June 7, 1966 E. H. LAND 3,254,583

PHOTOGRAPHIC APPARATUS AND PRODUCT USEFUL THEREIN

Filed July 31, 1963 6 Sheets-Sheet 1

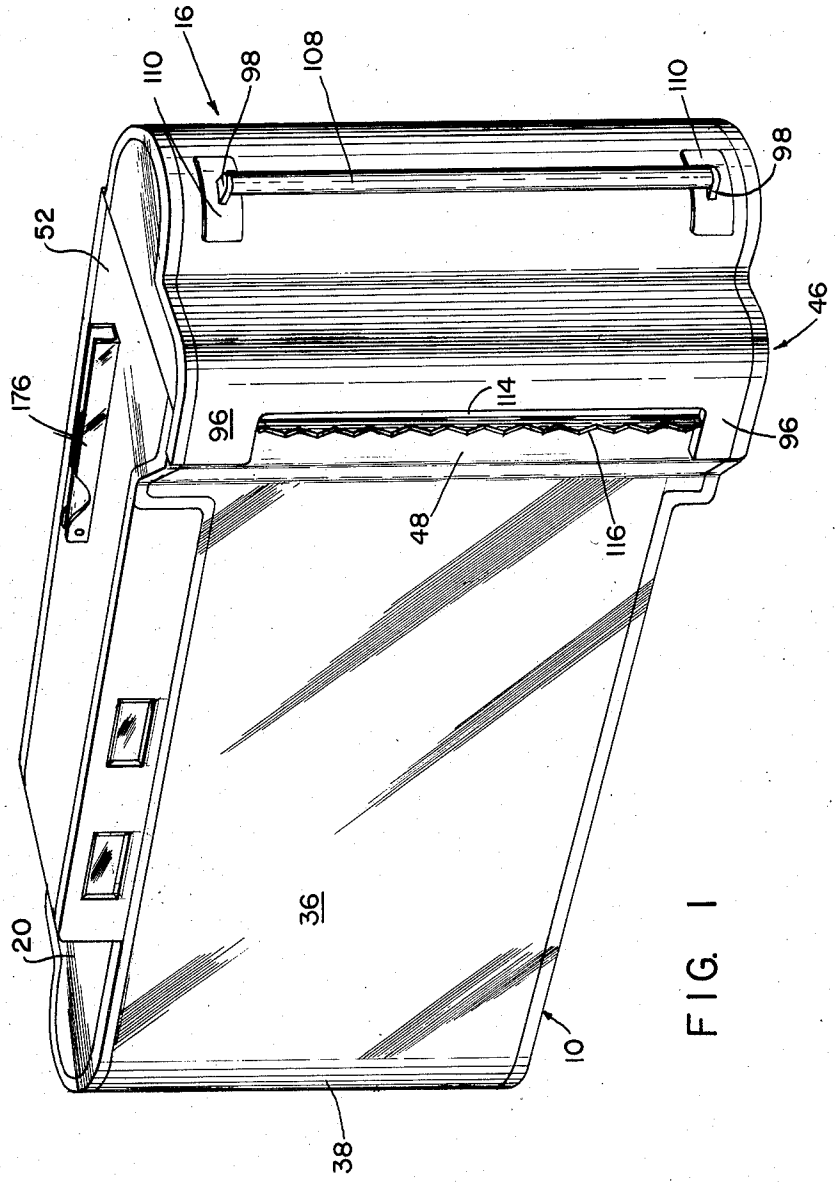


FIG. 1

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PHOTOGRAPHIC APPARATUS AND PRODUCT USEFUL THEREIN

Filed July 31, 1963 6 Sheets-Sheet 2

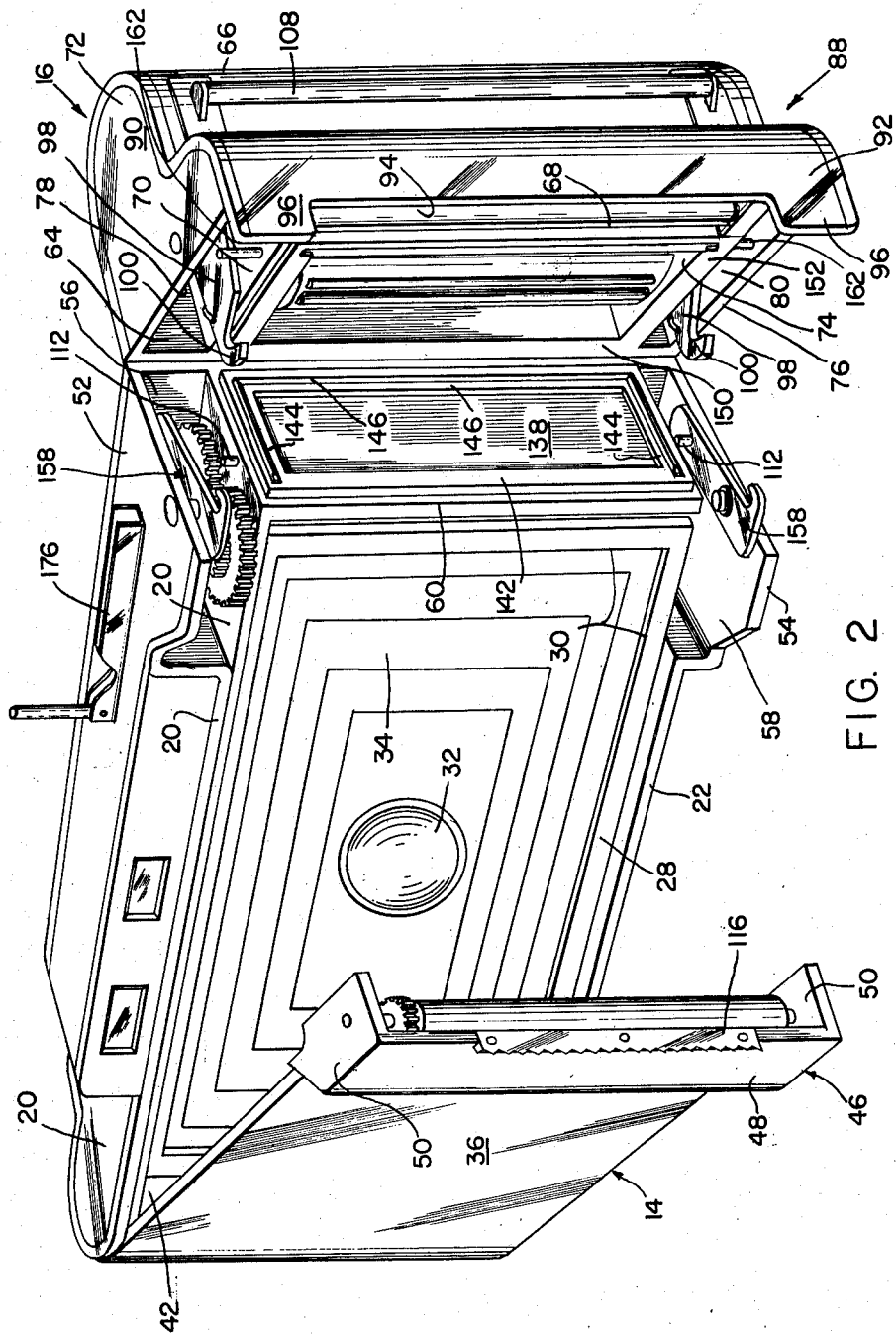


FIG. 2

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PHOTOGRAPHIC APPARATUS AND PRODUCT USEFUL THEREIN

Filed July 31, 1963 6 Sheets-Sheet 3

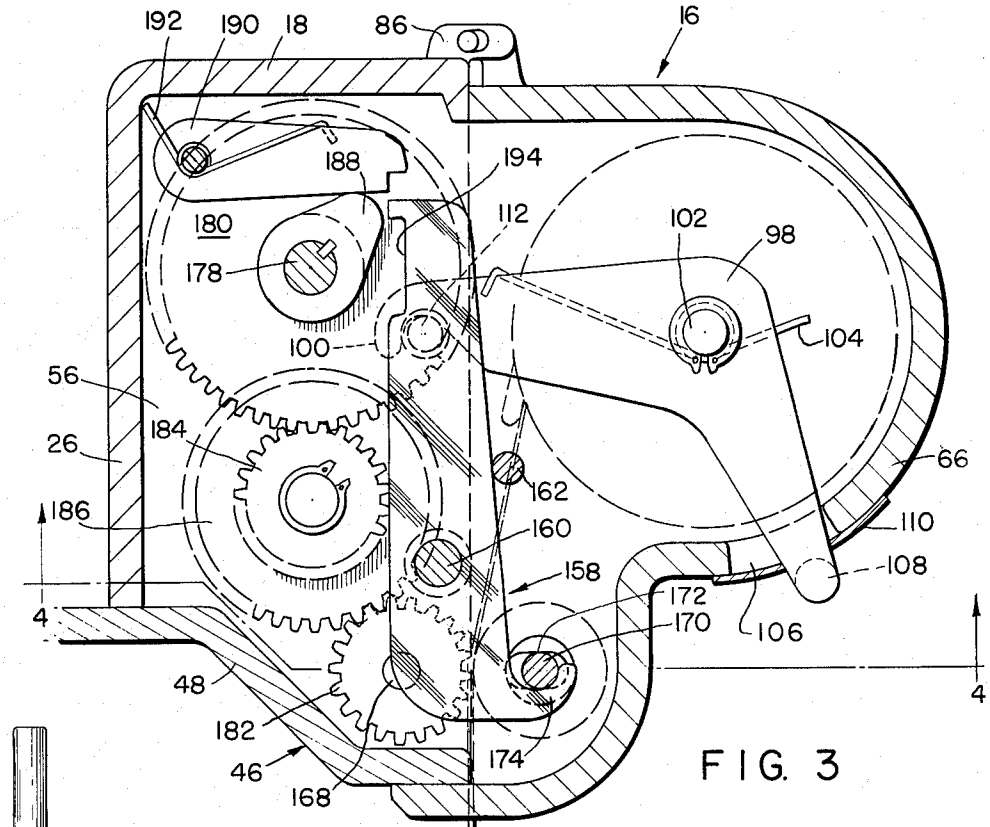


FIG. 3

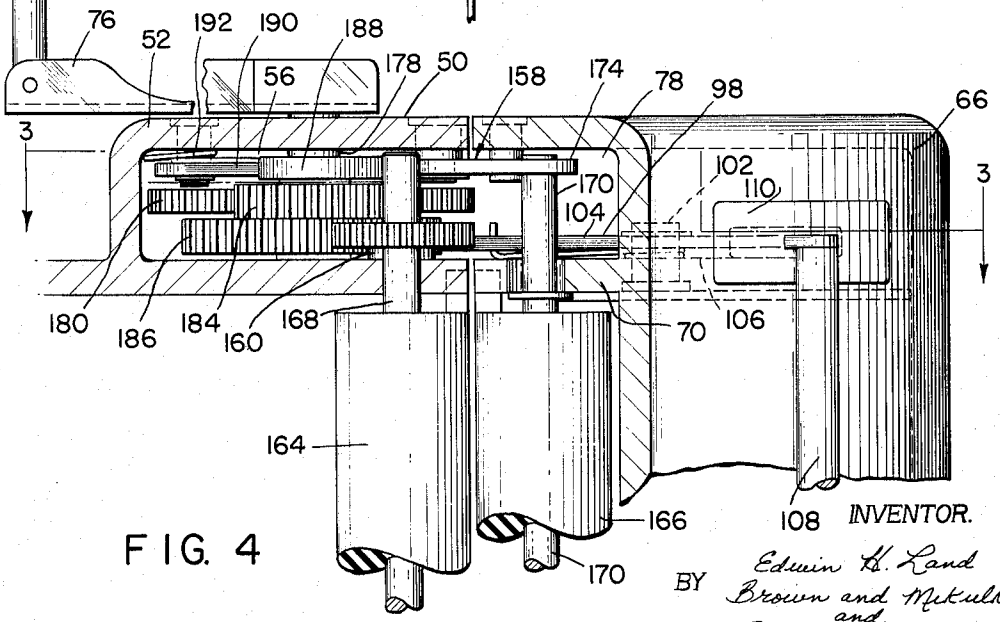


FIG. 4

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PHOTOGRAPHIC APPARATUS AND PRODUCT USEFUL THEREIN

Filed July 31, 1963 6 Sheets-Sheet 4

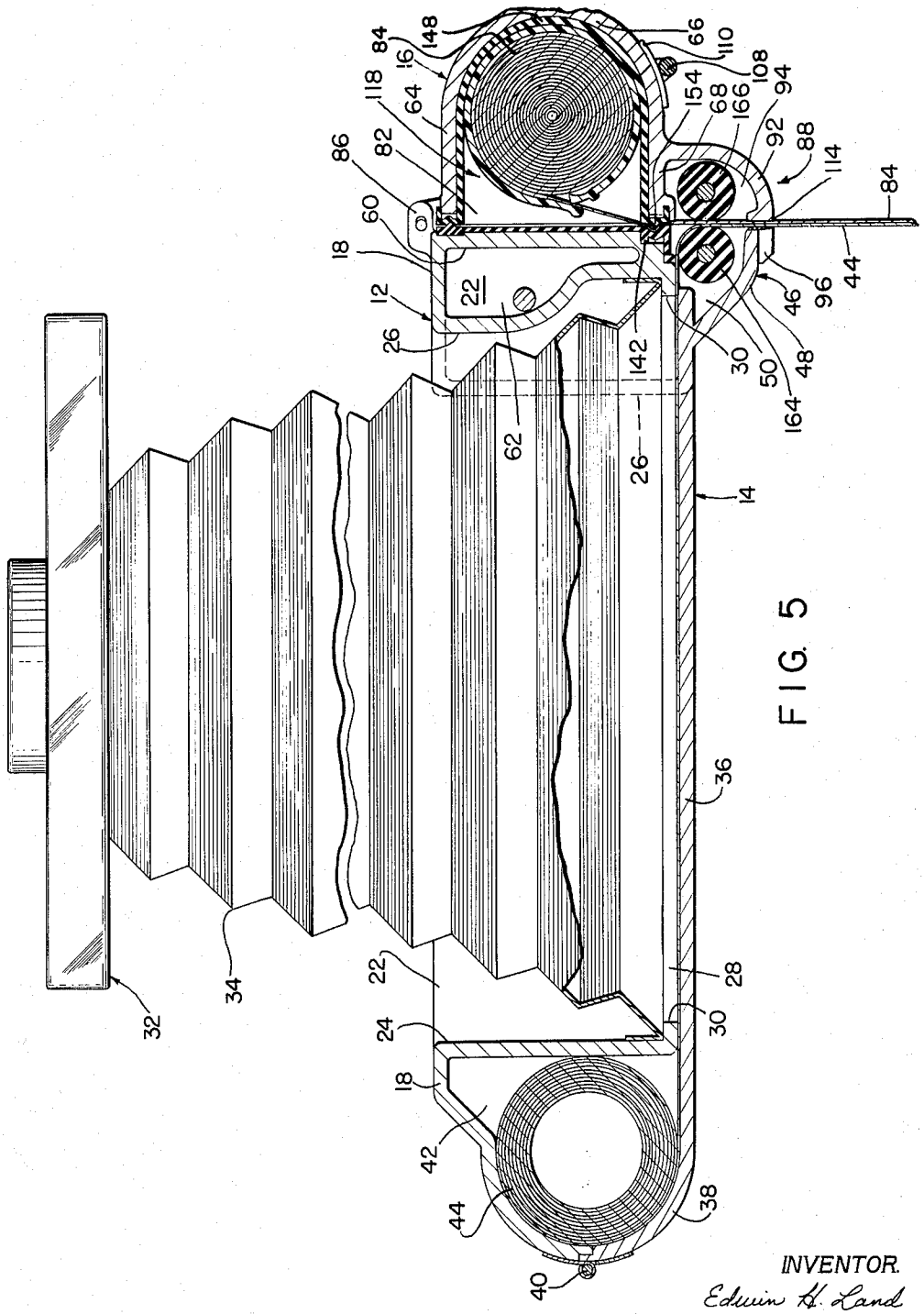


FIG. 5

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PHOTOGRAPHIC APPARATUS AND PRODUCT USEFUL THEREIN

Filed July 31, 1963 6 Sheets-Sheet 5

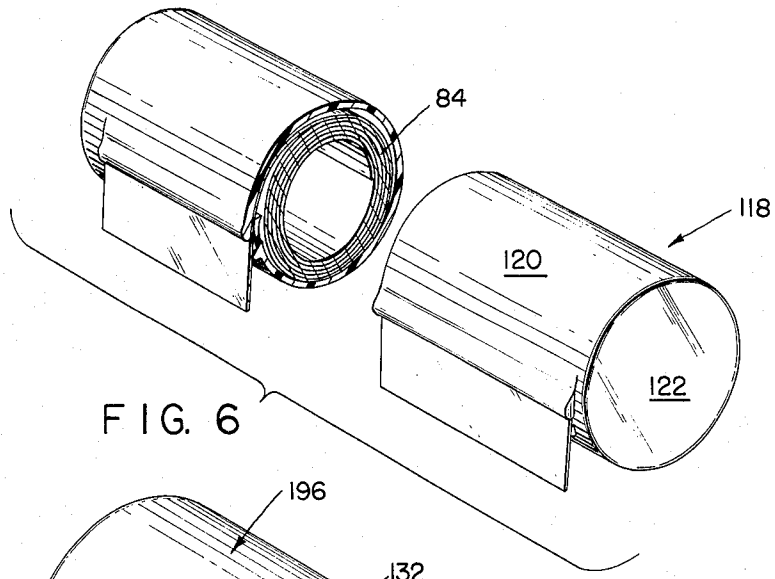


FIG. 6

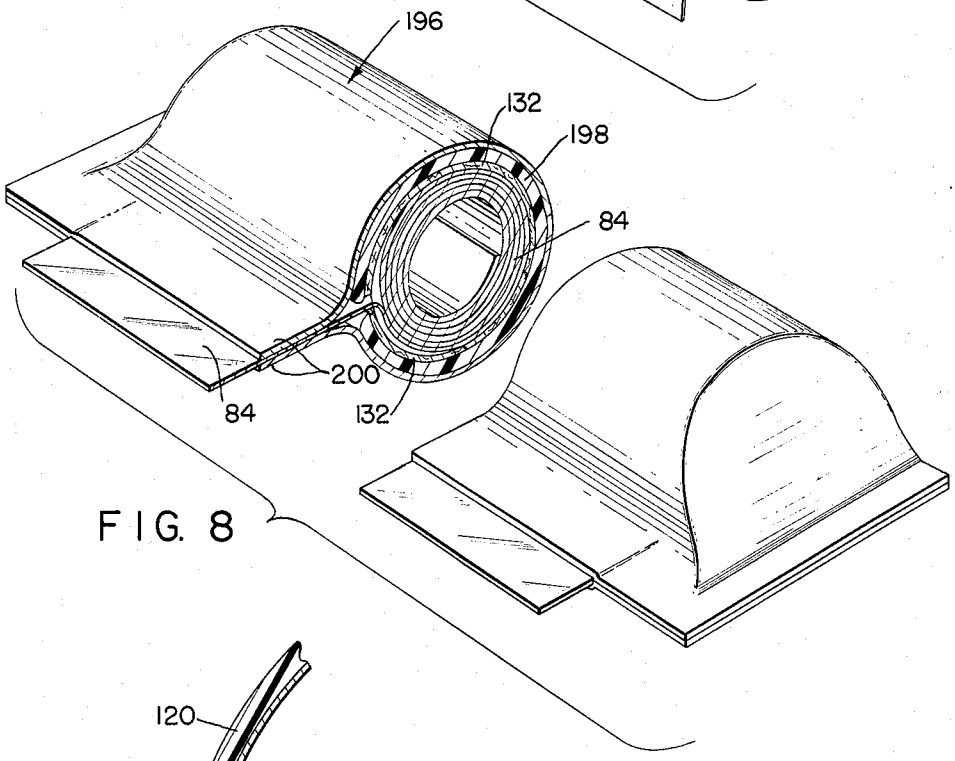


FIG. 8

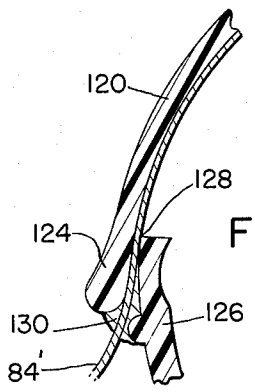


FIG. 7

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June 7, 1966 E. H. LAND 3,254,583

PHOTOGRAPHIC APPARATUS AND PRODUCT USEFUL THEREIN

Filed July 31, 1963 6 Sheets-Sheet 6

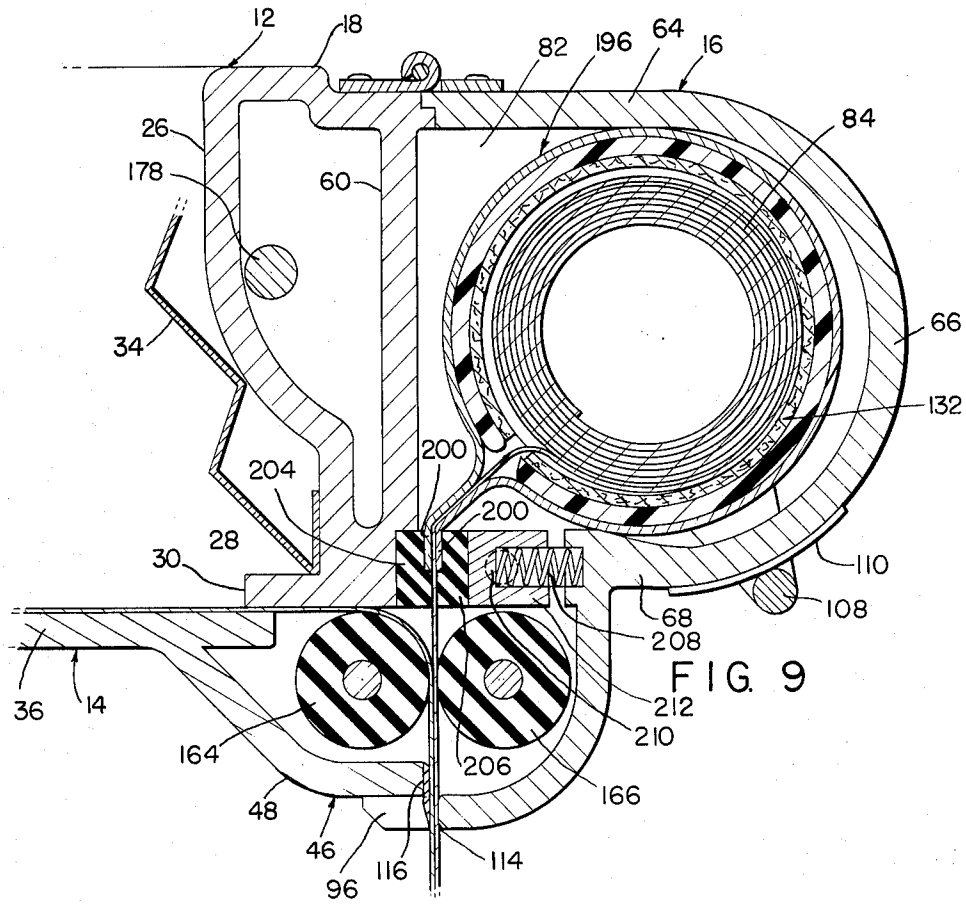


FIG. 9

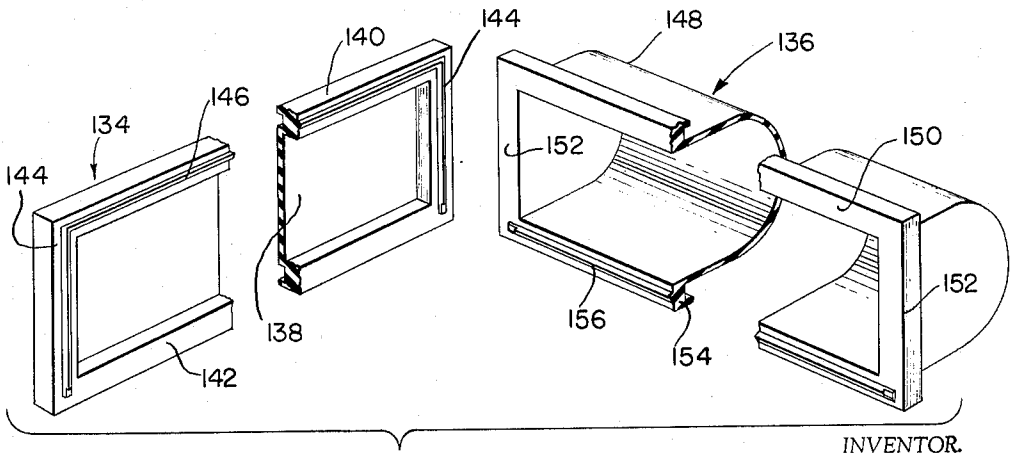


FIG. 10

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United States Patent Office 3,254,583 Patented June 7, 1966

3,254,583

PHOTOGRAPHIC APPARATUS AND PRODUCT USEFUL THEREIN

Edwin H. Land, Cambridge, Mass., assignor to Polaroid Corporation, Cambridge, Mass., a corporation of Delaware

Filed July 31, 1963, Ser. No. 298,968
18 Claims. (Cl. 95—13)

This invention relates to photographic apparatus, and particularly to apparatus for exposing and treating successive areas of a photosensitive image-recording sheet with a liquid.

A number of different types of photographic apparatus, especially cameras, have been proposed for exposing a succession of areas of a photosensitive image-recording sheet, superposing each exposed area with an area of a second sheet and distributing a processing liquid between the superposed sheets in order to produce a positive transfer print in an image-receiving layer on the second sheet by a diffusion-transfer process. The materials employed in the apparatus comprises an image-recording sheet including an image-forming material such as a heavy metal salt (e.g., silver halide), a second or image-receiving sheet for supporting an image-receiving layer containing a diffusion-transfer image, and a processing liquid including a developing agent for the photosensitive material and an alkali for rendering the developing agent reactive. It has been proposed to incorporate all of the materials for producing a transfer print including the photosensitive image-recording material, image-receiving material, developing agent, alkali, transferable image-forming substances, and/or agents capable of forming transferable image-forming substances and even water, in layers or strata comprising the image-recording and second sheets. However, when water or more particularly, an aqueous alkaline liquid, has been included in a stratum or component of one of the two sheets, it has been necessary to provide a barrier for isolating the liquid from other strata and agents incorporated therein, together with means for removing the barrier and bringing all of the reagents into association when processing is to be effected. Heretofore, film assemblages of this general type have had a mechanically complex and expensive construction and have required correspondingly complex and expensive apparatus to achieve their exposure and processing.

An object of the invention is to provide novel and improved photographic apparatus for exposing successive areas of an image-recording sheet including a photosensitive image-forming material and a developing agent therefor, and processing each exposed area by pressing the image-recording sheet into contact with an area of a second sheet impregnated with an aqueous alkaline liquid and contained within a container within the apparatus.

Other objects of the invention are: to provide in apparatus of the character described, means providing a gas-tight container for the second sheet and means for moving the sheets through the apparatus, opening the container at the commencement of sheet movement, closing the container at the termination of sheet movement and pressing the sheets into face-to-face contact; to provide apparatus as described in which the container and means for sealing the container are components of the apparatus; and to provide apparatus as described in which components of the apparatus cooperate with the components of the film assemblage to provide a sealed container and means for opening and closing the sealed container.

Still another object of the invention is to provide photographic apparatus as described which make possible the storage and withdrawal from storage of successive sections of a sheet impregnated with a liquid having a very high pH, i.e., at least 12, and maintaining the pH of the liquid at a predetermined high level.

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

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

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

FIGURE 1 is a perspective view, of photographic apparatus in the form of a camera embodying the invention;

FIG. 2 is a view similar to FIGURE 1 showing the camera with components of the housing thereof in an open position;

FIG. 3 is a fragmentary sectional view of the camera taken substantially along the line 3—3 of FIG. 4;

FIG. 4 is a sectional view of the camera taken substantially along the line 4—4 of FIG. 3;

FIG. 5 is a sectional view of the camera taken substantially midway between the upper and lower sides thereof and showing a film assemblage within the camera;

FIG. 6 is a perspective view, partially in section, of a film assemblage useful in the camera of the invention;

FIG. 7 is a fragmentary sectional view of a portion of the film assemblage of FIG. 6;

FIG. 8 is a perspective view, partially in section, of another form of film assemblage useful in the camera of the invention;

FIG. 9 is a view, similar to FIG. 5, of a modified embodiment of the camera incorporating the film assemblage of FIG. 8; and

FIG. 10 is a perspective view, partially in section, showing components of the camera of FIG. 2.

The basic components of the camera of the invention include: a housing for enclosing a supply e.g., roll, of a photosensitive image-recording sheet; means for locating successive areas of the image-recording sheet in position for exposure; juxtaposed members for pressing exposed areas of the image-recording sheet into superposition with successive areas of a liquid impregnated second sheet; closure means for sealing a container, holding the second sheet and liquid, against the admission of gas and providing a sealable opening in the container through which the second sheet can be withdrawn; drive means for advancing the sheets through the camera and into superposition; and means coupled with the drive means for opening the container during movement of the sheets and retaining the container in a closed and sealed condition at other times.

The camera is especially designed for producing multicolor photographic transfer prints according to the process disclosed in U.S. Patent No. 2,983,606 issued May 9, 1961 to Howard G. Rogers; and utilizing integral multilayer negatives incorporating dye developers such as are disclosed in the copending U.S. application of Edwin H. Land and Howard G. Rogers, Serial No. 565,135, filed February 13, 1956.

In this process the multilayer negative (sheet) is exposed to form a latent image, is superposed with a second sheet including a receiving layer for image-forming dyes transferred by diffusion from the negative sheet; and a liquid reagent is distributed between the two sheets for permeation into the layers of the negative containing the photosensitive materials and dye developers and the image-receiving layer. The liquid reagent is alkaline in nature and serves to render the other reagents, particu-

larly the developers, reactive to develop the latent image, or images, thereby immobilizing image-forming dyes in areas where image development occurs and causing image-forming dyes in unexposed areas to transfer by diffusion to the image (dye)-receiving layer. The process performed by the camera of the invention and the products useful therein differ from known processes and products basically in the manner in which the liquid is supplied for permeation into the negative layers. Heretofore, this has been accomplished by providing a quantity of the liquid including a thickening agent in a layer between the two sheets and spreading the thickened (viscous) liquid in a thin layer over each exposed area by moving the sheets in superposition relative to and between a pair of pressure-applying members. It has been the practice to provide the liquid for processing successive areas in either of two ways, these being in a succession of rupturable containers mounted on one of the sheets for movement together with the sheets between the pressure-applying members, or in separate containers which are moved with respect to the sheets for dispensing their liquid contents between the sheets for subsequent distribution.

According to the present invention, the aqueous alkaline liquid required for processing is carried by the image-receiving layer itself thus making possible a very simple film assemblage essentially comprising two sheets and a container for the image-receiving sheet and liquid; as compared with existing film assemblages including such components as masks, containers, liquid-trapping devices, indexing members and the like, requiring careful and precise fabrication and assembly to insure proper operation, registration and location of the various components during processing. The processing components of the camera are correspondingly simple since they are not required to dispense and/or distribute a viscous processing liquid in a precise manner and trap excess processing liquid, but are required only to press the two sheets into face-to-face contact since the liquid is already distributed in the required amount in the image-receiving layer on one of the sheets.

The liquid, an example of which is given hereinafter, carried by the image-receiving layer is highly alkaline, this alkalinity being achieved by the inclusion in the liquid of an alkali metal hydroxide, such as sodium hydroxide or potassium hydroxide, preferably in sufficient quantity to achieve a pH of at least 12. In order to maintain the liquid in this highly alkaline condition, it is necessary to exclude carbon dioxide, such as is found in the atmosphere, from the liquid and for this reason the camera includes a container and/or a container closure for protecting the liquid-carrying, image-receiving sheet from the atmosphere while allowing successive areas of the image-receiving sheet to be withdrawn from a container (gas impermeable) in the camera and pressed into superposition with successive exposed areas of the image-recording sheet. The container and container closure may comprise components of the camera or cooperating components of both the camera and film assemblage employed therein, while achieving a primary object in providing the simplest and least expensive (expendable) film assemblage capable of being processed in the least complicated and expensive camera.

A film assemblage useful in the camera of the invention comprises a multilayer negative or image-recording sheet and image-receiving sheet including an image-receiving layer impregnated with an aqueous alkaline liquid, with the two sheets being joined to one another at their leading ends, and a container for the liquid impregnated receiving sheet. A typical multilayer negative for producing multicolor transfer prints includes blue sensitive, green sensitive and red sensitive silver iodobromide emulsion layers having positioned behind them, respectively, a yellow dye developer, a magenta dye developer and a cyan dye developer; gelatin interlayers positioned between the yellow dye developer layer and the green sensitive emulsion and between the magenta dye developer layer and the red sensitive emulsion; and a support for the emulsion layers, dye developer layers, and gelatin inner layers. Multilayer negatives of this type are disclosed, for example, in FIG. 9 of the aforementioned U.S. Patent No. 2,983,606.

The image-receiving sheet comprises a support, preferably of a material which is chemically inert to, is insoluble in and impermeable to aqueous alkaline liquids, and an image-receiving layer of a material receptive to the aforementioned dye developers, securely adhered to the support and so constituted, by virtue of its composition and thickness, as to retain an amount of liquid sufficient to process the negative. In a preferred embodiment of the image-receiving sheet, the aqueous alkaline liquid-permeable layer has a graded permeability ranging from an impermeable material on a support such as paper, to a highly permeable material swollen by the equeous alkaline liquid. Such an image-receiving layer comprises a combination of strata of different composition and permeability bonded to one another and the support with the degree of swelling increasing progressively outward from the support.

The sandwich comprising the two superposed sheets may be advanced directly from the camera in which exposure and processing is accomplished and accordingly, the supports of both the photosensitive and image-receiving sheets are each formed of a material or provided with a layer which is opaque to actinic light.

The camera, designated **10**, embodying the invention comprises a housing (see FIGS. 1, 2 and 5) including three relatively movable sections designated a forward section **12**, a rear section **14** and an end section **16**. The forward section of the camera housing comprises a forward wall **18** having a generally rectangular opening therein including a recessed section defined by an upper side wall **20**, a lower side wall **22**, end walls **24** and **26** and a rear wall **28** provided with a rectangular exposure aperture **30**. The camera is of the folding type and includes a conventional lens and shutter assembly **32** coupled with rear wall **28** by a bellows **34** which is collapsible (the usual erecting mechanism is not shown) to permit the bellows and the lens and shutter assembly to be contained within the recess in the forward housing section.

The rear housing section includes a rear wall **36** having a curved end section **38** (at the left in the drawings) at which the rear housing section is pivotally secured to the forward housing section by a hinge **40**. The forward and rear housing sections, specifically forward wall **18**, upper and lower side walls **20** and **22** and wall **24** and end section **38** of rear wall **36** cooperate to provide a storage chamber **42** for mounting and enclosing a roll of a photosensitive image-recording sheet **44** of the type described. The rear housing section also includes a portion designated **46** located at the end of rear wall **36** opposite end section **38** which projects rearwardly from rear wall **36** and includes a wall **48** having an L-shaped cross section (viewing FIG. 5) and upper and lower side walls **50** which are disposed above and below upper and lower side walls **20** and **22**. The rear housing section is pivotable between the closed or operative position shown in FIGS. 1, 3 and 5 in which the forward and rear housing section cooperate to provide closed storage chamber **42**; and an open position shown in FIG. 2 at which access is provided to chamber **42** for loading a roll of image-recording sheet **44** into the storage chamber and threading the sheet or a leader attached thereto through the camera between rear walls **28** and **36** across exposure aperture **30**. The rear surface of rear wall **28** and the forward surface of rear wall **36** are located generally at the focal surface of the lens of assembly **32** and cooperate to locate successive areas of the image-recording sheet in position for exposure to light transmitted by the lens through aperture **30**.

Forward housing section 12 includes an enlarged end section comprising outer upper and lower walls 52 and 54 spaced from and cooperating with upper and lower walls 20 and 22 to define chambers 56 and 58 at an end of the forward housing section in respectively the upper and lower portions thereof for enclosing components of the operating mechanism of the camera. The forward housing section also includes an end wall designated 60 spaced from end wall 26 and cooperating with the latter, forward wall 18 and upper and lower walls 20 and 22 to provide another chamber 62 for enclosing components of the apparatus. End wall 60 also functions to provide a wall for a sealed container (to be described hereinafter). End walls 26 and 60 extend rearwardly to join rear wall 36 at the end of the forward housing section 12 further from chamber 42.

End section 16 of the camera housing includes a forward wall 64, a curved end wall 66, a rear wall 68, inner upper wall 70, outer upper 72, inner lower wall 74 and an outer lower wall 76. The inner and outer upper walls cooperate to define a chamber 78, and the inner and outer lower walls cooperate to define chamber 80, chambers 78 and 80 being provided for enclosing elements of the camera. The inner upper and lower walls 70 and 74, forward wall 64, end wall 66, and rear wall 68 cooperate to provide an open storage chamber 82 for a supply of the image-recording sheet designated 84. End section 16 is coupled with forward housing section 12 by a hinge 86 constructed to provide for limited linear movement of the end section relative to the forward section as well as pivotal movement of the two sections with respect to one another. Hinge 86 is secured to forward walls 18 and 64 of, respectively, the forward and end housing sections and permits the end section to be pivoted with respect to the forward section between the operative or closed position shown in FIGS. 1, 3, and 5, and the open or inoperative position shown in FIG. 2. In the closed position of the end section of the housing, end walls 60 of the forward section cooperates with the end sections to provide a closure for storage chamber 82, whereas in the open position of the end section, chamber 82 is open to permit loading of a supply of an image-receiving sheet 84 into chamber 82.

End section 16 of the housing includes a rearwardly projecting portion 88 comprising upper and lower walls 90 joined by an L-shaped wall 92 extending rearwardly from rear wall 68 and then parallel with the rear wall and cooperating with upper and lower walls 90 to provide a chamber 94 for enclosing components of the apparatus.

The camera includes means for retaining the housing sections in the closed or operative position shown in FIGS. 1, 3 and 5. These means comprise extensions 96 on the upper and lower portions of L-shaped wall 92 which extend, in the closed position of the housing, outside of wall 48 of portion 46 of rear housing section 14. In order to close the housing, the rear housing section 14 is pivoted from the open position shown in FIG. 2 to a closed position whereupon end section 16 is pivoted from an open position to a closed position so that extensions 96 extend outside of wall 48 preventing pivotal movement of rear housing section from its closed position. Latch means are provided for retaining end housing section 16 in its closed position and in the form shown comprise a pair of generally L-shaped latching arms 98 each having a hook 100 on its inner end. Arms 98 are pivotally mounted intermediate their ends coaxially within chambers 78 and 80 on studs 102 and are biased into latching position, that is, in a counterclockwise direction viewing FIG. 3, by torsion spring 104. The ends of arms 98 opposite hooks 100 project from chambers 78 and 80 through slots 106 in end walls 66 and are coupled with one another by a bar 108 which may be engaged manually for pivoting latch arms 98 between latched and unlatched positions. Cover plates 110 are provided adjacent the outer ends of arms 98 for preventing the admission of light into the camera housing through slots 106. Latching studs 112 are provided mounted on upper and lower side walls 20 and 22 within chambers 56 and 58 of forward housing section 12 in position to be engaged by hooks 100 when the end housing section is pivoted into closed position and thereby retain the end housing section in closed position.

In the operative position of the housing sections, walls 48, 92 and extensions 96 of wall 92 cooperate to define a slot 114 connecting with chamber 94 defined by portions 46 and 88 of the rear and end housing sections. Slot 114 is dimensioned to permit withdrawal of the image-recording and image-receiving sheets in superposition from the camera housing and a cutting bar 116 having a sharpened, serrated edge, is provided within slot 114 on wall 48 for facilitating the severance of sheet materials extending from the camera housing through the slot.

Photosensitive image-recording sheet 44 is supplied in a coiled condition in the usual manner, e.g., on a spool, is housed in chamber 42 and is threaded from the chamber across opening 30 between rear walls 28 and 36 into chamber 94. The liquid impregnated image-receiving sheet 84 is supplied in a coiled condition in a container which is substantially impermeable to the processing liquid, water vapor and gases, particularly carbon dioxide. A typical container for the liquid impregnated image-receiving sheet is illustrated in FIGS. 5, 6 and 7 of the drawings. This container, designated 118, includes a generally cylindrical peripheral wall 120 and two circular end walls 122. Wall 120 is provided with an axial slot defined by a pair of overlapping outer and inner lips designated, respectively, 124 and 126. The edge portion of the outer lip is thickened and the inner lip is provided with a rib to stiffen the two lips and retain them in a closed position in engagement with a portion of image-receiving sheet 84 extending from the container through the passage between the lips. The edge 128 of inner lip 126 closest the outer lip is provided with a sharpened corner designed to function as a squeegee for removing liquid from a surface of image-receiving sheet 84. Container 118 may be formed of any suitable material particularly organic plastics, such as polyethylene, which are air and water vapor impervious and are compatible with aqueous alkaline liquids. The image-receiving sheet is supplied in a coiled condition in container 118 with a leading end portion of the sheet extending from the container through the passage between lips 124 and 126. Additional means may be provided for sealing the passage against the admission of air and the leakage of water or water vapor and in the form shown these sealing means may comprise a seal 130 of some material, such as wax, which may be introduced in a softened or molten condition into the passage between lips 124 and 126 in surrounding relation to the sheet to fill the passage and form a rupturable bond between the sheet and container to prevent the passage of air and water between the lips.

Container 118 in which liquid impregnated sheet 84 is supplied is unsealed at the commencement of withdrawal of the image-receiving sheet therefrom and in the form shown remains unsealed thereafter. Accordingly, the camera in which the container is employed includes either: means for sealing the container against the escape of water vapor and the admission of carbon dioxide, or a container for holding container 118 and which may be sealed against the escape of water vapor and the admission of carbon dioxide, between times when the image-receiving sheet is being withdrawn from container 118 and/or the container within the camera. The camera shown in FIGS. 2 through 5 includes a container which is substantially impervious to water vapor and carbon dioxide and may be sealed against the admission or escape of water vapor and carbon dioxide and may be opened to permit the withdrawal movement of the image-receiving sheet therefrom. This container comprises storage chamber 82 and is defined by end wall 60,

inner upper wall 70, inner lower wall 74 and end wall 66. Means are provided for sealing storage chamber 82 and, in the form shown in FIGS. 2, 5 and 10, comprise a pair of seals 134 and 136. Seals 134 and 136 are preferably formed of an elastomeric material which is compatible or unaffected by hydroxide, is substantially impervious to water vapor and carbon dioxide, and is highly resistant to assuming a permanent set. Seal 134 is generally rectangular in shape and includes a thin rectangular medial membrane 138 surrounded by marginal engagement portions termed and designated a forward sealing section 140, a rear sealing section 142 and end sealing sections 144. Forward sealing section 140 and end sealing sections 144 are formed with a continuous U-shaped projecting ridge 146 having a triangular cross section while rear sealing section 142 has a substantially flat surface. Seal 134 is secured to the surface of end wall 60 within storage chamber 82 and not only functions as a seal for the chamber but cooperates to protect end wall 60 from the highly corrosive processing liquid thereby permitting a wider choice of materials, including metals, for use in the construction of the camera housing.

Seal 136 includes a membrane 148 in the form of an open, tube-shaped container adapted to fit within storage chamber 82 against end wall 66 and inner and upper and lower walls 70 and 74. Seal 136 includes a forward sealing flange 150, end sealing flanges 152 and a rear sealing flange 154 which cooperate with respectively forward sealing section 140, end sealing section 144 and rear sealing section 142 to seal chamber 82 in the closed position thereof. Forward sealing flange 150 and end sealing flanges 152 include substantially flat surfaces which are engaged by the sharp edge of triangular ridge 146 to form a liquid and gas tight seal. Rear sealing flange 154 is provided with a projecting V-shaped ridge 156 which bears against the flat surface of rear sealing section 142 to form a water vapor and carbon dioxide impervious seal. The ends of ridges 146 and 156 are notched so as to overlap one another and cooperate to form a seal at the ends of the seal made by ridge 156. Ridge 156 may also function as a squeegee, and in an alternative embodiment may be provided on rear sealing section 142 rather than on rear sealing flange 154 as part of a continuous rectangular ridge and thereby function as a squeegee for removing liquid from that surface of the image-receiving sheet which faces seal 134 during withdrawal of the image-receiving sheet from storage chamber 82.

The camera housing sections are retained in closed position by latching arms 98 and studs 112 which are so designed as to cause compression of the mutually engageable sections of seals 134 and 136 when the camera housing sections are in closed position. In order to withdraw the image-receiving sheet from chamber 82, the chamber is opened at rear sealing section 142 and rear sealing flange 154 by pivoting end housing section 16 with respect to forward housing section 12 about an axis intermediate the forward and rear seals and extending approximately through the axis of studs 112. This pivotal movement is achieved by further compressing forward sealing section 140 and forward sealing flange 150 which, being elastomeric, function as a spring to close the seal at the rear of the storage chamber when the force tending to pivot the end housing section is removed. As a means for pivoting the end housing section to open the container to provide a withdrawal passage between rear sealing section 142 and rear sealing flange 154, there are provided a pair of levers 158 each pivotally mounted intermediate its ends on a stud 160 mounted in one of chambers 56 and 58 on respectively outer upper wall 52 and outer lower wall 54. Levers 158 are mounted coaxially and coact, when pivoted in a clockwise direction (viewing FIG. 3), with a pair of studs 162, one of which is mounted between inner and outer upper walls 70 and 72 and the other mounted between inner and outer lower walls 74 and 76.

To process an exposed area of image-recording sheet 44 to produce a transfer image in a corresponding area of the image-receiving sheet, the two sheets are pressed into superposition with one another. This processing is accomplished by a pair of pressure rolls 164 and 166. Each of rolls 164 and 166 is shown as comprising a metal shaft designated, respectively, 168 and 170, covered by an elastomeric material such that the rolls are slightly compressible and, in fact, the resiliency of the elastomeric material may be employed to apply the necessary pressure to the two sheets. Roll 164 is pivotally mounted on rear housing section 14 between upper and lower side walls 50 for movement into juxtaposition with roll 166 which is also mounted within chamber 94 on inner upper wall 70 and inner lower wall 74. Shaft 170 of roll 166 is journaled in slots 172 in inner upper wall 70 and inner lower wall 74 and extends into chambers 78 and 80 and thus mounting roll 166 for limited movement, in the closed position of the camera housing, toward and away from roll 164.

In the operative position of the camera housing sections, the rolls are urged against one another and for this purpose levers 158 are provided at their rearmost ends with hooks 174 for engaging shaft 170 of roll 166. In the operation of the camera, image-receiving sheet 84 extends from chamber 82 into superposition with image-recording sheet 44 between rolls 164 and 166. The rolls are rotated in engagement with the superposed sheets in order to superpose an exposed area of the photosensitive sheet with an area of receiving sheet and simultaneously advance the sandwich thus formed from the camera through slot 114 and advance the next succeeding area of the image-recording sheet into position for exposure in alignment with aperture 30. The means for rotating the rolls comprise a manually engageable crank 176 for rotating a shaft 178 extending downwardly through chamber 62 and 56. Keyed to shaft 178 is a gear 180 for driving a gear 182 keyed to shaft 168 through idler gears 184 and 186. The gear ratio is such that one complete revolution of crank 176 rotates roll 164 sufficiently to advance an exposed area of the image-recording sheet into superposition with the image-receiving sheet and from the camera. It should be noted that roll 164 is located as close as possible to the end edge of exposure aperture 30 and the opening into chamber 82 so as to minimize the length of sheet materials constituting waste between successive exposed areas of the photosensitive sheet and the length of the image-recording sheet superposed therewith.

Rolls 164 and 166 are normally spaced apart from one another, i.e., between processing operations which helps to prevent the elastomer material comprising the rolls from taking a set and are urged toward one another to compress the sheets only during movement of the sheets between the rolls. At the same time the rolls are spaced apart, i.e., between processing operations, chamber 82 is sealed, the chamber being opened by spacing apart rear sealing section 142 and rear sealing flange 154 only during advancement of the sheets and withdrawal of the image-recording sheet. The apparatus includes means operated by crank 176 for simultaneously opening the container to permit withdrawal of the image-receiving sheet and urging roll 166 toward roll 164 to press the sheets against one another at the commencement of advancement of the sheets. These last-mentioned means also function to close the container and relieve the bias on roll 166 to terminate the advancement of the sheets through the apparatus after predetermined lengths of the sheets have been moved in superposition as a sandwich between rolls 164 and 166 from the apparatus through slot 114. Advancement of the sheets is terminated in three ways, that is, by relieving the bias on roll 166 urging the rolls into frictional engagement with the sheets so that rotation of the rolls is ineffective to advance the sheets further; by closing chamber 82 so that rear sealing section 142 and rear sealing flange 154 grip the image-receiving sheet effectively sealing the chamber and preventing movement of the image-

receiving sheet; and discontinuing the rotation of crank **176**.

The aforementioned means for indexing the advancement of the sheets, sealing and unsealing storage chamber **82** and biasing and relieving the bias on the rolls comprise cams **188** keyed near the ends of shaft **178** within chambers **56** and **58** for engaging the forward ends of levers **158** during the initial portion of the clockwise rotation of shaft **178** to pivot levers **158** in a clockwise direction opening chamber **82** and urging roll **166** toward roll **164**. FIGS. 3 and 4 illustrate the operating mechanism of the camera in a position just prior to commencement of advancement of the sheets or, in other words, at the termination of advancement of preceding sections of the sheets. The mechanism is designed and constructed so that after the initial rotation of shaft **178**, the only torque required to be applied to the shaft is that necessary to rotate shaft **168** and roll **164** for advancing the sheets. This construction includes latch members **190** mounted for pivotal movement within chambers **56** and **58** and urged in a clockwise direction (viewing FIG. 3) by torsion springs **192** toward the forward ends of levers **158**. Thus the latch members and levers are so arranged that when the levers are pivoted during the initial portion of the rotation of cams **188**, latch members **190** pivot into engagement with levers **158** retaining the levers in their pivoted (clockwise) position at which the levers retain storage chamber **82** in an open position and urge roll **166** toward roll **164**. Levers **158** include recesses **194** which provide for clearance between cams **188** and the levers so that the cams may continue to rotate without engaging the levers. During the terminal portion of rotation of cams **188**, the cams engage latch members **190** pivoting the latch members in a counterclockwise direction out of engagement with levers **158** thereby relieving the bias on roll **166** and permitting storage chamber **82** to return to a closed position.

The film assemblage, including the sheet materials employed in the camera shown and described, is supplied with a leading end portion thereof, or leader attached thereto, extending from container **118** and coupled with a leader or the leading end of the image-recording sheet. To load the camera, the coil of image-recording sheet is introduced into chamber **42**; the rear housing section is pivoted into closed position; the container of image-receiving sheet is loaded into chamber **82**; end housing section **16** is then pivoted into closed position, and latching arms **98** are pivoted in a counterclockwise direction to retain the camera in closed position. The camera housing sections are thus closed with the coupled leaders extending between rolls **164** and **166** through slot **114**. Crank **176** is then rotated through 360° to advance an area of the image-recording sheet into position for exposure. Following exposure of this and each succeeding area of the image-recording sheet, crank **176** is again rotated through one revolution to process each exposed area of the image-recording sheet by pressing it into superposition with an area of the image-receiving sheet to form a sandwich and advancing the sandwich from the camera through slot **114**. The superposed areas of the two sheets comprising the sandwich may be severed from portions of the sheets remaining within the camera housing by drawing the sandwich against cutting bar **116**. The sheets are retained in superposition during a processing period of predetermined duration at the end of which the sheets are separated to reveal a transfer print on the image-receiving sheet.

In another embodiment of the apparatus of the invention, the camera includes a seal, which may be opened and closed, for the container in which the image-recording sheet is supplied, rather than a complete container in itself, so that the camera and film assemblage combine to form a container which can be sealed and unsealed. In the form shown in FIG. 8, image-receiving sheet **84** is supplied in a coiled condition in a container in the form of a bag **196**. The image-receiving sheet is coiled within a cylindrical sleeve **198** having an axial slot and designed to retain the image-receiving sheet in a coiled condition and allow it to be withdrawn from the coil. Bag **196** is formed by wrapping a generally rectangular sheet of a water vapor, alkali and gas impervious material around the coiled image-receiving sheet, bringing the edges of the sheet material comprising the bag together and sealing or adhering the edges to one another and to the sheet which is allowed to extend from the bag. The sheet material comprising the bag may be a multi-ply material formed, for example, of paper and/or metal foil with an inner ply of a polymeric material, preferably one which is thermoplastic and can be bonded to itself and other materials by application of heat and pressure. The completed container is formed with a pair of lips designated **200** releasably secured to the image-receiving sheet and defining a mouth through which the image-receiving sheet may be withdrawn. Alternatively, a clip or other means may be provided for holding lips **200** in a closed position prior to loading of the container into a camera. The film assemblage shown in FIG. 8 also includes a reservoir for excess water or processing liquid and a getter for carbon dioxide. This reservoir takes the form of sheet **132** of an absorbent material impregnated with the desired liquid disposed within sleeve **198** in surrounding relation to the coiled image-receiving sheet.

The camera for use with this film assemblage is shown in FIG. 9 and, in most respects, is substantially the same as the camera shown in FIGS. 1 through 5 and differs therefrom primarily with regard to the sealing of storage chamber **82** and a seal for bag **196**. Storage chamber **82** is provided without any means for sealing the chamber but instead, is provided with a container seal comprising a pair of shoes **204** and **206**. Shoe **204** is mounted in fixed position on end wall **60** and shoe **206** is mounted on a block **212** mounted on rear wall **68** in juxtaposition with shoe **204** for movement toward and away from the latter. Each of the shoes comprises an elongated member formed of a pliant and/or elastomeric material such that when the shoes are pressed together with lips **200** engaged therebetween, the shoes effectively seal the lips against the admission of gas into the container or the escape of water vapor therefrom. The film assembly of FIG. 8 is positioned within storage chamber **82** with the edges of the lips disposed between the shoes, shoe **206** being urged toward shoe **204** by resilient means such as a spring or springs **208**.

As a means for separating the shoes to permit withdrawal of image-receiving sheet **84** between lips **200**, there are provided a pair of pins **210** extending from the ends of block **212** on which shoe **206** is mounted. Pins **210** extend upwardly and downwardly into portions of the camera corresponding to chambers **78** and **80**, and levers **158** are provided with cams (not shown) for coacting with the pins during pivotal movement of levers **158** in a clockwise direction to space shoe **206** apart from shoe **204**. The form of camera shown in FIG. 9 is somewhat simpler than the one previously described inasmuch as chamber **82** is not required to function as a container thereby making seals **134** and **136** unnecessary and eliminating the necessity for a slidable hinge as shown in FIG. 5 and inner upper and lower walls **70** and **74**. In most other respects the camera of FIG. 9, particularly the operating mechanism, is substantially the same as that previously described.

The film assemblage described herein together with the camera are intended for intermittent frame by frame exposure and processing, with the film assemblage itself being substantially simplified, as compared to existing self-developing roll film assemblages, in that its essential elements are limited to an image-recording sheet, a liquid impregnated image-receiving sheet and a container for the latter. Masks, fluid collecting and retaining de-

vices, indexing references and the like, heretofore associated with this type of roll film assemblage, have been made unnecessary and the camera itself is simplified particularly with regard to the mechanism for pressing the two sheets together and distributing the processing liquid between the sheets.

The camera may be modified to provide for withdrawal of the sheets by manually engaging and pulling on the sheets. In this form of camera, an indexing system may be provided in association with the rolls replacing the drive system described, and manually operable means would be provided for at least opening the container to permit withdrawal of the image-receiving sheet.

Since certain changes may be made in the above apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In photographic apparatus for exposing and thereafter treating with a liquid successive portions of a photosensitive image-recording sheet, in combination:

a pair of juxtaposed members for pressing successive exposed portions of said image-recording sheet into superposition with successive portions of a second sheet impregnated with said liquid;

closure means for a container;

said closure means including sections movable between a first position in which said sections define an opening through which a portion of said liquid impregnated second sheet is withdrawn from said container, and a second position in which said sections engage said second sheet and substantially seal said opening against passage of gas therethrough;

means for retaining said sections of said closure means in said second position; and

means for moving said sections of said closure means into said first position to permit movement of one of said portions of said second sheet through said opening into superposition with said image-recording sheet.

2. In photographic apparatus for exposing and thereafter treating with a liquid successive portions of a photosensitive image-recording sheet, in combination:

a pair of juxtaposed members for pressing successive exposed portions of said image-recording sheet into superposition with successive portions of a second sheet impregnated with said liquid;

means for moving closure members of a container, located within said apparatus, between a first position in which said closure members define an opening through which a portion of said liquid-impregnated second sheet is withdrawn from said container and a second position in which said closure members engage said second sheet and substantially seal said opening against the passage of gas therethrough;

means cooperating with said first-mentioned means for retaining said closure members in said second position;

drive means for advancing said sheets through said apparatus to withdraw a portion of said second sheet from said container through said opening and press said portion of said second sheet into superposition with an exposed portion of said image-recording sheet between said juxtaposed members; and

said first-mentioned means being coupled with said drive means and operated thereby for moving said closure members into said first position to permit movement of one of said portions of said second sheet through said opening into superposition with said image-recording sheet.

3. The photographic apparatus of claim 2 in which said first-mentioned means include at least a pair of members movable to a position apart from one another to permit introduction of a roll of said second sheet into said apparatus between the last-mentioned members.

4. In photographic apparatus for exposing and thereafter treating with a liquid successive portions of a photosensitive image-recording sheet, in combination:

a pair of juxtaposed members for pressing successive exposed portions of said image-recording sheet into superposition with successive portions of a second sheet impregnated with said liquid;

closure means for a container;

said closure means including sections movable between a first position in which said sections define an opening through which a portion of said liquid impregnated second sheet is withdrawn from said container, and a second position in which said sections engage said second sheet and substantially seal said opening against the passage of gas therethrough;

means for retaining said sections on said closure means in said second position;

drive means for advancing said sheets through said apparatus to withdraw a portion of said second sheet from said container through said opening and press said portion of said second sheet into superposition with an exposed portion of said image-recording sheet between said members; and

means coupled with said drive means and operated thereby for moving said sections of said closure means into said first position to permit movement of one of said portions of said second sheet through said opening into superposition with said image-recording sheet.

5. The photographic apparatus of claim 4 in which said closure means are movable to a third position to permit introduction of a roll of said second sheet through said opening.

6. Photographic apparatus as defined in claim 4 comprising a housing for mounting and enclosing the components of said apparatus and said sheets, said housing including two sections movable relative to one another to permit loading of said sheets into said housing, one of said sections of said closure means being mounted on one of said housing sections and another of said sections of said closure means being mounted on the other of said housing sections for movement relative to said one section of said closure means.

7. Photographic apparatus as defined in claim 4 comprising a housing for mounting and enclosing the components of said apparatus and said sheets, said housing including first, second and third sections movable with respect to one another to permit loading of said sheets into said housing, said first and second housing sections including means for holding said image-recording sheet, one of said juxtaposed members being mounted on said second housing section, the other of said juxtaposed members and one of said sections of said closure means being mounted on said third housing section and the other of said sections of said closure means being mounted on said first housing section.

8. Photographic apparatus as defined in claim 4 comprising means within said apparatus for mounting a container holding said second sheet and said liquid and including closure sections defining a narrow passage through which said second sheet extends, and said sections of said closure means including means for engaging said second sheet and said closure sections of said container for substantially sealing said container against the admission of gas to said container through said passage.

9. The photographic apparatus of claim 8 in which at least one of said closure sections of said container includes a squeegee for engaging said second sheet within said container during withdrawal movement of said second sheet to remove liquid from at least one surface thereof.

10. The photographic apparatus of claim 4 in which said closure means comprise a pair of water and gas impermeable, compliant members mounted for movement

toward and away from one another and means for pressing said compliant members against one another with portions of said one container surrounding said opening and a portion of said second sheet extending through said opening located between said compliant members to prevent the passage of gas and water through said opening.

11. Photographic apparatus for exposing successive areas of a photosensitive image-recording sheet and treating each of said exposed areas by pressing said exposed area into superposition with an area of a second sheet impregnated with a liquid, said apparatus comprising, in combination:

a housing;

means within said housing for holding a supply of said image-recording sheet and locating successive areas thereof in position for exposure;

a pair of juxtaposed rolls for pressing successive areas of said image-recording sheet and said second sheet into superposition;

drive means for rotating at least one of said rolls for advancing said sheets through said apparatus into superposition between said rolls;

closure means for a container holding a supply of said second sheet;

said enclosure means including juxtaposed closure members movable between an open position in which said closure members define an opening through which said liquid impregnated second sheet can be withdrawn from said container and a closed position in which said closure members engage said second sheet to seal said container against the admission of gas thereto and prevent withdrawal movement of said second sheet therefrom;

means for retaining said closure members in said closed position; and

means coupled with said drive means and operated thereby for moving said closure members to said open position simultaneously with commencement of movement of said sheets through said apparatus into superposition and moving said closure members to said closed position simultaneously with termination of said movement of said sheets.

12. In photographic apparatus for exposing and thereafter treating with a liquid successive portions of a photosensitive image-recording sheet, in combination:

a pair of juxtaposed members for pressing successive exposed portions of said image-recording sheet into superposition with successive portions of a second sheet impregnated with said liquid;

a container for holding a length of said liquid impregnated second sheet;

said container including sections movable with respect to one another to provide a narrow passage through which said second sheet is movable;

sealing means providing a substantially gas and liquid impermeable seal between said container sections;

means for holding said container sections and said sealing means in a closed and sealed condition;

driving means for advancing said sheets through said apparatus to withdraw a portion of said second sheet from said container through said passage and press said portion of said second sheet into superposition with an exposed portion of said image-recording sheet between said members; and

means coupled with said drive means and operated thereby for moving said container sections to open said passage during withdrawal movement of said second sheet from said container through said passage.

13. The photographic apparatus of claim 12 in which said container sections are movable between a first position in which said container is substantially sealed, a second position in which said narrow passage is open to allow withdrawal movement of said second sheet therethrough, and a third position in which said sections are separated sufficiently to permit loading of a roll of said second sheet into said container.

14. Photographic apparatus of claim 12 in which a squeegee is provided within said container for removing liquid from a surface of said second sheet during withdrawal movement of said second sheet from said container.

15. Photographic apparatus as defined in claim 12 comprising a housing for mounting and enclosing the components of said apparatus and said sheets, said housing including two sections movable with respect to one another to permit loading of said sheets into said housing, one of said container sections being mounted on one of said housing sections and another of said container sections being mounted on the other of said housing sections for movement relative to said one container section to separate said container sections sufficiently to permit loading of a roll of said second sheet into said container.

16. Photographic apparatus as defined in claim 12 comprising a housing for mounting and enclosing the components of said apparatus and said sheets, said housing including first, second and third sections movable with respect to one another to permit loading of said sheets into said housing, said first and second housing sections including means for holding said image-recording sheet and positioning successive portions thereof for exposure, one of said juxtaposed members being associated with said second housing section, the other of said juxtaposed members and one of said container sections being associated with said third housing section, and the other of said container sections being associated with said first housing section.

17. Photographic apparatus for exposing successive areas of a photosensitive image-recording sheet and treating each of said exposed areas by pressing said exposed area into superposition with an area of a second sheet impregnated with a liquid, said apparatus comprising, in combination:

a housing;

means within said housing for holding a supply of said image-recording sheet and locating successive areas thereof in position for exposure;

a pair of juxtaposed rolls for pressing successive areas of said image-recording sheet and said second sheet into superposition;

drive means for rotating at least one of said rolls for advancing said sheets through said apparatus into superposition between said rolls;

a container for holding a supply of said second sheet impregnated with said liquid;

said container including juxtaposed closure means movable relative to one another between an open position in which said closure means define an opening through which said liquid impregnated second sheet can be withdrawn from said container and a closed position in which said closure means engage said second sheet to seal said container against the admission of gas thereto and prevent withdrawal movement of said second sheet therefrom;

means for retaining said closure means in said closed position; and

means coupled with said drive means and operated thereby for moving said closure means to said open position simultaneously with commencement of movement of said sheets through said apparatus into superposition with one another between said rolls and moving said closure means to said closed position simultaneously with termination of said movement of said sheets.

18. Photographic apparatus for exposing successive areas of a photosensitive image-recording sheet and treating each of said exposed areas by pressing said exposed area into superposition with an area of a second sheet im-

pregnated with a liquid, said apparatus comprising, in combination:

a housing including means holding a supply of said image-recording sheet and locating successive areas thereof in position for exposure;

a pair of relatively movable closure members disposed in engagement with portions of a container adjacent an opening therein and with an image-receiving sheet impregnated with said liquid and extending from said container;

a pair of juxtaposed members for pressing successive areas of said image-recording sheet and said image-receiving sheet into superposition;

drive means for advancing said sheets through said apparatus to move successive areas of said photosensitive sheet into position for exposure and following

exposure thereof, superpose said areas with areas of said image-receiving sheet withdrawn from said container between said closure members; and

said closure members being coupled with said drive means and operated thereby for moving said closure members between a first position in which said container is sealed against the admission of gas and a second position at which said image-recording sheet can be withdrawn from said container.

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