Nov. 2, 1971 V. K. ELORANTA 3,616,740

SYSTEM AND METHOD FOR PROCESSING A STRIP OF EXPOSED PHOTOGRAPHIC MATERIAL

Filed Jan. 13, 1969 3 Sheets-Sheet 1

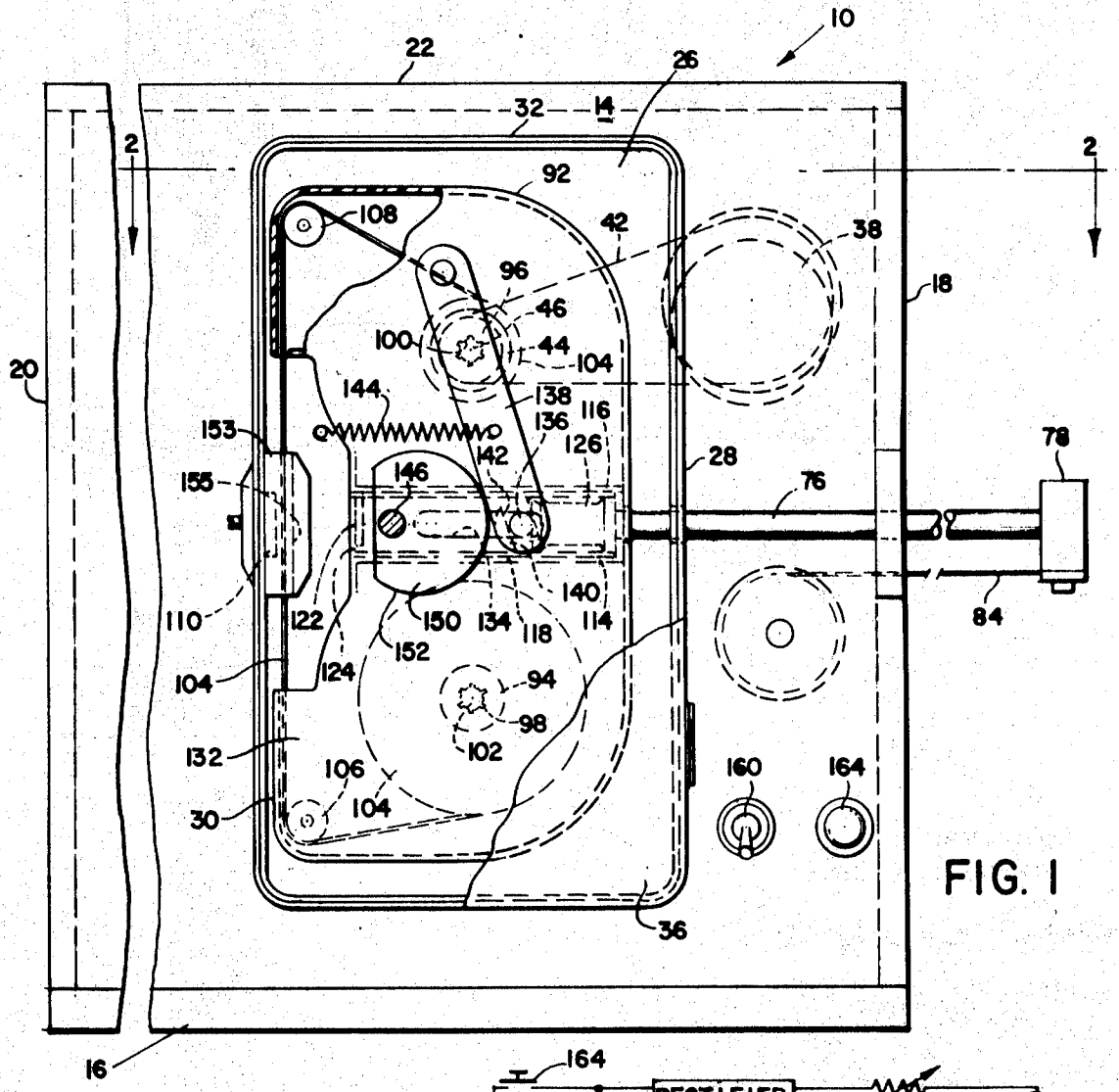



FIG. 1

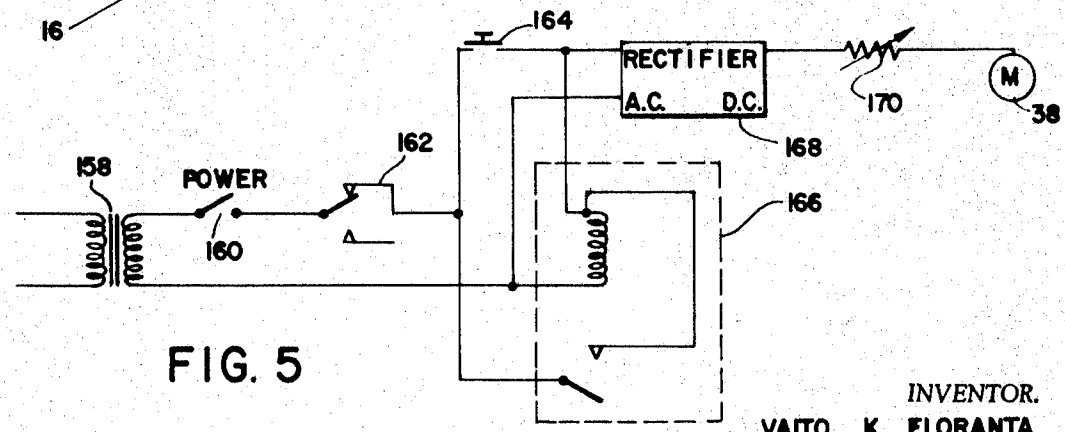



FIG. 5

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SYSTEM AND METHOD FOR PROCESSING A STRIP OF EXPOSED PHOTOGRAPHIC MATERIAL

Filed Jan. 13, 1969 3 Sheets-Sheet 2

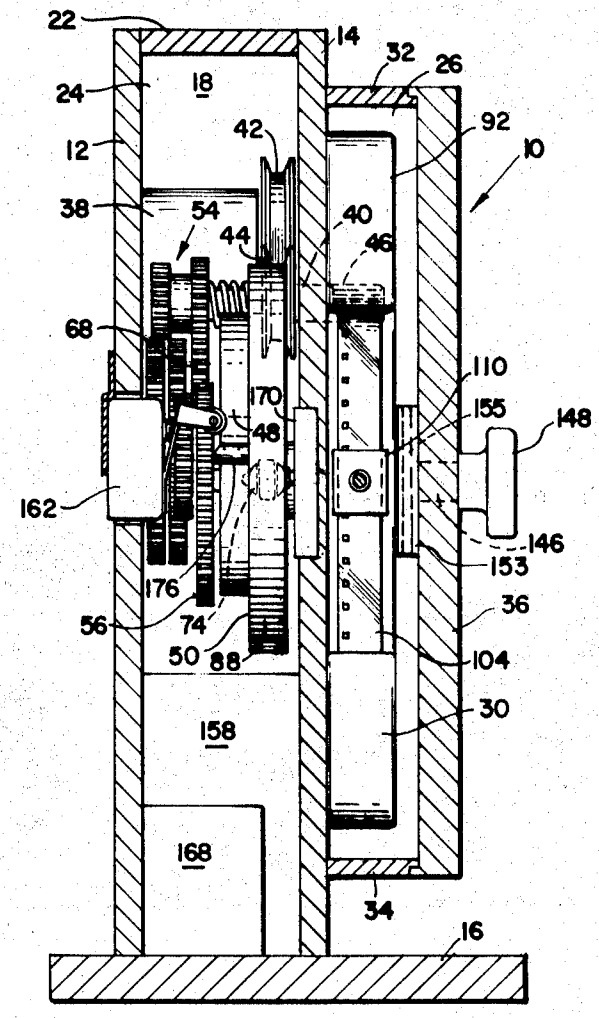



FIG. 3

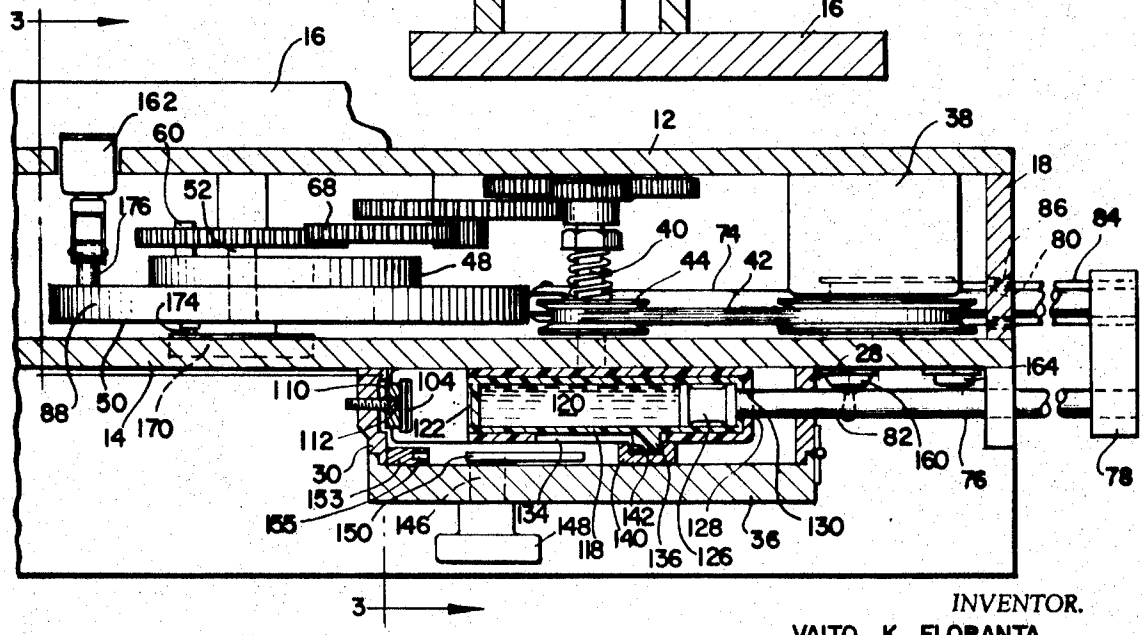



FIG. 2

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SYSTEM AND METHOD FOR PROCESSING A STRIP OF EXPOSED PHOTOGRAPHIC MATERIAL

Filed Jan. 13, 1969 3 Sheets-Sheet 3

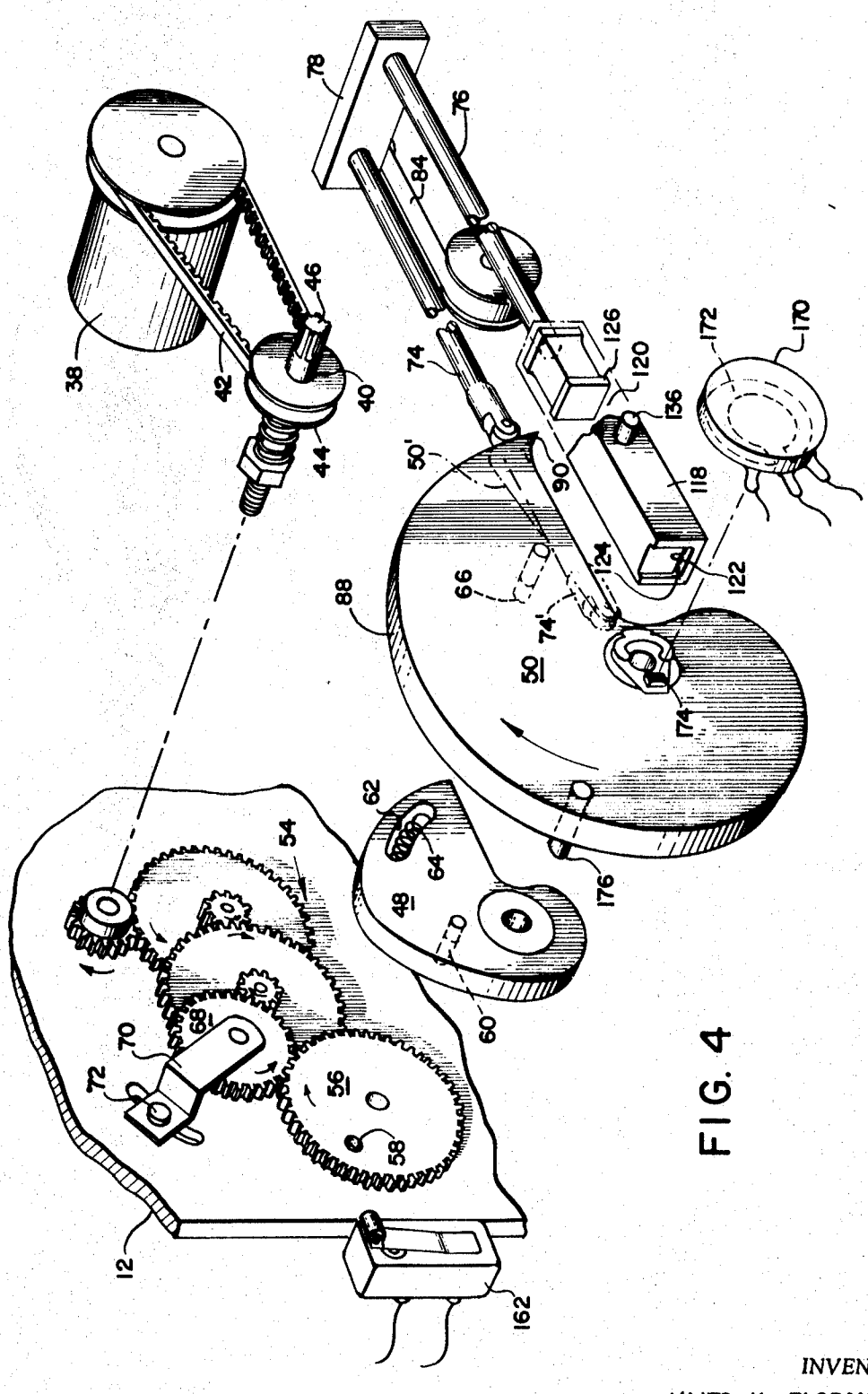



FIG. 4

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3,616,740

# SYSTEM AND METHOD FOR PROCESSING A STRIP OF EXPOSED PHOTOGRAPHIC MATERIAL

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Filed Jan. 13, 1969, Ser. No. 790,553
Int. Cl. G03d 5/00
U.S. Cl. 95—89 R 13 Claims

## ABSTRACT OF THE DISCLOSURE

A motion picture film processing system and method employing an applicator in which processing fluid is initially stored and having a doctor blade formed at one end thereof. The applicator also includes a plunger slidably mounted on the opposite side of the processing fluid from the doctor blade so that displacement of the plunger inwardly of the applicator causes the processing fluid to be expressed from the applicator across its doctor blade. An exposed strip of film is initially coiled around a supply reel with a leader extending to a takeup reel and, in passing from the supply reel to the takeup reel, the film is drawn across the doctor blade. A cam, which controls the displacement of the plunger within the applicator, is connected to the takeup reel to make substantially one complete revolution during the time that the takeup reel has made the number of revolutions required to draw the entire exposed film strip across the doctor blade. Additionally, a variable resistor in series with the processors motor varies the speed of the motor to impart a substantially constant speed of the film strip as it passes across the doctor blade.

## BACKGROUND OF THE INVENTION

### Field of invention

This invention relates to photography and, more particularly, to an improved system and method for applying a uniform coating of processing fluid to an exposed strip of photosensitive material.

### Description of the prior art

Traditionally, after motion picture film has been exposed in a camera, the operator mails the reel of exposed film to a processing laboratory. At the laboratory the film is removed from the reel and subjected to a series of operations in order to develop visible images from the latent images recorded thereon. The fully developed film is then rewound onto a reel at the laboratory and returned to the user.

The extended delay normally incurred between the time the exposed film is mailed to the laboratory and returned ready for viewing has proved to be a significant inconvenience to the user and a source of great annoyance.

The field of still photography is no longer hampered by extensive periods of delay associated with the processing of exposed film. The impact on the public of the one step photographic process employing diffusion transfer techniques is a matter of record and generally well known. The home still photographer can now enjoy the fruits of his efforts in a matter of seconds. This important convenience has been available to the amateur still photographer for many years.

Most recently, important technological advances have made it possible for the home photographer interested in motion pictures to enjoy the same convenience. Radically different motion picture systems have been developed which permit the photographer himself to quickly and easily process a strip of motion picture film shortly after the pictures have been taken. Exemplary of such new and unique systems are those described in copending applications Ser. No. 755,901 of Edwin H. Land filed Aug. 28,



1968; Ser. No. 761,771 of Rogers B. Downey filed Sept. 23, 1968; Ser. No. 776,481 of Rogers B. Downey filed Nov. 18, 1968; Ser. No. 722,789 of Vaito K. Eloranta and Benjamin C. Ruggles filed Nov. 1, 1968; and Ser. No. 788,897 of Rogers B. Downey filed Jan. 3, 1969; all of which applications are assigned to the assignee of the present invention.

In commercial and industrial operations such rapid motion picture processing systems are not only an improvement as a matter of convenience, but have other important effects as well. For instance, motion picture newsreel programs can be presented on television to the viewing public shortly after events of interest have occurred and been photographed.

In some of these new systems, the processing fluid is initially stored in an applicator, in others the fluid is initially stored in a rupturable container or pod from which it is fed into an applicator, while in still others the processing fluid is initially stored in a frangible container from which it is later released into a reservoir of the cassette to facilitate the processing operation. Considerable funds and effort are currently being expended to further improve and refine various features of these systems in order to reduce their cost, to further simplify the task of the operator, to improve their reliability, and to improve the quality of the final product. The present invention is directed to an improved system and method, employing an applicator of the type in which processing fluid is initially stored, for expressing processing fluid onto a strip of exposed motion picture film and which are capable of being utilized by the photographer himself.

One of the objects of this invention therefore is to provide an improved system and method for applying a processing fluid to a sheet of exposed photographic material.

Another primary object of this invention is to provide a system which applies a uniform coating of processing fluid along the entire length of a strip of exposed photographic material.

A further object of this invention is to provide an improved system for expressing amounts of processing fluid from an applicator onto a strip of exposed photographic material as a function of the rate of relative motion between the strip of material and the applicator.

Still another object of this invention is to provide an improved system for controlling the amount of processing fluid expressed from an applicator onto a strip of exposed photographic material.

Also an object of this invention is to provide an improved processing fluid applicator system in which the amount of fluid expressed from the applicator onto a strip of exposed photographic material and the rate of relative motion between the strip of material and applicator are simultaneously controlled.

## 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 additional objects and advantages thereof will best be 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 cut away front elevation view of a motion picture film processor embodying the present invention;

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

FIG. 3 is a sectional side elevation view taken along line 3—3 of FIG. 2;

FIG. 4 is an exploded perspective view illustrating various details of the processor shown in FIG. 1; and

FIG. 5 is a schematic representation of the electrical control system employed in the processor illustrated in the other figures of the drawing.

## SUMMARY OF THE INVENTION

The preferred embodiment of this invention briefly comprises a supply reel around which a strip of exposed motion picture film is initially coiled, the strip of film being provided with a leader connected to a takeup reel. Means are provided to displace an applicator, having a doctor blade, from an initial position spaced from the film strip into contact with the film strip whereby a section of the film strip disposed between the supply reel and the takeup reel is slidably engaged between and a support plate and the end of the applicator adjacent its doctor blade. Processing fluid is initially retained within the applicator which includes a plunger slidably disposed on the opposite side of the processing fluid from the doctor blade.

A motor connected to the takeup reel also drives a rotatably mounted cam provided with a convolute peripheral surface through a reduction gear train. This gearing arrangement is designed to rotate the cam substantially one revolution during the time in which the motor drives the takeup reel the number of revolutions required to draw the entire length of exposed film strip across the doctor blade.

A slidably mounted rod, adapted to seat against the applicator's plunger, is connected in parallel relationship to a cam follower. This assembly is spring biased to simultaneously urge the rod against the applicator's plunger and the cam follower against the convolute peripheral surface of the cam. The cam and the applicator are configured such that the cam follower contacts the section of the cam's convolute peripheral surface disposed the greatest distance from the axis of rotation of the cam at the same time that the rod makes initial contact with the plunger of the applicator. In this manner, displacement of the plunger within the applicator responsive to the force of the biasing spring transmitted thereon through the rod is controlled by the angular displacement of the cam. As a result of this arrangement, the linear displacement of the plunger within the applicator during any given period of time is a function of the amount of film strip drawn across the applicator's doctor blade in that same period of time. Consequently, an accurately controlled amount of processing fluid is continually expressed onto the film strip regardless of the rate of relative motion between the film strip and the doctor blade to produce a fluid coating of uniform thickness along the entire length of the exposed film strip.

Additionally, a rotary potentiometer responsive to the angular displacement of the cam is connected in series with the processor's motor. Thus means are provided to vary the speed of the motor in order to impart a substantially constant speed to that section of the film strip passing across the applicator's doctor blade regardless of the amount of film strip coiled around the takeup reel at any particular instant.

Other unique and advantageous features are embodied in this system including means for yieldably restraining the applicator against the film strip, means for automatically shutting down the system when the entire length of exposed film has been treated with processing fluid and means for recycling the system.

The supply and takeup reels, the film strip and the applicator may be conveniently incorporated into a compact multipurpose film handling cassette.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of this invention is illustrated as applying a compatible processing fluid to a film structure which comprises both a photosensitive negative emulsion and an image-receiving layer to which a positive image may be transferred by diffusion during development without necessitating the subsequent removal of the emulsion containing its developed negative image. This highly desirable type of film structure is made possible by a developed negative image having low covering power.



In typical silver transfer reversal processes for the projection of black-and-white images, a silver halide developer and a silver halide solvent are applied in an aqueous alkaline solution to a photoexposed silver halide stratum or emulsion where they develop exposed silver halide to silver and react with unreduced silver halide to form a soluble silver complex. This complex, in order to form a positive print, is transferred and reduced to silver on a silver-receptive stratum upon which the silver halide stratum has been superposed. It has generally been the practice, in the completion of this process, to separate the silver-receptive and silver halide strata in order to render the positive print visible.

However, as indicated above, the positive print may be rendered visible without separation of the silver halide and silver receptive strata. For example, the silver receptive stratum may be so constituted as to provide an unusually vigorous silver precipitating environment which causes the silver deposited upon it, in comparison with silver developed in the silver halide stratum, to possess very high covering power, i.e., opacity for a given mass of reduced silver. If the silver halide is in such a concentration as to give rise only when fully developed to a predetermined low maximum density, and if the silver complex is reduced to silver in a vigorous silver precipitating environment, the resulting negative and positive prints in super-position provide a composite print that presents a good image for projection purposes as long as they are contained on a transparent support. Since the silver halide stratum and the silver receptive stratum need not be separated, an overall simplification of the silver transfer-reversal process is achieved.

A composite film assembly of this type as well as processing compositions for producing a fully developed black-and-white image without the necessity of removing the developed negative image after processing are shown in prior U.S. Pat. No. 2,891,885 to Edwin H. Land which issued on Nov. 25, 1958. Other composite film assemblies capable of producing developed full-color images without the necessity of removing the developed emulsion are shown in prior U.S. patents of Edwin H. Land Nos. 726,154 issued Dec. 6, 1955 and 2,944,894 issued July 12, 1960. All of these prior patents are assigned to the assignee of the present invention.

However, it should be noted that the present invention is not directed to the chemistry by which images are developed in the photosensitive emulsion and transferred to an image receiving stratum. While an illustrated preferred embodiment of the invention is shown applying a compatible processing fluid to a film structure not requiring the removal of the negative emulsion after development, the invention itself is also applicable for use with other types of processing fluids and film structures.

The illustrated preferred embodiment of this invention can best be understood by first referring to FIGS. 1, 2 and 3 of the drawings. As shown therein, a film processor **10** includes a pair of opposed walls **12** and **14** mounted on a support base **16**. Side wall members **18**, **20** and **22** connected between the opposed walls **12** and **14** cooperate therewith and with the support base **16** to define an enclosed section **24** of the processor **10**. The film processor **10** addditionally includes a second enclosed section **26** defined by the wall **14**, projections **28**, **30**, **32** and **34** which extend from the face of the wall **14** exterior of the enclosed section **24**, and a hinged door **36**.

Mounted from the inside face of the wall **12** within the processor's enclosed section **24** is a motor **38** adapted to drive a drive shaft **40** journaled in the wall **14** through

a timing belt **42** and a pulley **44**. The drive shaft **40** actually extends through the wall **14** into the processor's enclosed section **26** and terminates in a spline **46**.

A cam carrier **48** and a cam **50** are mounted within the projector's enclosed section **24** for free rotational movement about a shaft **52**. As may best be seen in FIG. 4 of the drawings, the cam carrier **48** is connected to the motor **38** through a reduction gear train **54**. In this respect, the last spur gear **56** in this gear train **54** is also mounted for free rotational movement on the shaft **52** and is provided with a circular recess **58**. Additionally, the cam carrier **48** is provided with a pin **60** which extends from one of its parallel faces to seat within the circular recess **58** of the spur gear **56**.

Mounted within an arcuate slot **62** of the cam carrier **48** is a spring **64**. A pin **66** extending from the face of the cam **50** adjacent the cam carrier **48** is adapted to enter the cam carrier's arcuate slot **62** and engage the spring **64**. This spring **64** resiliently urges the pin **66** and the cam **50** from which that pin extends in a clockwise direction with respect to the arcuate slot **62** as viewed in FIG. 4. It will thus be appreciated that as the motor **38** drives the cam carrier **48** and the cam **50** in a clockwise direction as viewed in FIG. 4 of the drawings around the shaft **52**, the rotational movement of the cam may be stopped while the cam carrier is free to rotate several degrees further. Additionally, should the element restraining the rotational movement of the cam **50** be subsequently withdrawn, the force of the now compressed spring **64** acting through the pin **66** will cause the cam to rotate on the shaft **52** until it has once more reached its original position with respect to the cam carrier **48** on the shaft **52**. The purposes for this unique cam drive system will subsequently become apparent.

It will be noted that the gear **68** of the reduction gear train **54** that engages the spur gear **56** is mounted on a bracket **70** connected to the inner face of the wall **12** by a pin **72**. This arrangement permits the reduction ratio of the gear train **54** to be quickly altered by simply replacing the gear **68** with another appropriately selected gear.

As is most clearly apparent in FIG. 4 of the drawings, a cam follower **74** is connected in parallel arrangement to a rod **76** through a plate member **78**. This plate member **78** itself is positioned externally of the enclosed sections **24** and **26** of the processor **10** (see FIGS. 1 and 3). However, the cam follower **74** is introduced into the enclosed section **24** of the processor **10** through an aperture **80** provided through the side wall member **18**, while the rod **76** is introduced into the second enclosed section **26** of the film processor through an aperture **82** provided through the projection **28**. One end of a spring **84**, which may be of the negator type, is connected to the wall **14** internally of the projector's enclosed section **24**. This spring extends through a slot **86** of the side wall member **18** and has its other end connected to the plate member **78**. Thus, this spring continually urges the cam follower **74** and the rod **76** internally of the processor's enclosed sections **24** and **26**, respectively.

Preferably the cam follower **74** and the rod **76** are in alignment along the axis of rotation of the cam **50** and, of course, the cam follower **74** is slidably positioned in the plane of the cam so as to be seated against its convolute peripheral surface **88**. The cam follower **74** is initially seated against this convolute peripheral surface **88** of the cam **50** adjacent its leading edge **90** under the force of the spring **84**. It will therefore be appreciated that as the cam is rotated in a clockwise direction as viewed in FIG. 4, the cam follower will be gradually displaced from its furthermost position away from the axis of rotation of the cam to its innermost position with respect to the cam's axis of rotation as shown in phantom in FIG. 4. It will also be appreciated that at the time the cam follower **74** has reached its innermost position, the cam **50** will have been rotated slightly less than 360° and its leading edge **90** will have contacted the cam follower thereby preventing further rotation of the cam in this direction. However, at such time, the spring **64** permits the cam carrier **48** to complete its 360° rotation. By then withdrawing the plate member **78** away from the side wall member **18**, the operator can disengage the cam follower **74** from the cam **50** and the force exerted on the cam by the spring **64** through the pin **66** will cause the cam to complete a 360° rotation, i.e., to assume its original position with respect to the cam carrier **48**. The operator can then release the plate member **78** and the force exerted thereon by the spring **84** will return the cam follower to its original position in contact with the cam's convolute surface **88** adjacent its leading edge **90**.

The second enclosed section **26** of the film processor **10** is adapted to receive a film handling cassette **92** through its door **36**. Coplanarly mounted for rotary movement within the cassette **92** are a supply reel **94** and a takeup reel **96**. These reels **94** and **96** are provided with fluted recesses **98** and **100**, respectively. When the film handling cassette **92** is positioned within the enclosed section **26** of the processor **10**, the spline **46** of the drive shaft **40** seats in the fluted recess **100** of the takeup reel **96**. Additionally, a pin **102** rotatably mounted from the wall **14** is adapted to engage the fluted recess **98** of the cassette's supply reel **94**. A strip **104** of exposed motion picture film of the type previously discussed is initially substantially entirely coiled around the supply reel **94** and has a leader connected to the takeup reel **96**. In passing from the supply reel **94** to the takeup reel **96**, the film strip **104** passes sequentially around idlers **106** and **108**. Intermediate of the idler **106** and the idler **108**, the film strip **104** is disposed externally of the housing of the cassette **92** and passes in close proximity to a support plate **110** mounted on a bearing **112** extended from the projection **30** so that it can pivot in any direction on that bearing for purposes which will subsequently become apparent.

The film handling cassette **92** also includes a pair of parallel guide tracks **114** and **116** between which an applicator **118** is slidably disposed. Contained within the applicator **118** is a quantity of processing fluid **120**. The end of the applicator **118** adjacent the support plate **110** comprises a doctor blade **122** communicating with the interior of the applicator through an orifice **124**. Slidably disposed within the applicator **118** on the opposite side of the processing fluid **120** from the doctor blade **122** in a plunger **126**. The applicator **118** is provided with an aperture **128** whereby the rod **76** may be first introduced into the cassette **92** through an aperture **130** and then into the applicator through the aperture **128** to seat against the plunger **126**. Thus, once the applicator has been restrained from movement in a left handed direction along the guide tracks **114** and **116** as viewed in FIG. 1, inward displacement of the rod **76** within the processor **10** will drive the plunger **126** against the processing fluid **120** to cause amounts of that fluid to be expressed from the applicator across the doctor blade **122**.

The film handling cassette **92** includes a removable cover plate **132** which facilitates replacement of the applicator **118** and/or film strip **104**. This cover plate **132** is provided with an elongated slot **134** adapted to slidably receive a pin **136** extending from the applicator **118**.

When the film handing cassette **92** is initially mounted within the processor's enclosed section **26**, the applicator **118** is positioned along the guide tracks **114** and **116** as shown in FIG. 1. Pivotally connected from the interior face of the door **36** is an arm **138**, the free end of which is provided with a retaining seat **140** having a groove **142**. One end of a spring **144** is connected to the arm **138** and has its other end connected to the door **36** whereby the spring continually exerts a force on the arm tending to rotate it in a clockwise direction as viewed in FIG. 1.

A pin **146** extends through the door **36** and its ends external of the door terminates in a hand knob **148**. The other end of this pin **146**, i.e., the end extending interi-

orly of the enclosed section **26**, is connected to a cam **150**. The peripheral surface **152** of this cam **150** is adapted to contact the edge of the pivoted arm **138**. When the cam **150** is in the position shown in FIG. 1, it restrains the arm **138** in position such that the applicator's pin **136** will be engaged by the groove **142** when the cassette **92** is mounted in the processor **10** and the processor's door **36** is closed. Responsive to the subsequent turning of the hand knob **148**, the cam **150** revolves to permit the arm **138** under the force of the spring **144** to slide the applicator **118** along the guide tracks **114** and **116** until it has contacted the film strip **104** and seated a portion of the film strip **104** against the support plate **110**. In this respect, one end of a sealing member (not shown) may initially be adhered to the applicator **118** to seal its orifice **124** and have its other end affixed to the outside face of the housing of the cassette **92**. Thus, the seal will automatically be removed from the orifice **124** as the applicator is displaced into contact with the film strip **104**. The self-aligning feature of the support plate **110** permits the film strip **104** to be effectively slidably engaged between the support plate and the applicator **118**.

The processor's projection **30** includes an internally mounted latching element **153** having an elongated slot **155** provided therein. This latching element **153** and its elongated slot **155** are positioned such that, as the hand knob **148** is rotated to permit the applicator **118** to slidably engage the film strip **104** against the support plate **110**, the cam **150** enters the slot **155** to lock the door **36** in its closed position. Thus, the cam **50** serves the dual function of bringing the doctor blade **122** into operable relationship with the film strip **104** after the processor's door **36** has been closed and of locking the door **36** in its closed position. It will also be noted that after the film strip **104** has been slidably engaged between the support plate **110** and the applicator **118**, the applicator **118** is yieldably restrained against the film strip by the spring **144**. Additionally, as the door **36** is closed, the inside face of the retaining seat **140** engages the cover plate **132** to firmly position the cassette **92** on the shaft **40** and the pin **102**.

In FIG. 4 the applicator **118** is depicted in its position wherein the film strip **104** is slidably engaged between the applicator and the support plate **110**. As shown in that figure of the drawings, the rod **76** makes initial contact with the plunger **126** at the time the cam follower **74** is seated against that cam's convolute peripheral surface **88** adjacent its leading edge **90**. As the cam **50** rotates in a clockwise direction, as viewed in FIG. 4, the cam **50** and cam follower **74** control the displacement of the plunger **126** within the applicator **118** and, consequently, the rate at which processing fluid is expressed from the applicator across the doctor blade **122**. When the cam **50** has rotated to the position of the cam follower **74** as shown in phantom in FIG. 4, the full effective displacement of the plunger **126** within the applicator **118** has been realized.

Reduction gear train **54** is designed such that, after the takeup reel **96** has made the number of revolutions required to draw the entire length of exposed film strip **104** across the doctor blade **122**, the cam carrier **48** will have made one complete revolution on the shaft **52** thus causing the plunger **126** to be displaced its full effective distance within the applicator **118**.

The processor's electrical control system is housed within the enclosed section **24** and is schematically illustrated in FIG. 5 of the drawings. This system includes an AC transformer **158**, a normally open power switch **160**, a normally closed microswitch **162**, a normally opened start button **164**, a normally opened relay **166**, an AC-DC rectifier **168** and a potentiometer **170**. The operation of this control system will be described in considerable detail hereinafter. However, at this point it should be noted that the potentiometer **170** is connected in series with the processor's motor **38** whereby the speed of that motor is inversely proportional to the resistance of the potentiometer.

As is shown most clearly in FIG. 4 of the drawings, the preferred embodiment of the invention employs a potentiometer **170** of the rotary type. The resistive element **172** of the potentiometer **170** is mounted from the inside face of the processor's wall **14**, while its brush **174** is mounted on the adjacent face of the cam **50**. It will therefore be appreciated that the resistance of the potentiometer **170** at any instant is a function of the angular displacement of the cam **50** and, more importantly, a function of the amount of film strip **104** coiled around the takeup reel **96** at that instant. In this manner the speed of the film strip **104** across the doctor blade **122** may be held substantially constant regardless of the number of turns the film strip has made on the takeup reel **96**.

The microswitch **162** is mounted from the processor's wall **12** and is adapted to be opened when contacted by a pin **176** extending from the cam **50**. This pin **176** is located on the cam **50** so as to open the microswitch **162** when the cam has been rotated to the position where the cam follower **74** is in its position shown in phantom in FIG. 4. At this time the leading edge **90** of the cam **50** is in contact with the cam follower **74** so as to prevent its further rotation in a clockwise direction as viewed in that figure of the drawing. However, the system is designed such that inherent inertia of the drive system acting against the spring **64** causes the cam carrier **48** to complete its 360° rotation on the shaft **52**. When the operator subsequently withdraws the cam follower **74** from contact with the cam **50**, the cam is rotated a few more degrees under the force of the spring **64** exerted through the cam's pin **66** until it has once again assumed its original position with respect to the cam carrier **48** on the shaft **52** at which point the pin **176** has passed the microswitch **162** permitting that element to return to its normally closed position.

The power switch **160** and start button **164** are conveniently positioned on the outside face of the projector's wall **14**.

## OPERATION OF THE PREFERRED EMBODIMENT

The cassette **92** may be initially adapted for mounting in a camera (not shown) to facilitate exposure operations. In this respect, the cassette **92** is furnished with substantially the entire length of film strip **104** in a photosensitive state coiled on the reel **96** and having a leader extending around idlers **108** and **106** to the reel **94**. Drive means of the camera engage the recess **98** of the reel **94** through a slip clutch and also drive a conventional camera claw mechanism which engages a section of the film strip **104** disposed exteriorly of the cassette **92** to selectively transport the film strip across the camera's film gate and onto the reel **94** during the picture taking sequences. At this time the applicator **118** is filled with processing fluid **120** and is in its furthermost right handed position along guide tracks **114** and **116** as viewed in FIG. 1.

In this usage, the idler **108** around which the film strip **104** passes on its way from the reel **96** to the film gate may, if desired, be mounted on a movable post spring biased toward the corner which it occupies of cassette **92** and capable of being moved resiliently inward away from that corner. Concurrently, idler **106** may be designed in accordance with current practice to provide a snubbing action during exposure operations. Also, this idler **106** may be spring biased toward the corner which it occupies of the cassette **92** and capable of being moved resiliently inward away from that corner. This arrangement represents one way to minimize strain exerted on the film strip **104** by the conventional intermittent film advancement mechanism of the camera which engages sprocket holes of the film during these operations.

After the entire length of the photosensitive film strip **104** has been exposed to image-carrying light rays in the camera, the cassette **92** should be removed from the camera and may be replaced as desired by a similar cassette containing film in a photosensitive state. The operator may now turn the hand knob **148** on the processor's door **36** to withdraw the cam **150** from the latching element **153** and to displace the arm **138** into its furthermost position from the latching element **153**. With the processor's door **36** opened, the film handling cassette **92** can be mounted within the closed section **26** of the film processor **10**. In this respect, spline **46** of the drive shaft **40** engages the fluted recess **100** of the takeup reel **96** and the pin **102** engages the fluted recess **98** of the supply reel **94**. While mounting the cassette **92** in the processor **10**, the operator must displace the plate member **78** against the force exerted thereon by the spring **84** a sufficient distance away from the wall **18** to permit the cassette to clear the rod **76**. By closing the door **36**, the pin **136** extending from the applicator **118** is seated in the groove **142** of the restraining seat **140** which itself engages the outside face of the cover plate **132** to fixedly position the film handling cassette **92** within the processor's enclosed section **26**. The hand knob **148** may now be turned to bring the applicator **118** into contact with the film strip **104** so as to press the film strip against the support plate **110** and also to lock the door **36** in its closed position. Releasing the plate member **78** seats the cam follower **74** against the convolute peripheral surface **88** of the cam **50** adjacent the cam's leading edge **90** and causes the rod **76** to make initial contact with the applicator's plunger **126**. The operator should now close the power switch **160** and momentarily depress the start button **164** to energize the processor's motor **38**. In this respect, with the start button **164** depressed, power from the transformer **158** passes through the microswitch **162** to close the relay **166**. This relay **166** thereafter remains in a closed condition even though the start button **164** returns to its normally opened position and power from the transformer **158** is connected to the motor **38** through the power switch **160**, the microswitch **162**, the relay **166**, the rectifier **168** and the potentiometer **170**.

The energized motor **38** drives the takeup reel **96** to progressively draw the exposed film strip **104** from the supply reel **94** across the doctor blade **122**. Simultaneously, the energized motor **38** drives the cam carrier **48** and the cam **50** connected thereto by the pin **66** through the gear train **54**. As the cam **50** rotates on the shaft **52**, it permits the plunger **126** to be gradually displaced inwardly of the applicator **118** under the force exerted on it by the rod **76** thereby causing the processing fluid **120** to be expressed onto the film strip **104** as it passes the doctor blade **122**.

As previously explained, the leading edge **90** of the cam **50** contacts the cam follower **74** and its rotational movement therefore ceases slightly before it has been rotated a complete 360°. When the leading edge **90** of the cam **50** contacts the cam follower **74**, the pin **176** extending from the cam **50** trips the microswitch **162** to de-energize the motor **38**. At this time the entire length of exposed film strip **104** has been drawn across the doctor blade **122** and the plunger **126** has completed its effective displacement within the applicator **118**. Inertia of the gear train **54** and the cam carrier **48** is sufficient to thereafter cause the cam carrier to complete its 360° rotation.

During this time, a controlled amount of processing fluid **120** has been expressed from the applicator **118** across the doctor blade **122** onto exposed motion picture film strip **104** to form a uniform fluid coating therealong. Reiterating, the amount of fluid **120** expressed from the applicator **118** during any given period of time is a direct function of the length of film strip **104** drawn across the doctor blade **122** in that same given period of time.

The quality of the coating of the processing fluid **120** applied to the exposed film strip **104** is further improved in this embodiment of the invention by drawing the film strip **104** across the doctor blade **122** at a substantially constant speed. As previously suggested, this highly desirable feature is made possible by the potentiometer **170** connected in series with the processor's motor **38** and responsive to the angular displacement of the cam **50**. As the cam **50** rotates about the shaft **52**, the resistance of the potentiometer **170** is gradually increased, thereby decreasing the speed of the motor as a function of the amount of film strip **104** coiled around the take up reel **96**.

By now withdrawing the plate member **78** away from the processor's side wall member **18**, the cam follower **74** is removed from contact with the cam **50** and the cam is free to complete its 360° rotation on the shaft **52** under the force exerted on it by the spring **64** through the pin **66**. As the cam thus completes its 360° rotation, its pin **176** passes out of contact with the microswitch **162** permitting that element to return to its normally closed position. When the operator subsequently releases the plate member **78**, the force of the spring **84** seats the cam follower **74** against the cam's convolute peripheral surface **88** adjacent its leading edge **90**. After the cassette **92** containing the now fully processed film strip **104** has been removed from the processor **10**, the processor is ready to accept another cassette containing exposed, but undeveloped, film.

Those familiar with the motion picture arts will readily appreciate the novel and highly unique advantages of this system and method for applying processing fluid to a strip of exposed film. The displacement of the plunger **126** within the applicator **118** is effectively controlled as a function of the amount of film strip **104** drawn across the applicator's doctor blade **122**. In this manner the amount of processing fluid **120** expressed from the applicator's doctor blade **122** onto the film strip **104** is independent of environmental conditions, for example, temperature changes which would affect the viscosity of the processing fluid. Also, the amount of processing fluid **120** expressed from the doctor blade **122** is independent of any variations which might occur in the force of the spring **84**. It is only necessary that the force of the spring **84** always be sufficient to urge the cam follower **74** against the cam **50** and the rod **76** against the plunger **126**. Simultaneously as positive means are employed to control the displacement of the plunger **126**, efficient and effective means are employed to continually impart a substantially constant speed to the film strip **104** as it passes across the applicator's doctor blade **122**.

The gear **68** may readily be replaced to accommodate changes in the applicator, length of film strip and/or thicknesses of fluid coatings.

This invention may be practiced or embodied in other ways without departing from the spirit or essential character thereof. For instance, the film handling cassette **92** may also incorporate a film projection capability such as that employed in the system disclosed in the aforementioned copending application Ser. No. 772,789 of Vaito K. Eloranta and Benjamin C. Ruggles. Thus, after the film strip has been processed in the processor, the cassette could be removed therefrom and mounted in a specially configured projector. Alternately, in this instance, the processor itself could include a projection capability and thereby serve the dual function of first processing the film strip and then projecting the images recorded thereon. Still further, it will be readily apparent to those skilled in the art, that while a film handling cassette **92** is employed in the illustrated preferred embodiment, the invention itself is not limited to use with cassette structures. In other words, the applicator may form part of the processor itself and the exposed but undeveloped film strip may be

coiled on a reel independently mounted within the projector and extending to a second or takeup reel independently mounted in the processor.

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. A system for processing a strip of photographic sheet material after said material has been exposed to image carrying light rays to record latent images thereon, comprising:

an applicator, containing a processing fluid and having an orifice through which said processing fluid may be expressed onto said exposed sheet material and including a plunger slidably disposed on the opposite side of said processing fluid from said orifice, whereby displacement of said plunger inwardly of said applicator causes said fluid to be expressed through said orifice;

first means for effecting relative motion between said strip of material and said applicator whereby substantially the entire length of said strip of material passes across said applicator adjacent said orifice; and

second means for progressively displacing said plunger inwardly of said applicator as a function of the rate of said relative motion between said strip of material and said applicator, said second means including a cam operable to control the displacement of said plunger within said applicator, whereby the amount of said fluid expressed from said applicator through said orifice by said plunger into said strip of material is continuously controlled to produce a uniform fluid coating on said strip of material regardless of said rate of said relative motion.

2. The system of claim 1 wherein said first means includes at least one rotatably mounted reel to which one end of said strip of material is connected and third means for driving said reel whereby said strip of material is passed across said applicator and coiled on said reel, and said second means includes a rotatably mounted cam driven by said third means and operable to control the displacement of said plunger within said applicator.

3. The system of claim 2 wherein said second means additionally includes a rod adapted to engage said plunger within said applicator, a cam follower connected to said rod and adapted to simultaneously engage said cam and fourth means for continuously urging said cam follower against said cam and said rod against said plunger whereby said cam controls the displacement of said rod inwardly of said applicator against said plunger under the force exerted on said rod by said fourth means.

4. The system of claim 2 wherein said third means drives said reel the number of rotations required to pass substantially the entire length of exposed strip of material across said applicator in the time said third means drives said cam substantially one complete revolution.

5. The system of claim 2 wherein said third means in- said motor as a function of the amount of said strip of macludes a motor and fifth means for varying the speed of terial coiled on said reel, whereby said strip of material may be passed across said applicator at a substantially constant speed.

6. The system of claim 5 wherein said fifth means includes a rotary potentiometer connected in series with said motor and responsive to the angular displacement of said cam.

7. The system of claim 3 wherein said cam is connected to said reel to make substantially one complete rotation in the time that said reel has made the number of rotations required to pass substantially the entire length of said exposed strip of material across said applicator, said cam including a convolute peripheral surface against which said cam follower is seated, said cam follower and said rod connected thereto being slidably mounted in a plane perpendicular to the axis of rotation of said cam, said peripheral surface being configured to permit said cam follower and said rod connected thereto to be displaced under the force exerted thereon by said fourth means a distance equal to the perdetermined effective displacement of said plunger within said applicator during one substantially complete revolution of said cam.

8. The system of claim 7 wherein said second means additionally includes a cam carrier, said cam carrier and said cam being mounted in juxtaposition for rotation about the same axis and wherein said cam follower initially seats against the section of said convolute peripheral surface disposed the greatest distance from said axis of rotation of said cam adjacent the leading edge of said cam, said cam carrier being driven by said third means and resiliently rotatably connected to said cam whereby said cam carrier may rotate slightly beyond the point where said cam follower has reached its closest position to said axis of rotation along said convolute peripheral surface and been contacted by said leading edge of said cam to stop the rotational movement of said cam and the resilient force, established between said cam carrier and said cam as said cam carrier rotates beyond the point where said cam follower restrains the rotation of said cam, causes said cam to return to its original position adjacent said cam carrier when said cam follower is withdrawn from contact with said convolute peripheral surface and said leading edge of said cam.

9. The system of claim 8 additionally including a support plate, said exposed strip of material passing between said support plate and said applicator as said strip of material is coiled on said reel, and sixth means for causing said strip of material to be slidably engaged by said support plate and said applicator to be yieldably restrained against said strip of material.

10. A system for processing an elongated strip of motion picture photographic sheet material after said material has been exposed to image carrying light rays to record a plurality of latent images lengthwise thereon, comprising:

a source of processing fluid;

an applicator communicating with said source of processing fluid and from which processing fluid from said source may be expressed onto said exposed sheet material;

first means for effecting relative motion between said strip of material and said applicator whereby substantially the entire length of said exposed strip of material comprising said plurality of latent images progressively passes across said applicator;

displaceably mounted second means for forcing said fluid from said source to said applicator and onto said strip of exposed photographic material; and

third means independent of said fluid coupling said first means to said second means for controlling the displacement of said second means and causing said second means to continually force amounts of said fluid from said applicator during substantially the entire period of said relative motion between said exposed strip of material and said applicator as a function of the rate of said relative motion to progressively apply a thin fluid coating of uniform thickness to the entire length of said exposed strip of material as it passes said applicator regardless of changes in said rate of relative motion.

11. The system of claim 10 wherein said third means includes a cam operable to control the amounts of said fluid expressed from said applicator through said orifice.

12. A system for processing a strip of photographic sheet material after said material has been exposed to

image carrying light rays to record latent images thereon, comprising:

an applicator containing a processing fluid and having an orifice through which said processing fluid may be expressed onto said exposed sheet material and including a plunger slidably disposed on the opposite side of said proecssing fluid from said orifice, whereby displacement of said plunger inwardly of said applicator causes said fluid to be expressed through said orifice;

first means for effecting relative motion between said strip of material and said applicator whereby substantially the entire length of said strip of material passes across said applicator adjacent said orifice; and

second means coupled to said first means independently of said fluid for progressively displacing said plunger inwardly of said applicator as a function of the rate of said relative motion between said strip of material and said applicator, whereby the amount of said fluid expressed from said applicator through said orifice by said plunger onto said strip of material is continuously controlled to produce a uniform fluid



coating on said strip of material regardless of said rate of said relative motion.

**13.** The system of claim **12** wherein said applicator includes a doctor blade.


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U.S. Cl. X.R.

95—14; 118—410

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,616,740 Dated November 2, 1971

Inventor(s) Vaito K. Eloranta

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

IN THE ABSTRACT:

Column 1, line 29, "processors" should be --processor's--
Column 1, line 31, "of" should be --to--

IN THE SPECIFICATION:

Column 3, line 16, after "between" delete "and"
Column 4, line 34, "super-position" should be --superposition--
Column 4, line 44, "to" should be --of--
Column 6, line 73, "ends" should be --end--

IN THE CLAIMS:

Column 11, lines 61 & 62, transpose lines 61 and 62
Column 12, line 6, after "under" delete the hyphen
Column 12, line 8, "perdetermined" should be --predetermined--
Column 12, line 37, after "applicator" insert --and said applicator--
Column 13, line 7, "proecssing" should be --processing--.

Signed and sealed this 11th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents



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