United States Patent

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[72] Inventor **David Van Allen**
Malden, Mass.

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[73] Assignee **Polaroid Corporation**
Cambridge, Mass.

[54] **PHOTOGRAPHIC FLUID-SPREADING APPARATUS**
20 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** ..... **95/89 R,** 95/14, 95/89 L
[51] **Int. Cl.** **G03d 3/00**
[50] **Field of Search** ..... 100/168; 95/89 R, 89 A, 89 L, 13, 14

[56] **References Cited**

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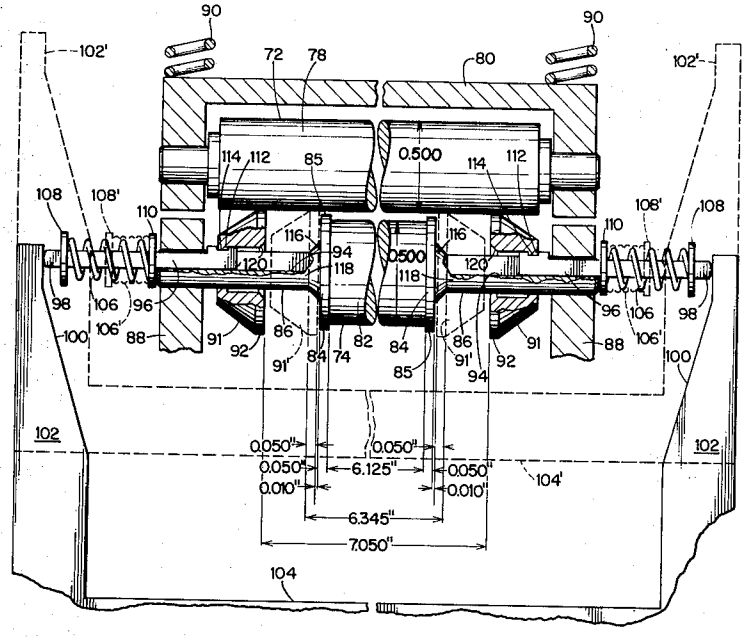
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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Richard L. Moses
Attorneys—Brown and Mikulka, William D. Roberson and Robert L. Berger

ABSTRACT: Photographic apparatus for alternately distributing processing fluid in a layer having a first predetermined thickness and in a layer having a second predetermined thickness less than such first predetermined thickness between sheet materials of a predetermined width. A first roller has a facing surface extending a distance greater than the width of such materials. A second roller is positioned in juxtaposed relationship thereto and has a shorter facing surface and collars at each end thereof spaced a distance apart less than the width of such sheet materials and extending from that facing surface and a radial distance substantially equal to such second predetermined fluid thickness. Movable annular collars are mounted on respective shafts of the second roller for simultaneous displacement between first positions wherein sheet-contacting surfaces thereof are spaced apart a distance greater than the width of such sheet materials and second positions wherein their sheet-contacting surfaces are spaced apart a distance less than such width. These sheet-contacting surfaces on the movable rollers are disposed a radial distance from the facing surface of the second roller substantially equal to such first predetermined thickness of fluid. The two rollers are continually yieldably urged towards each other.



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SHEET 1 OF 3

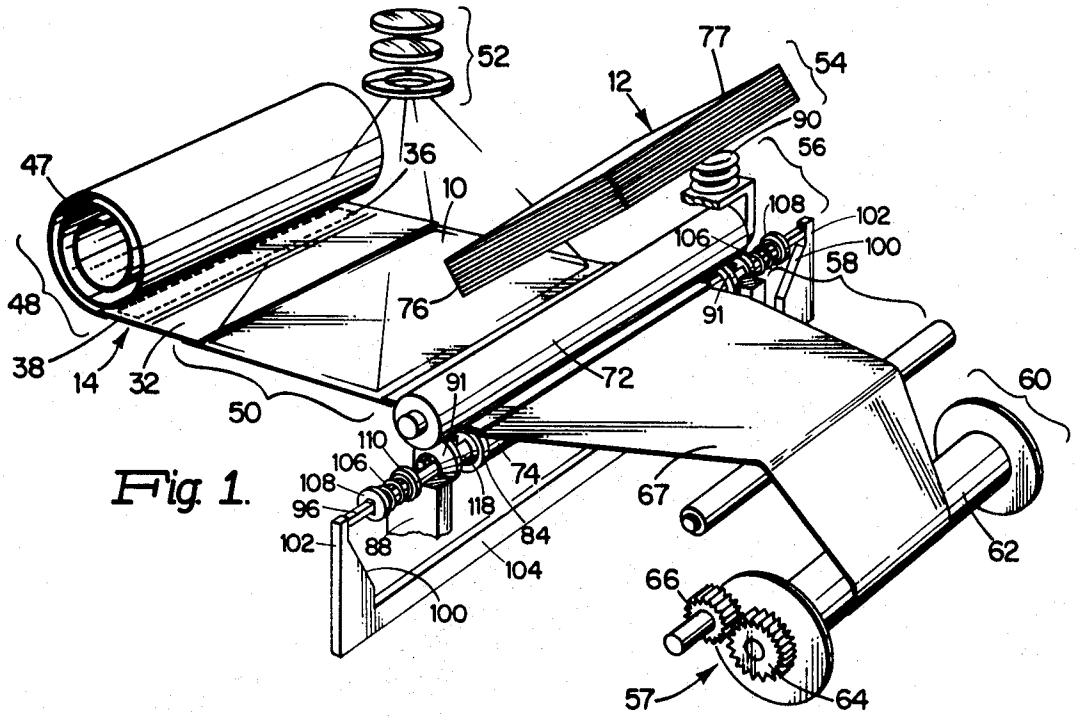


Fig. 1.

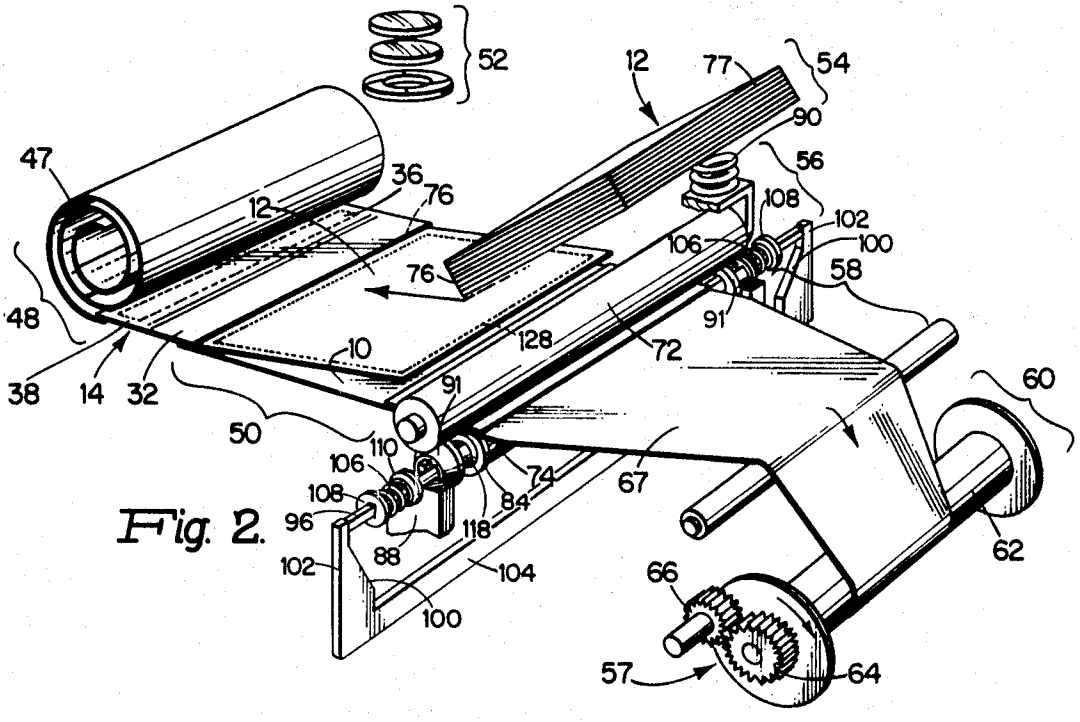


Fig. 2.

INVENTOR.
DAVID E. VAN ALLEN

BY Brown and Mikulka
and
Robert L. Berger
ATTORNEYS

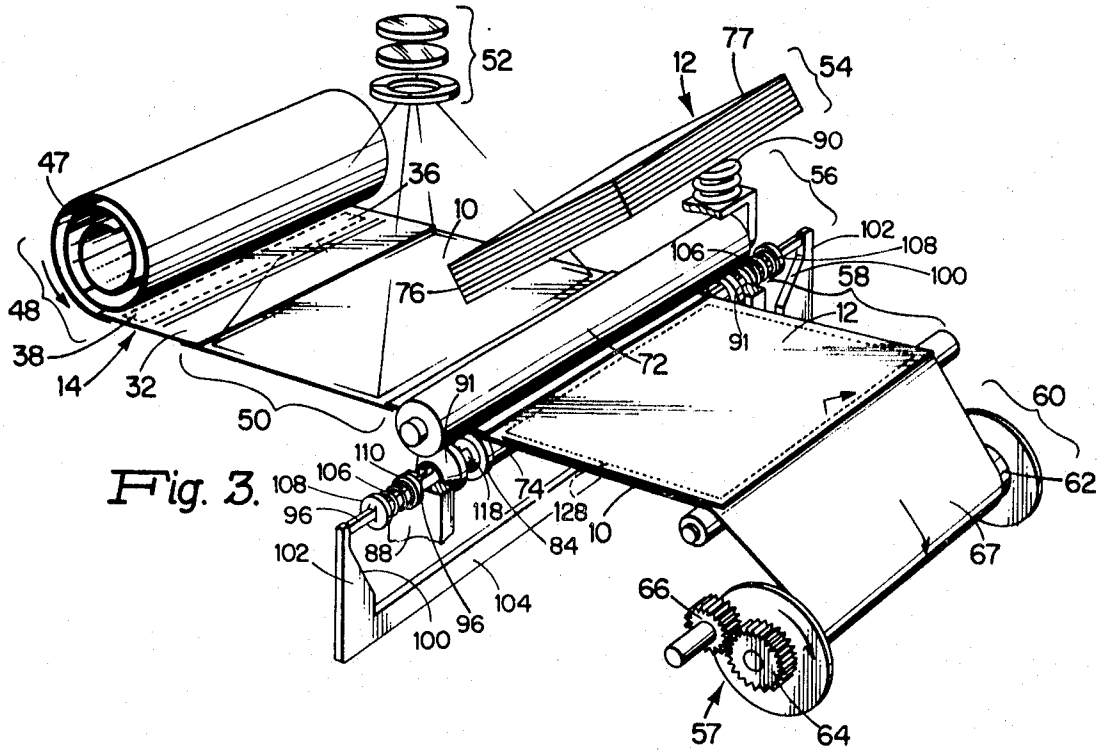


Fig. 3.

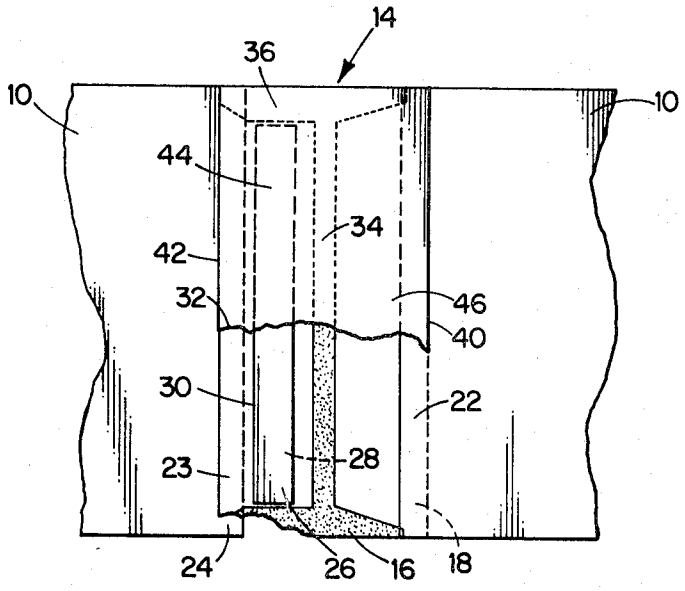


Fig. 4.

INVENTOR.
DAVID E. VAN ALLEN

BY Brown and Mikulka
and
Robert L. Berger
ATTORNEYS

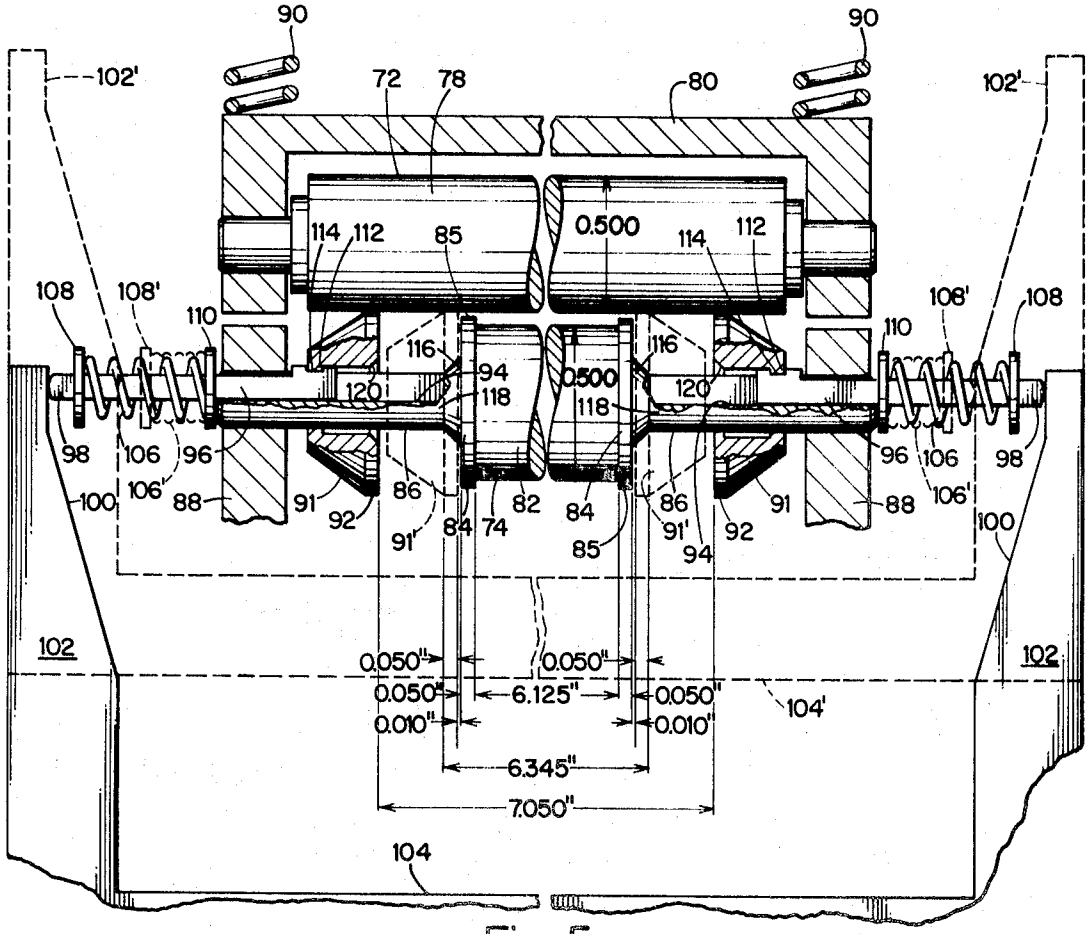


Fig. 5.

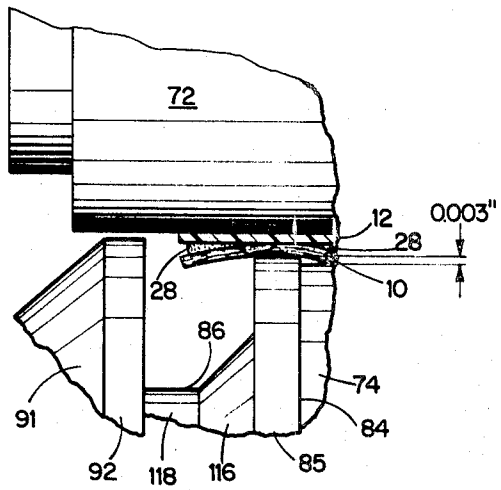


Fig. 6.

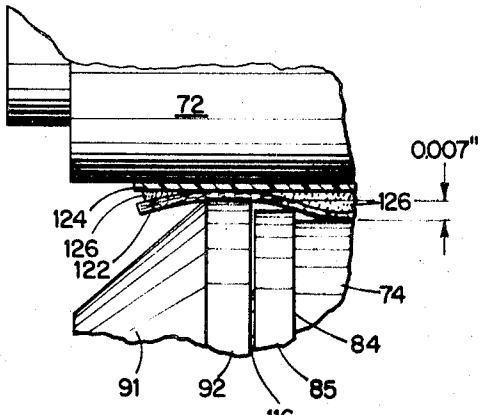


Fig. 7.

INVENTOR
DAVID E. VAN ALLEN

BY Brown and Mikulka
and
Robert L. Berger
ATTORNEYS

PHOTOGRAPHIC FLUID-SPREADING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to photography and, more particularly, to apparatus for spreading a processing fluid in layers of differing thickness between pairs of superposed sheet material.

2. Description of the Prior Art

There are a number of photographic processes which may be effected by distributing a processing fluid in a uniformly thin layer between a pair of superposed sheets. Generally, one of the superposed sheets comprises a photosensitive image-recording material, and the second sheet may merely aid in distributing the processing fluid over the first sheet or may, if desired, also possess other characteristics. The processing fluid, in processes with which the present invention is typically concerned, is usually of a viscous type, initially being retained in a rupturable container carried in one of the superposed sheets.

In these processes, the photosensitive sheet is first exposed and then superposed with respect to the second sheet. The two superposed sheets are then moved relative to, and between, a pair of juxtaposed members. These members may comprise a pair of substantially parallel rollers, a roller and a nonrolling member, or other apparatus that will, as the sheets are moved therethrough, first collapse the fluid-carrying pod or container, thereby forcing the fluid out of the container and between the superposed sheets as a mass extending transversely across the sheets and then subsequently distribute the fluid from this mass so as to produce an approximately uniform fluid layer between the desired portions of the superposed sheets.

These photographic techniques may be employed to produce viewable images of either the black-and-white or full-color types. However, when producing a full-color viewable image, it has generally been necessary to distribute a layer of processing fluid between the superposed sheets which is of a thickness considerably greater than that of the layer of processing fluid which need be distributed between superposed sheets in producing a viewable image of the black-and-white type. Further, in both instances it has been the general practice to provide a pair of rails on one of the superposed sheets, one such rail being disposed along each longitudinal edge thereof, to control the thickness of the layer of processing fluid distributed between the sheets as they are advanced between the fluid-spreading members. Consequently, the rails provided on the sheets employed in full-color processes are substantially thicker than those provided on the sheets employed in black-and-white processes. In any event, such arrangements have in the past permitted the same set of spreader elements to be employed in both black-and-white and full-color photographic operations.

It will be recognized that the rails associated with such photographic sheet materials represent a significant element of cost in the production of finished prints by the diffusion-transfer process. Also, other auxiliary film components normally associated with diffusion-transfer photographic operations, i.e., pods, leaders, masks, bibs, and traps, significantly increase the cost of producing finished prints by such processes. After each photographic print of the diffusion-transfer type has been made, the photographer frequently has been required to handle and dispose of considerable waste material. Such waste material may not only include the above-mentioned auxiliary film components, but also the processed negative emulsion-bearing sheet. This task has proved to be somewhat of an inconvenience to the operator and one which, in some instances, can be quite messy considering the fact that certain of these materials are wetted with processing fluid.

In order to overcome some of these limitations of the prior art, it is desirable that the structure of the film units employed in processes of these general types be simplified. Along these lines, such film products have been devised which include, as one of their advantages, the elimination of any requirement for rails and masks. Such simplified film products are the subject of the copending application Ser. No. 51,250 entitled Simplified Diffusion-Transfer Film Products, filed on June 30, 1970 by the applicant and Frank W. Knight. Since these film products do not require rails, there is no means within the film unit itself for controlling the thickness of the layer of processing fluid distributed between the superposed sheets as they are advanced through the fluid-spreading members.

An important object of this invention, therefore is to provide improved processing fluid-spreading apparatus for use with film structures of a simplified type to alternately distribute layers of differing thicknesses of processing fluid between superposed sheets of such units.

Another primary object of this invention is to provide improved processing fluid-spreading apparatus of the type indicated which may be alternately employed to produce photographic prints of the black-and-white and full-color types.

A further object of this invention is to provide an improved fluid-spreading apparatus of the type indicated which may be employed in the production of both black-and-white and full-color photographic prints and which, in both such operations, includes an arrangement for preventing processing fluid escaping from between the longitudinal edges of the superposed sheet materials as they are advanced between fluid-spreading elements.

SUMMARY OF THE INVENTION

In its illustrated embodiment, the fluid-spreading apparatus of this invention is adapted to alternately distribute processing fluid in a layer having a first predetermined thickness and in a layer having a second predetermined thickness less than such first predetermined thickness between superposed sheet materials of a predetermined width. The spreading of the processing fluid between the superposed sheet materials is effected as they are advanced lengthwise through such apparatus. In each instance, a viewable image is ultimately formed in one of the superposed sheets having a width less than that of the sheets themselves. Typically, the nature of the superposed sheets is such that when the fluid layer spread therebetween has such first predetermined thickness, the subsequently developed viewable image is of the full-color type, while the nature of the superposed sheets is such as to facilitate the production of a viewable image of the black-and-white type when the fluid layer spread therebetween is of such second predetermined thickness.

As depicted in the drawings, the preferred form of the apparatus of the present invention comprises a pair of elongated rollers having their axes of rotation disposed in parallel alignment. The mounting arrangement for these rollers facilitates a limited amount of relative movement thereof toward and away from each other, and includes spring means for continually urging them into contact.

One of the rollers is provided with a facing surface extending a distance greater than the width of such sheet materials. The second roller has a facing surface generally equal in length to the width of the viewable images to be ultimately produced in one of the superposed sheets and is aligned centrally of the facing surface of the first roller. A collar is provided at each end of the facing surface of the second roller that extends radially therefrom a distance substantially equal to such second predetermined thickness of fluid. This second roller is mounted between a pair of axially extending cylindrical shafts of reduced diameter.

Slidably disposed on each such shaft is a movable collar having a relatively short, axially extending, sheet-contacting surface. These sheet-contacting surfaces of the movable collars are disposed outwardly of the facing surface of the second roller a radial distance substantially equal to such first predetermined thickness of fluid. Each such movable collar is connected to a key slidably mounted in an axially extending recessed channel of the shaft around which it is mounted.

Springs acting against these keys continually urge the movable collars toward their respective first positions wherein their sheet-contacting surfaces are spaced apart a distance greater than the width of the sheet materials. A camming arrangement acting against the aforementioned keys may be selectively employed in cooperation with the spring forces on such movable collars, to displace such movable collars between their first-mentioned positions and second positions wherein they are disposed adjacent a respective one of the annular collars provided on the second roller. At such latter time, i.e., when these collars are in their second-mentioned position, their sheet-contacting surfaces are spaced a distance apart slightly less than the width of the sheet materials.

Prior to advancing the sheet materials between the rollers, the spring forces acting thereon cause the facing surface of the first roller to seat against the sheet-contacting surfaces of the movable collars thereby establishing an initial minimum spacing, or pregap, between the two juxtaposed facing surfaces substantially equal to such first predetermined thickness of fluid. When the movable annular collars are disposed in their second positions, they will engage the edge portions of superposed sheet materials being advanced therethrough against the facing surface of the first roller and control the thickness of the layer of processing fluid spread therebetween. When the movable annular collars are disposed in their first positions, the annular collars of the second roller will engage the edge portions of superposed sheet materials being advanced therethrough against the facing surface of the first roller and control the thickness of the layer of processing fluid spread therebetween.

In either instance, i.e., whether the thickness of the layer of processing fluid is being controlled by the movable collars or the annular collars of the second roller, no pressure is exerted against the longitudinal edge portions of the sheet materials tending to squeeze processing fluid therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with other objects and advantages thereof, will be best understood from the following description of the preferred embodiment when read in connection with the accompanying drawings wherein like numbers have been employed in the different figures to denote the same parts and wherein:

FIG. 1 is a perspective view diagrammatically depicting the unique fluid-spreading apparatus of the present invention as being incorporated in a camera of the self-developing type and its relationship to the photographic sheet materials at such time as the first photosensitive image-recording component thereof is disposed in position for exposure;

FIG. 2 is a view similar to FIG. 1 depicting the relationship between the fluid-spreading apparatus and the photographic sheet materials at such time as an image-receiving sheet is being superposed over the first exposed image-recoding sheet;

FIG. 3 is a view similar to FIGS. 1 and 2 depicting the relationship between the fluid-spreading apparatus and photographic sheet materials at such time as the first superposed pair of such materials has just been advanced through the spreading apparatus;

FIG. 4 is a diagrammatic, fragmentary, partially cutaway, plan view of the pod assembly forming part of the photographic materials illustrated in FIGS. 1–3;

FIG. 5 is a diagrammatic, fragmentary, profile view of the fluid-spreading apparatus illustrated in FIGS. 1–3;

FIG. 6 is an enlarged, diagrammatic, fragmentary, profile view of the fluid-spreading apparatus illustrated in FIG. 5 at such time as a pair of superposed sheet materials suitable for producing a black-and-white viewable image is being advanced therethrough; and

FIG. 7 is a view similar to FIG. 6 at such time as a pair of superposed sheet materials suitable for producing a full-color viewable image is being advanced through the fluid-spreading apparatus.

DESCRIPTION OF A PREFERRED EMBODIMENT

In its illustrated embodiment, the present invention is depicted as effecting the distribution of layers of processing fluid between pairs of superposed photographic sheet materials of the types which are the subject of copending application Ser. No. 51,250 entitled Simplified Diffusion-Transfer Film Products, filed on June 30, 1970 by the applicant and Frank W. Knight. Consequently, it is deemed appropriate to set forth at this time a brief description of the nature and form of such film products.

The production of a visible image by a diffusion-transfer process, whether of the black-and-white or full-color variety, has most frequently employed the use of two sheets of material. One of these sheets includes a photosensitive image-recording layer, and an image-receiving component may either be associated with that same sheet or with the second sheet. As previously indicated, in carrying out the photographic process after the photosensitive medium has been exposed to image-carrying light rays to record a latent image therein, a suitable processing fluid is spread as a thin layer between the two sheets of material by drawing the sheets in superposed relationship between a pair of compressive force-applying members while the fluid is being fed between the sheets. In the former situation, i.e., wherein both the image-recording and image-receiving components are contained in the same sheet, the second sheet primarily serves to facilitate the spreading of the fluid across that sheet, but is may also serve to subsequently strip the processed image-recording component therefrom.

For example, in producing a black-and-white print by a diffusion-transfer process, a first flexible image-recording sheet may comprise a support formed of baryta paper, or of a plastic such as cellulose acetate, with a photosensitive layer on one side thereof in the form of a silver halide gelatin emulsion. The processing liquid may comprise an aqueous alkaline solution of a silver halide developer, a silver halide complexing agent, and a thickening or film-forming agent such as sodium carboxymethyl cellulose, which last-stated constituent facilitates dispensing and distributing the processing fluid and the adhering of the two sheets to one another once the fluid has been spread therebetween. A flexible image-receiving sheet may comprise a support consisting of the same materials employed to form the support in the photosensitive sheet and a gelatin or polyvinyl alcohol silver-receptive medium wherein a positive image may be formed. When the image-recording sheet is exposed to actinic light and subsequently superposed with respect to the image-receiving sheet, with a layer of the processing fluid distributed therebetween, the developing reagent in the fluid acts to develop the exposed silver halide in the negative emulsion to dissolve the nonexposed silver halide to provide an image-forming component. The soluble silver complex comprising the image-forming component migrates to the silver-receptive stratum of the image-receiving sheet where it is reduced to silver to provide a fixed positive of the latent image initially recorded in the photosensitive emulsion.

For example, in producing a print in full-color by a diffusion-transfer process, a first flexible image-recording sheet may comprise a support formed of baryta paper, or of a plastic such as cellulose acetate, on which are carried, in sequence, a cyan dye developer layer, a red-sensitive silver halide emulsion layer, a spacer layer, a magenta dye developer layer, a green-sensitive silver halide emulsion layer, a spacer layer, a yellow dye developer layer and a blue-sensitive silver halide emulsion layer. A second flexible image-receiving sheet for use with this type of image-recording sheet may include a dye-receptive layer comprising a dyeable polymer carried on a baryta paper or a plastic, such as cellulose acetate, support.

A processing composition suitable for use with these sheet materials may comprise a liquid which, similar to the processing liquid employed in the black-and-white process, is preferably of a generally viscous nature. A suitable viscosity-imparting agent for use in such a processing fluid is sodium carboxymethyl cellulose. When spread between the image-recording and image-receiving sheets, the processing liquid permeates or migrates into the various photosensitive and dye developer layers of the image-recording sheet. During permeation into the dye developer layers, unreacted dye developer contained in these layers is dissolved in the processing liquid and transported, in solution, into respective photosensitive layers to distribute unreacted dye developer in those layers. Where the dye developer, transported to the photosensitive layers, reacts with the exposed silver halide, it is oxidized as a function of the amount of silver halide reduced to silver while the oxidation product of the developer forms an image that is substantially coextensive with the developed silver.

Preferably, the dye developer utilized is selected for its property of having an oxidation product as a result of silver development which is of considerably lower solubility in the liquid processing composition than the unreacted dye developer itself. Under these conditions, the oxidation product is substantially immobilized or retained in the respective photosensitive layers.

It is the formation of an insoluble oxidation product, i.e., an oxidation product which is at least sufficiently less soluble to preclude its diffusion to the image-receiving sheet during imbibition that provides the principal mechanism for controlling the transfer of dye image-forming components to the image-receiving sheet. Thus, portions of the dye developer which have become oxidized are exhausted or made unavailable for dye image formation on the positive or image-receiving element. This immobilization of dye developer may also be due in part to a tanning effect on the emulsion by oxidized developing agent and in part to a localized exhaustion of alkali as a result of development.

AT the time that the dye developer is developing silver and providing an insoluble oxidation product, an imagewise distribution of unoxidized and unreacted dye developer is formed in the negative material in places where unexposed silver halide grains are present or in places where exposure and subsequent development is less complete. Dye developer present in solution in this imagewise distribution is transportable, at least in part, by imbibition to the image-receiving sheet. The image-receiving layer of that sheet is dyed or otherwise colored by the transported and unreacted dye developer where the dye developer is deposited to provide the desired reverse image in color of the latent image initially recorded in the image-recording sheet.

The image-receiving sheet, when stripped from the image-recording sheet, will contain substantially only dye developer which provides the desired color positive image. In this regard, the image-receiving element, during the processing thereof, is maintained free of appreciable amounts of material which, during the processing of the film unit or which, in the presence of light and air, will impart to the image-receiving sheet a color that would adversely affect the visibility of the image of dye developer formed therein.

Film systems of these types, including appropriate processing compositions, as well as of other types applicable for use in connection with the present invention for producing fully developed black-and-white and full-color images, are well known in the art. For instance, typical such systems are disclosed and described in greater detail in U.S. Pat. No. 2,543,181 of E. H. Land, issued on Feb. 27, 1951 , and U.S. Pat. No. 2,983,606 of H. G. Rogers, issued on May 9, 1961 . It should be clearly understood, however, that the present invention is not directed to specific film structures, or to the chemistry by which images are formed in an exposed photosensitive material and/or formed in an image-receiving material associated therewith. To the contrary, the present invention is equally applicable for use with a variety of film structures and processing fluids other than those set forth by way of example herein.

It is important to recognize at this point that it has generally been necessary to employ a greater amount of fluid in processing full-color prints than is required to process a black-and-white print of equivalent size. More specifically, in the former case the thickness of the layer of processing fluid distributed between the superposed sheet materials is necessarily significantly thicker in full-color processes than in black-and-white processes. Typically the layer of processing fluid in full-color processes is on the order of 0.007 inches, and in black-and-white processes is on the order of 0.003 inches.

The present invention may best be understood by now referring to FIGS. 1 through 4 of the drawings. As illustrated therein, the present invention is employed in conjunction with film products which include a plurality of photosensitive image-recording sheets **10** and a plurality of image-receiving sheets **12**. These sheets **10** and **12** are of substantially the same size and shape so that each such image-receiving sheet may be selectively superposed over a respective image-recording sheet. Further, these sheets **10** and **12** may be considered as taking the form of one of the types previously indicated as being associated with the production of a black-and-white viewable image and, as such, are preferably flexible in nature.

Adjacent photosensitive image-recording sheets **10** are connected together by pod assemblies **14**, the details of which are best shown in FIG. 4. In this connection, each pod assembly **14** includes a carrier sheet **16** preferably having one of its lateral edge portions **18** lapped under and attached to the trailing lateral edge portion **22** of one adjacent image-recording sheet **10** and its other lateral edge portion **23** lapped over and attached to the leading lateral edge portion **24** of the other image-recording sheet adjacent thereto. Each carrier sheet **16** may, for instance, be formed of flexible baryta paper which is bonded to the adjacent image-recording sheets **10** by any suitable adhesive. Mounted on each carrier sheet **16** and extending laterally thereacross intermediate of, and in spaced-apart relationship to, the carrier sheet's lateral edge portions **18** and **23** is an elongated rupturable pod or container **26**. Container **26** initially retains a quantity of processing fluid **28**, of a type previously indicated, slightly in excess of that required to treat the surface of one image-recording sheet **10**.

Pods or containers of this general type are now well known and may, for instance, be formed of sheet materials, which are flexible and deformable, bonded together in the vicinity of their peripheral edge surfaces to form a cavity therebetween containing the processing fluid **28**. In this manner, whenever an externally mounted force-applying member is pressed against the container **26**, hydraulic pressure is transmitted to the processing fluid **28** retained therein. When such pressure reaches a predetermined level, the container is caused to rupture, and the fluid is released therefrom. It is desirable that the walls of the container **26** be substantially impervious to the processing fluid **28** and inert to attack by that fluid. Typically, they may consist of an outer layer of pouch or glassine paper, an intermediate layer of lead foil, and an interliner of polyvinylchloride material. Under proper pressure and temperature conditions, the polyvinylchloride liners may be bonded together to effect the sealing of the fluid-filled cavity.

In order that the fluid **28** within the container **26** be released therefrom in a predetermined manner upon rupture thereof, i.e., in the direction of one of the adjacent image-recording sheets **10**, it is important that the seal along the lateral edge **30** of the container be substantially weaker than the seals along the other marginal sections thereof. This result may be readily effected during fabrication of the container by appropriately adjusting the heat and/or pressure employed to effect the weakened seal along its lateral edge **30**. Any suitable adhesive may be employed to attach the pod or container **26** to its carrier sheet **16**.

Overlying each carrier sheet **16** and container **26** mounted thereon is another sheet of flexible material **32** which, for in-

stance, may also be formed of baryta paper. A relatively narrow lateral portion 34 of this sheet 32 is bonded by a suitable adhesive to the carrier sheet 16 adjacent the rupturable container 26 on the side thereof removed from its lateral edge 30. Also, the longitudinal edge portions 36 and 38 of this sheet 32 are bonded in a similar manner to the adjacent sections of the carrier sheet 16. It will be noted that the lateral edges 40 and 42 of the sheet adjacent sheet 32 respectively overlap the adjacent lateral edges 24 and 24 of the leading and trailing photosensitive image-recording sheets 10 connected to each pod assembly's carrier sheet 16. Thus, the flexible sheet 32 is effectively divided into a first section overlying and extending beyond the container 26 constituting a bib 44 and a second section constituting a trapping sheet 46. Means are therefore provided as part of each pod assembly 14 in the form of the bib 44 for controlling the flow of the fluid 28 as it is released from the container 26 onto the trailing image-recroding sheet 10 connected to that pod assembly. Also, means are provided on each pod assembly 14 in the form of the trapping sheet 46 for cooperating with the section of the carrier sheet 16 adjacent thereto to define a space wherein excess processing fluid 28, spread across the other image-recording sheet attached to that particular pod assembly, may be trapped or accumulated.

It will be appreciated that this arrangement of pod assemblies 14 and photosensitive image-recording sheets 10 provides an elongated strip of photographic materials 47 comprising alternatively spaced pod assemblies and image-recording sheets which is readily coilable. As will subsequently be explained in more detail, such an elongated strip of photographic materials 47 is adapted to be employed in conjunction with a plurality of discrete image-receiving sheets 12 within a camera of the self-developing type to provide a substantially waste-free photographic operation. Since certain details of a camera system in which the heretofore described photographic film products are devised to be employed do not form part of the present invention, they have not been illustrated in the drawings forming part of this specification. However, such a camera system may, if desired, take the general form of that shown and described in copending application Ser. No. 51,191 , entitled Unique Waste-Free Camera System of the Self-Developing Type, filed on June 30, 1970 by the applicant and Frank W. Knight.

In any event, it is desirable that such a camera system include a station 48 for initially receiving a coiled strip of photographic materials 47; an exposure station 50 wherein image-carrying light rays from a subject may be selectively, sequentially imaged by the camera's shutter and objective lens arrangement 52 onto the image-recording sheets 10; a station 54 for initially storing a supply of image-receiving sheets 12; means (not shown) for sequentially positioning individual such image-receiving sheets over respective exposed image-recording sheets 10 within the exposure station; a fluid-spreading station 56, comprising the present invention; an imbibition station 58; means 57 for selectively advancing the image-recording sheets 10 through the camera; and a station 60 for temporarily storing such expended sheets 10 and associated pod assemblies 14 as they are removed from the imbibition station 58.

Removably and rotatably mounted within the last-stated station 60 of the camera system is a reel 62 to which the elongated strip of photographic materials 47 may be initially connected and subsequently progressively coiled therearound. In this connection, the reel 62 is provided with a spur gear 64 adapted to mesh with the teeth of a pinion 66 journaled in the frame structure of the camera system whenever the reel is mounted therein. The pinion 66 may be designed for either manual or automatic operation. To facilitate the proper initial arrangement of the elongated strip of photographic materials 47 within the camera system, a leader 67 is attached to the first image-recording sheet 10 thereof and is adapted to extend from the camera's receiving station 48 through the intermediate camera stations 50, 56, and 58 into the station 60 where it may be attached to the reel 62. It will thus be appreciated that subsequent rotation of the pinion 66 in a counterclockwise direction as viewed in FIGS. 1–3 will advance the first image-recording sheet 10 into position within the station 50 for its exposure (See FIG. 1). At such time, the leading pod assembly 14 of the elongated strip of photographic materials 47 is disposed immediately in front of a pair of juxtaposed fluid-spreading rollers 72 and 74. This invention is specifically directed to the rollers 72 and 74 and arrangements associated therewith to control the operation thereof. The nature and mode of operation of these elements will be discussed in more detail hereinafter. For reasons which will become obvious, the leading pod assembly 14 need not include a trapping sheet 46. Similarly, the reasons which will subsequently become obvious, the last pod assembly 14 of the elongated strip of photographic materials 47 need not include a bib.

After this leading photosensitive image-recording sheet 10 has been exposed, means (not shown) within the camera system advances a first image-receiving sheet 12 into superposed relationship therewith (See FIG. 2). During such operation, the exposed image-recording sheet 10 is generally maintained within the camera system's exposure station 50. It will be noted that the trailing lateral edge 76 of this superposed image-receiving sheet 12 is positioned under the trapping sheet 46 of the second pod assembly 14. Therefore, as the first exposed image-recording sheet 10 continues its advance through the camera's fluid-spreading station 56 and into its imbibition station 58, this arrangement of the image-receiving sheet 12 and the trapping sheet 46 facilitates concurrent movement of the image-receiving sheet 12 through the camera system in superposed relationship therewith. Also it will be noted at this time that, when the image-receiving sheet 12 is superposed over the image-recording sheet 10 within the camera's exposure station 50, its leading lateral edge 77 is disposed over the lateral edge 42 of the first pod assembly's bib 44. The purposes for this particular arrangement will be explained hereinafter.

By now further turning the pinion 66 in a counterclockwise direction, the superposed exposed image-recording sheet 10 and image-receiving sheet 12 are advanced from the exposure station 50 through the fluid-spreading station 56 into the camera's imbibition station 58 (See FIG. 3). At the same time, this operation causes the second photosensitive image-recording sheet 10 of the elongated strip of photographic materials 47 to be advanced into exposure position within the camera's station 50.

The nature of, and mounting arrangement for, the fluid-spreading rollers 72 and 74 are best shown in FIG. 5 of the drawings. As depicted therein, the roller 72 is journaled in a support structure 80 and comprises a facing surface 78 extending transversely thereacross. The roller 74 includes a facing surface 82 disposed in juxtaposition with respect to the facing surface 78 of the roller 72 which facing surface 82 is substantially shorter in length than the facing surface 78 and disposed centrally thereof. Also, the roller 74 includes a pair of collars 84, each of which is located adjacent a respective end of that roller's facing surface 82 and provided with a sheet-contacting surface 85. Extending axially from each end of the roller 74 is a shaft 86 which serves to rotatably mount that roller to the support structure 88. This roller 74 is fixedly positioned within the camera against translatory motion for rotation about its axis. However, the fluid-spreading roller 72 is not only mounted for rotation about an axis parallel to the axis of rotation of the roller 74, but is also mounted to facilitate a limited amount of translatory displacement towards and away from the roller 74. In this respect, the support structure 88 for the roller 74 is fixedly positioned within the camera, while the support structure 80 for the roller 72 is displaceably mounted within the camera in operably relationship with a pair of springs 90. These springs 90 serve to continually yieldably urge the roller 72 towards the roller 74.

Mounted on each shaft 86 is movable annular collar 91 having a sheet-contacting surface 92 disposed above the facing

surface 82 of the roller 74 a radial distance greater than that at which the sheet-contacting surfaces 85 of the collars 84 are disposed above such facing surface.

To facilitate selective displacement of the movable annular collars 91 between their positions shown in FIG. 5 and their positions shown in phantom in that same figure of the drawings, each shaft 86 is provided with a recessed channel 94. Slidably mounted in each channel 94 is a key 96, one end 98 of which extends exteriorly of the support structure 88 to seat against a cam track 100 formed along the inside face of a respective arm 102 of a yoke 104. Further in this connection, a coiled spring mounted between a pair of washers 108 and 110 on each key 96 continually urges the end 98 of the key against its respective cam track 100. Inwardly extending annular projections 112 of each movable collar 91 seat in recesses 114 of their respective keys 96 to connect those members one to the other. Thus, as the yoke 104 is selectively moved between its position illustrated in FIG. 5 and its position illustrated in phantom in that same figure, the annular collars 91 will be displaced along their respective shafts 86 between their illustrated positions and their positions shown in phantom.

Each shaft 86 includes a frustoconical section 116 which serves to connect its primary, or generally cylindrical section 118, to the roller 74. The purpose for providing these frustoconical sections 116 adjacent the collars 84 of the roller 74 will be explained hereinafter. However, it should be noted that the slope of these conical sections 116 may be, for example, on the order of 45°.

It will be seen that each annular collar 91 includes a frustoconical recess 120 having a slope preferably identical to that of the frustoconical section 116 of the shafts 86. In this manner, when the annular collars 91 are disposed in their positions shown in phantom, their recesses 120 engage the conical section 116 and serve to properly align these members with respect to the rollers 72 and 74. At such times the annular collars 91 are spaced a small distance, for example, on the order of 0.010 inches, from the adjacent collars 84.

As previously indicated, in FIGS. 1, 2, and 3 of the drawings, the fluid-spreading rollers 72 and 74 are shown in connection with the processing of photographic materials suitable for producing a viewable image of the black-and-white type. In this connection, it will be noted that the annular collars 91 are disposed in their positions furthermost removed from the ends of the roller 74. This situation, i.e., the spreading of the processing fluid 28 as a layer between a pair of superposed sheets 10 and 12 to facilitate the production of a black-and-white viewable image, is also depicted in FIG. 6 of the drawings. A is also apparent in that figure, when the rollers 72 and 74 are affecting the spreading of the fluid 28 between sheets 10 and 12, the annular collars 91 are spaced a grater distance apart than the width of the superposed sheets. As such, the sheet-contacting surfaces 85 of the collars 84 serve to press adjacent sections of the longitudinal edge portions of the superposed sheets 10 and 12 against the facing surface 78 of the roller 72. Consequently, the radial heights of these collars 84 serve to establish the thickness of the layer of fluid 28 spread between the superposed sheets 10 and 12. Additionally, at such times, sections of the longitudinal edge portions of the superposed sheets 10 and 12 extend beyond the sheet contacting surfaces 85 of the collars 84. Thus, no compressive force is exerted against such superposed materials 10 and 12 in the immediate vicinity of their longitudinal edges tending to squeeze fluid 28 therefrom.

The pregap spacing initially established between the facing surfaces 78 and 82 of the rollers 72 and 74 by the annular collars 91 facilitates the disposition of the leader 67, associated with the elongated strip of photographic materials 47, between the camera's receiving station 48 and its station 60 when the elongated strip is initially loaded into the camera.

As a pair of superposed exposed image-recording and image-receiving sheets 10 and 12 is advanced from the camera's exposure station 50 towards the fluid-spreading rollers 72 and 74, the pod assembly 14 in advance thereof first passes between these rollers. The compressive force thus exerted on the fluid-filled container 26 causes that member to rupture along its lateral edge 30 and the fluid 28 initially retained therein to be expelled therefrom in the direction of the superposed sheets 10 and 12. Flow of the fluid 28 as it is expelled from the container 26 is controlled by the bib 44 associated with that container in a manner to facilitate the introduction of the released fluid between the superposed sheets 10 and 12. As the sheets 10 and 12 continue their advance through the camera's station 56, the fluid-spreading rollers 72 and 74 act thereagainst under the influence of the springs 90 to effect the distribution of the released processing fluid 28 therebetween in a thin layer of generally uniform thickness. As best shown in FIG. 6, the thickness of this layer of processing fluid is substantially equal to the radial height of the collars 84 provided on the roller 74.

It should be noted at this time that a "resist" 128 is imprinted or otherwise formed around the peripheral border of the face of each image-receiving sheet 12 adapted to be contacted by the processing fluid 28 (See FIG. 1). This resist 128 may comprise an acrylic plastic material, such as Krylon, manufactured by Krylon, Inc. of Norristown, Pa., or any other material which will function to preclude the adherence of any of the processing fluid 28 thereto and to preclude any adverse discoloring of the sheet 12 by that fluid.

As previously indicated, each container 26 is initially supplied with a quantity of fluid 28 slightly in excess of that required to process photographic sheets 10 and 12. Therefore, just before the superposed sheets 10 and 12 leave the bite of the rollers 72 and 74, this excess amount of processing fluid 28 is expelled from between the trailing lateral edges thereof into the space provided under the trapping sheet 46 associated with the next pod assembly 14. Inasmuch as the trailing lateral edge portion of the superposed sheet 10 is disposed over the carrier sheet's edge portion 22, the leading edge of the carrier sheet 16 does not obstruct flow of the excess fluid 28 under the trapping sheet 46. Additionally in this arrangement, the thickness of the sheet 10 functions to provide fluid storage space under the trapping sheet 46.

In this condition the superposed exposed image-recording and image-receiving sheets 10 and 12 are retained within the camera's station 58 for a predetermined amount of time sufficient to impregnate the materials with the processing fluid 28 previously distributed therebetween and to facilitate the formation of a visible image in the image-receiving sheet 12 from the latent image initially recorded in the sheet 10 during exposure thereof. After the lapse of such predetermined amount of time, access means (not shown) provided in the camera structure adjacent the imbibition station 58 enables the operator to strip the image-receiving sheet 12, now constituting a finished photographic print, from its associated image-recording sheet 10. The portion of the sheet 12 comprising the resist 128 defines a border or frame for the finished print.

After the next photosensitive image-recording sheet 10 of the sheet of photographic materials 47 has been exposed within the camera station 50 and overlaid with the next image-receiving sheet 12, the pinion 66 can once again be turned in a counterclockwise direction to simultaneously effect the processing of the second photographic print, the coiling of the expended photographic materials associated with the production of the first photographic print onto the reel 62, and the positioning of the third image-recording sheet within the exposure station 50. Once all the photographic materials comprising the elongated strip 47 have been expended in the process of producing a plurality of photographic prints and coiled onto the reel 62, that reel may be removed from the camera system and discarded as convenience may dictate.

FIG. 7 is similar to FIG. 6 except that it illustrates the situation wherein the fluid-spreading rollers 72 and 74 are employed to distribute a layer of processing fluid 126 between an exposed image-recording sheet 122 and an image-receiving sheet 124 superposed thereover to facilitate the production of a full-color viewable image in the latter sheet. The yoke 104

has been displaced upwardly from its position shown in FIG. 5 to locate the movable collars 91 in their positions shown in phantom in that figure, i.e., adjacent their respective collars 84. It will be recognized that, at such time, the thickness of the layer of processing fluid 126 is controlled by the radial height of the sheet contacting surfaces 92 above the facing surface 82 and, consequently, is substantially equal to the pregap or initial spacing between the facing surfaces 78 and 82 of those rollers (See FIG. 5). Further at such time, the longitudinal edge portions of the superposed sheets 122 and 124 are respectively disposed beyond the ends of the sheets contacting surfaces 92 of the annular collars 91. This situation is therefore similar to that depicted in FIG. 6 in connection with the production of a black-and-white viewable image, i.e., processing fluid 126 is not squeezed from between the edges of the sheets 122 and 124 as they are advanced through the rollers 72 and 74.

Reiterating, whether the rollers 72 and 74 are being employed in connection with a black-and-white or with a full-color process, means are provided for precluding processing fluid from being expressed from between the longitudinal edges of the superposed sheets as they pass therebetween. The radial heights of the sheet-contacting surfaces 92 of the annular collars 91 outwardly of the facing surface 82 of the roller 74 serve (1) to establish the minimum spacing or pregap between the facing surface 82 of the roller 74 and the facing surface 78 of the roller 72, and (2) determine the thickness of the layer of processing fluid 126 spread between superposed sheets 122 and 124 in connection with the production of a viewable image in full-color. The radial heights of the collars 84 outwardly of the facing surface 82 of the roller 74 serve to establish the thickness of the layer of processing fluid 28 spread between the superposed sheets 10 and 12 as they are advanced between the rollers 72 and 74 to produce a viewable image of the black-and-white variety. In order to convert from black-and-white operations to full-color operations, it is only necessary to effect a displacement of the yoke 104 from one of its positions into its other position. When the yoke 104 is disposed in its upwardmost position as shown in phantom in FIG. 5, the fluid-spreading system is adapted to facilitate full-color operations. When it is disposed in its lowermost position shown in that figure of the drawings, the fluid-spreading apparatus is adapted to facilitate black-and-white film-processing operations.

Certain dimensions have been indicated on FIGS. 5, 6, and 7 in order to impart a full understanding of the present invention. Photographic sheet materials suitable for use in spreading apparatus of the dimensions reflected on the drawings may typically be of a width on the order of 6.700 inches. However, it is to be expressly understood that these dimensions are exemplary only and are not to be interpreted as restricting the scope of applicant's invention in any manner.

Those familiar with the photographic arts will readily appreciate the novel and highly unique advantages of this invention. Most importantly, a novel processing fluid-spreading apparatus is provided which may alternately be employed with film products of a simplified type to produce viewable images of the black-and-white and full-color variety. In its illustrated embodiment, this invention has been shown as comprising a pair of rollers having parallel facing surfaces, It may be desirable in certain instances that these facing surfaces be configured with convex curvatures having large radii to effect a certain desired control over the fluid as it is released between the sheets. Also, while the illustrated fluid-spreading members comprise rollers, they may take other forms, for instance, a pair of rigid nonrolling elements. This invention may be practiced or embodied in still other ways without departing from the spirit or essential character thereof. The preferred embodiment described herein is therefore illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all variations which come within the meaning of the claims are intended to be embraced therein.

What is claimed is:

1. In apparatus for alternately distributing processing fluid in a layer having a first predetermined thickness and in a layer having a second predetermined thickness less that said first predetermined thickness between a pair of sheet materials, at least one of such sheet materials comprising a photographic component, the improvement comprising:

a first elongated fluid-spreading member having a facing surface;

a second elongated fluid-spreading member extending in a generally parallel relationship to said first fluid-spreading member and having a facing surface intermediate the ends thereof disposed in juxtaposition to an intermediate section of said facing surface of said first fluid-spreading member;

means for yieldably urging such fluid-spreading members together;

means for establishing a minimum spacing between said juxtaposed facing surfaces and for controlling the spread of such processing fluid in a layer of such first predetermined thickness between a pair of sheet materials as they are advanced between said spreading members; and

means on said second fluid-spreading member for controlling the spread of such processing fluid in a layer of such second predetermined thickness between a pair of sheet materials as they are advanced between said spreading members.

2. In apparatus for alternately distributing processing fluid in a layer having a first predetermined thickness and in a layer having a second predetermined thickness less than said first predetermined thickness between sheet materials of a predetermined width, at least one of such sheet materials comprising a photographic component, the improvement comprising:

a first elongated fluid-spreading member having a facing surface;

a second elongated fluid-spreading member extending in generally parallel relationship to said first fluid-spreading member and having a facing surface intermediate the ends thereof disposed in juxtaposition to an intermediate section of said facing surface of said first fluid-spreading member;

first means for yieldably urging said fluid-spreading members together;

second means for establishing a minimum spacing between said juxtaposed facing surfaces and for controlling the spread of such processing fluid in a layer of such first predetermined thickness between such sheet materials as they are advanced lengthwise between said spreading members, said second means including a pair of elements disposed adjacent respective ends of said second fluid-spreading member for displacement between first positions wherein they are spaced a distance apart greater than the width of such sheet materials and therefore ineffective to control the thickness of the fluid layer spread between such sheet materials as they are advanced lengthwise between said spreading members and second positions wherein they are spaced a distance apart less than the width of such sheet materials and therefore adapted to control the thickness of the fluid layer spread between such sheet materials as they are advanced lengthwise between such spreading members;

third means for controlling the spread of such processing fluid in a layer of such second predetermined thickness between such sheet materials as such sheet materials are advanced between said spreading members and said elements are disposed in their said first positions; and

fourth means for selectively displacing said members between their said first and second positions.

3. The improvement of claim 2 wherein said third means are formed on one of said spreading members.

4. The improvement of claim 2 wherein said third means comprises a pair of projecting members disposed adjacent respective ends of said second facing surface and spaced a distance apart less than the width of such sheet materials.

5. The improvement of claim 3 wherein said third means extend from said facing surface of one said spreading member towards said facing surface of the other said spreading member a distance substantially equivalent to such second predetermined thickness.

6. The improvement of claim 5 wherein at least said one spreading member comprises a roller and said third means comprises a pair of collars on said roller adjacent opposite ends of said facing surface of said roller.

7. The improvement of claim 2 wherein said minimum spacing between said juxtaposed facing surfaces is substantially equivalent to such first predetermined thickness.

8. The improvement of claim 2 wherein said apparatus additionally comprises means for precluding processing fluid from being expressed from between the longitudinal edges of such sheet materials as they are advanced between said fluid spreading members.

9. The improvement of claim 8 wherein said means for precluding the expressing of such fluid comprises configurations of respective ends of said fluid-spreading members providing a spacing between juxtaposed sections of said fluid-spreading spreading members extending beyond said juxtaposed facing surfaces thereof greater than the spacing between said juxtaposed facing surfaces, whereby said fluid-spreading members do not exert a pressure on the longitudinal edge portions of such sheet materials tending to force such fluid therefrom.

10. The improvement of claim 9 wherein said means for precluding the expressing of such fluid at such times as said elements are disposed in their said second positions comprises sheet contacting surfaces on said second members configured to engage respective longitudinal edge portions of such sheet materials at positions spaced from respective longitudinal edges of such sheet materials.

11. The improvement of claim 2 wherein at least one of said fluid-spreading members comprises a roller.

12. The improvement of claim 1 wherein said fluid-spreading members comprise a pair of rollers.

13. The improvement of claim 2 wherein each said element comprises a circular sheet contacting surface.

14. The improvement of claim 2 wherein said third means comprises a pair of circular sheet-contacting surfaces.

15. The improvement of claim 2 wherein each said element comprises a annular collar having a circular sheet-contacting surface.

16. The improvement of claim 2 wherein said fourth means comprises at least one camming device.

17. The improvement of claim 2 wherein said second spreading member comprises a pair of shafts respectively extending beyond the ends of said facing surface thereof and spaced a greater distance from said facing surface of said first spreading member than is said facing surface of said second spreading member and each said element is slideably mounted on one of said shafts.

19. 8. The improvement of claim 17 wherein each said shaft has a recessed channel extending therealong, said second means additionally includes a key slidably mounted in each said channel and connected to a respective said element, and said fourth means comprises means for continually urging said keys in a direction wherein said elements are disposed in their first or second respective positions and means to selectively displace said keys in opposite directions along said channels to locate said elements in their respective positions.

19. The improvement of claim 18 wherein said means to displace said keys comprises at least one cam track disposed in operable relationship to the ends of one said key furthermost disposed from said facing surface of said second spreading member.

20. The improvement of claim 17 wherein said second spreading member comprises a roller, said shafts each comprises a cylindrical portion connected to said roller by a frustoconical section having a cross section which increases in area as it extends away from said cylindrical portion, and the end of each said element adjacent said roller includes a complementary frustoconical recess whereby said frustoconical sections of said shafts and said recesses of their respective said elements serve to accurately align said elements on said extensions when said elements are disposed in their said second positions.

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