including a marginal compression-applying means for engaging the longitudinal margins of each said film assembly during its advancement to compress said margins and prevent escape of the released liquid, apparatus for influencing a generally lateral flow of said processing liquid toward said margins thereby opposing the effect of said marginal compression-applying means in concentrating said liquid in central areas of said inner surfaces of said film assembly, said apparatus comprising a generally planar plate-like member positioned closely adjacent to said pressure rolls and adapted to be substantially superimposed with a transverse area of each film assembly, said plate-like member terminating

at portions thereof nearest said bite of the pressure rolls in an edge of predetermined curvature which is curved in a direction opposite to that in which said film assemblies are advanced for bearing against one face of said film assembly, whereby a central sector of said edge bears against said film assembly prior to sectors thereof at each of said central sector and each said film assembly during its advancement is subjected to a differentially-located bearing force along a transverse, curved, band-like area thereof delineated by said edge just prior to the entrance of said area into said bite, thereby providing said lateral flow of said processing liquid, and support means embodied in one of said camera and film pack so as to project toward, but be predeterminedly spaced from, said curved edge of the plate member for bearing against the opposite face of said film assembly and thus slidably holding the film assembly in opposition to said bearing force applied to the first-named face of the latter.

9. Photographic apparatus, as defined in claim 1, wherein said curved edge lies in a plane disposed at an acute angle of approximately 8° to a plane normal to a plane including the axes of both said pressure rolls.

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