Dec. 13, 1960 D. R. BISHOP ET AL 2,963,953

PHOTOGRAPHIC APPARATUS

Filed July 13, 1955 2 Sheets-Sheet 1

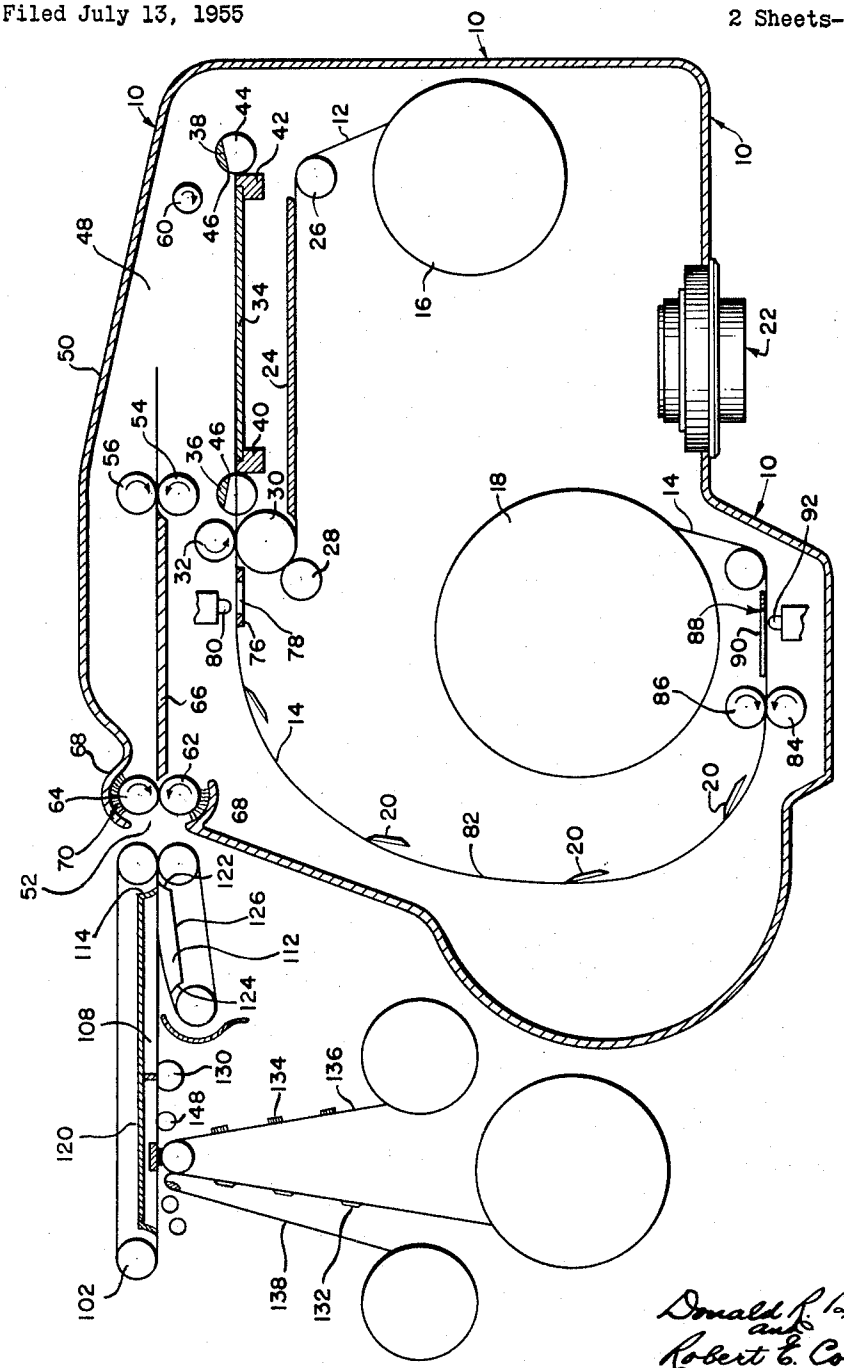


FIG. 1

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Dec. 13, 1960 D. R. BISHOP ET AL 2,963,953

PHOTOGRAPHIC APPARATUS

Filed July 13, 1955 2 Sheets-Sheet 2

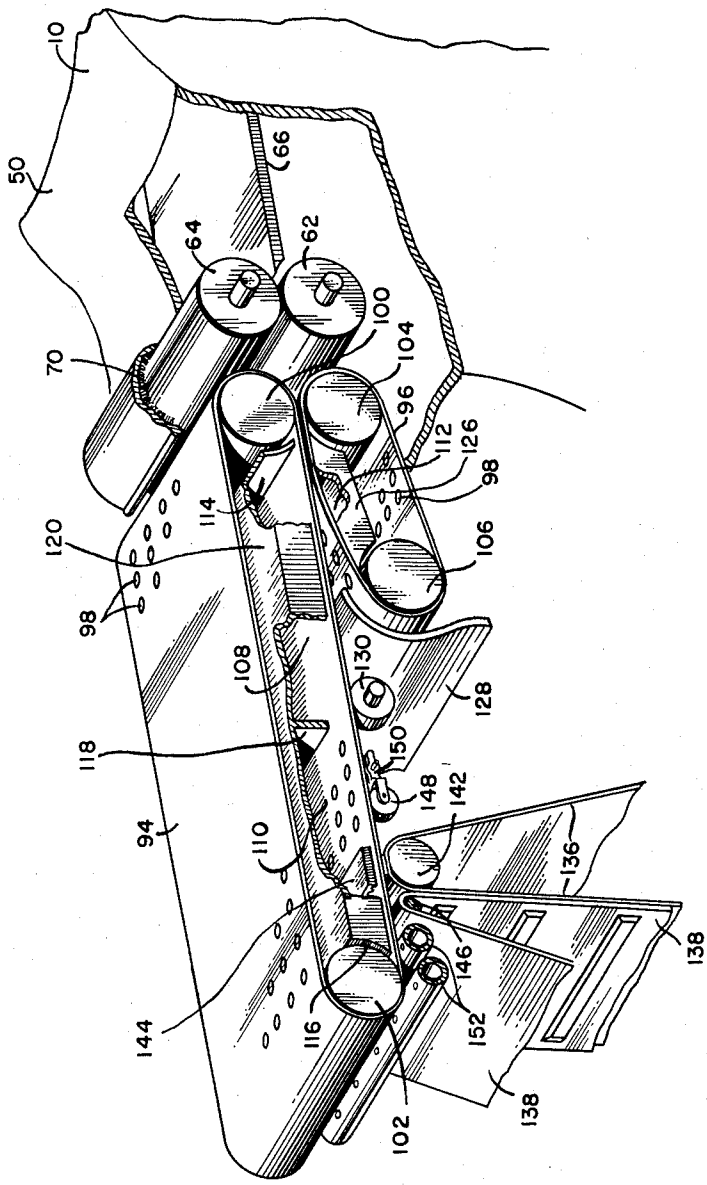


FIG. 2

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2,963,953

PHOTOGRAPHIC APPARATUS

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Filed July 13, 1955, Ser. No. 521,792

9 Claims. (Cl. 95—89)

This invention relates to photographic methods and apparatus for photoexposing successive areas of light-sensitive sheet material and processing each exposed area in conjunction with another sheet to produce a visible photographic image on at least one of the sheets, and is particularly concerned with methods and apparatus of this type including the steps of and means for substantially automatically separating the two sheets following processing and protectively treating the photographic image.

Methods and apparatus have been proposed for automatically exposing successive frames of a photosensitive sheet and thereafter processing said frames by superposing them with areas of another sheet with a processing composition distributed between the outer surfaces of the two sheets. The other sheet may merely aid in the distribution of the processing composition or it is preferably capable of receiving and supporting a positive photographic silver image formed by any one of the transfer processes now well known in the art. It is desirable, shortly after completion of the processing, to strip apart and treat the photographic silver image in such a manner as to protectively coat the image surface. This protective treatment preferably includes the application of a transparent protective coating to the photographic silver image with attendant cleansing therefrom of any residual processing reagents which may prove harmful to the image. Heretofore, the stripping, coating and washing operations have been performed almost entirely as manual operations following completion of the exposure and processing steps in apparatus such as an automatic camera.

Accordingly, it is an object of the present invention to provide improved photographic methods and apparatus for exposing and completely processing photographic sheet materials to produce a finished photographic print having a protective coating on its image surface.

The removal of residual processing reagents is essentially a washing action and is an adjunct of the coating operation, effected by wiping or rubbing the surface to be protectively coated and washed with an absorbent coating element charged with a coating and washing liquid. During coating and washing of each print, the absorbent material comprising the coating element may become charged with processing reagents washed from the print so that repeated use of one coating element may result in depletion of the coating liquid and buildup of the concentration of processing reagents on the absorbent material sufficient to render the coating element ineffective to wash and coat a print surface. For these reasons and because the coating liquid is preferably of the type adapted to harden or solidify on exposure to the atmosphere, it is desirable that a coating element be provided in a substantially hermetically sealed container the walls of which are impervious to the coating liquid; that the container be opened immediately prior to employment of the coating element to wash and coat a print surface; and that the coating element be used for only one print.

Accordingly, other objects of the present invention are to provide novel methods and apparatus for substantially automatically protectively coating and washing the image surface of a photographic print; and to provide methods and apparatus of the above type for protectively coating and washing silver image surfaces of successive photographic prints, said methods including providing a plurality of coating elements, maintaining each of said elements out of contact with the atmosphere until immediately prior to employment of the element to coat and wash a print surface by rubbing said element in frictional contact with the surface to be coated and washed, and disposing of each of said coating elements following employment of the element to coat and wash the image surface of a single photographic print.

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

The invention accordingly comprises the process involving the several steps and the relation and order of one or more of such steps with respect to each of the others, and 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 sectional view of apparatus embodying the present invention taken along a plane substantially midway between the sides of the apparatus; and

Fig. 2 is a perspective view with parts broken away of one component of the apparatus of Fig. 1.

The process steps of the herein disclosed invention preferably comprise a method of automatically processing photographic sheet material and the apparatus of the invention is embodied in photographic apparatus such as a substantially automatic camera capable of exposing successive frames of a photosensitive sheet material and immediately processing the sheet material to produce a succession of individual completely finished photographic prints. Photographic apparatus of this type preferably includes means for processing an exposed photosensitive sheet by superposing said photosensitive sheet on another sheet and spreading a thin layer of processing composition between said sheets. The photosensitive sheet includes a layer of photosensitive material, preferably an emulsion of silver halide, in which a latent image may be attained by differential exposure to actinic light. The second sheet is adapted to serve as a support for an image-receptive layer in which a visible print of a latent image in a photosensitive layer may be produced. The processing composition, when spread in a uniformly thin layer between the photosensitive and second sheets, preferably effectuates a silver halide diffusion transfer-reversal process by which a latent image in the photosensitive sheet is developed and a positive silver image is produced in the second sheet. Examples of photographic materials useful in processes of the foregoing type are described in detail in Patent No. 2,543,181, issued to Edwin H. Land on February 27, 1951. It is, of course, to be understood that the photographic apparatus herein described is not limited to use with any particular species of photosensitive or second sheets, the terms "photosensitive" and "second" sheet being used in their broadest sense to indicate a first sheet which is photosensitive and a second sheet which may assist in the uniform layer-wise distribution of a liquid processing composition over the photosensitive sheet, may carry one or more of the processing reagents in condition to be dissolved in the

layer of processing liquid, or may, if desired, possess other characteristics.

Photographic silver images of the type produced by the above described process are ordinarily extremely thin and usually retain traces of photographic reagents with which they have been processed and the continued presence of which may adversely affect their stability. For example, silver may be oxidized by sulphur from the oxidation of sodium thiosulfate which has been employed as a solvent. Also, silver may be oxidized by such agents as hydrogen sulfide often present in the atmosphere, and traces of unoxidized developer, if oxidized by atmospheric oxygen, may slightly discolor the highlights of the image. The present invention contemplates the method of and apparatus for washing and coating such an image with a composition comprising an aqueous dispersion of a film-forming material. The water acts to wash traces of the photographic reagents from the image and to so distribute the film-forming material that it dries to provide a coating on the image for protecting the image from reaction with chemicals in the atmosphere and such other hazards as dust, dirt, fingerprints, scratches and the like. Compositions of this type may include, for example, a vinyl pyridine polymer and a hydantoin condensation polymer and preferably a salt of a heavy metal which forms an insoluble sulfide. Processes and compositions of the foregoing type are more fully described in applications Serial Nos. 302,746, filed August 5, 1952 and 412,944, filed February 26, 1954, both in the name of Edwin H. Land.

The apparatus as illustrated is specifically suited for automatically exposing a plurality of successive frames of a photosensitive sheet of considerable length and for processing the successive frames by superposing them with areas of a second sheet of substantially equal length, with a layer of processing composition between the frames and areas. The apparatus includes means for cutting the two sheets into sections of predetermined length each including preferably one frame and area, separating each frame and area of the two sheets and washing and/or protectively coating or otherwise treating either or both the frame and area. The apparatus is also adapted to the automatic processing of previously exposed photosensitive sheet in comparatively long strips or in successive exposed sheets of individual frame lengths.

Reference is now made to the drawings, wherein like numerals denote like parts, and particularly to Fig. 1 wherein there is shown, somewhat schematically, a substantially automatic camera comprising the present invention. The camera includes a lighttight housing **10** in which is mounted a supply of a photosensitive sheet **12** and another sheet **14**. Sheet **12** is preferably coiled on a spool **16** of conventional design located within housing **10** adjacent one end thereof and sheet **14** is preferably coiled on a somewhat larger supply spool **18** of conventional design mounted in the lower portion of housing **10** toward the other end thereof. Spool **18** is larger than spool **16** in order to accommodate the greater cross-sectional bulk of sheet **14**, due in large measure to a succession of containers **20** provided thereon for carrying a liquid processing composition. As shown, containers **20** are affixed to sheet **14** at substantially regularly spaced intervals from a location adjacent its leading end toward its trailing end, the containers being so spaced that one container is associated with one image-receiving area. Each container is provided with a rupturable mouth facing the trailing end of sheet **14**, this mouth being adapted to eject processing composition when opposed compressional forces are applied to the container.

A conventional lens and shutter assembly, designated at **22**, is mounted on a lower wall of housing **10** in position to direct light along a path between spools **16** and **18**. As a means for positioning successive frames of sheet **12** for exposure to actinic light from the lens of assembly **22**, there is provided such means as a guide plate **24** positioned above and between spools **16** and **18** and with its lower surface substantially in the focal plane of the lens. Successive frames of sheet **12** are advanced in contact with the lower surface of plate **24** and are thereby positioned for exposure. A pair of guide rollers **26** and **28** are provided at opposite ends of plate **24** for retaining sheet **12** in contact with the lower surface of guide plate **24**, sheet **12** being advanced along a path extending from spool **16** around the upper portion of guide roller **26** and across plate **24** to guide roller **28**.

To effect the processing of latent images in frames of sheet **12**, there are provided pressure-applying means in the form of a pair of rollers **30** and **32** between which sheets **12** anad **14** are advanced in superposition. Advancement of a frame of sheet **12** and an associated image-receiving area of sheet **14** between the rollers causes ejection of the processing composition from the mouth of a container **20** and spreading of the processing composition between the frame and area to form a sandwich. Within the sandwich the latent image in the frame is processed and a positive silver image is formed in the image-receiving area. Rollers **30** and **32** are mounted in juxtaposed relation above and adjacent one end of guide plate **24**, roller **30** being positioned closely adjacent or in contact with guide roller **28**. Resilient means (not shown) are provided for urging rollers **30** and **32** toward one another so that they apply compressive pressure to the sheets as the latter are advanced between the juxtaposed surfaces of the rollers. In practice, sheet **12** extends from guide plate **24** between rollers **28** and **30** into superposition with sheet **14** between rollers **30** and **32** to form a sandwich.

A generally flat elevator platform **34** is provided, normally positioned above guide plate **24** in a plane substantially tangent to the surfaces of rollers **30** and **32** and in position to support a sandwich comprising sheets **12** and **14** as the sandwich is advanced from between rollers **30** and **32**. Cutting means are provided adjacent each end of platform **34** for severing the portion of the sandwich supported thereon, and including a superposed frame and area, from the leading end portion of the sandwich, which includes a collapsed container **20**, and from the leading portions of sheets **12** and **14** extending between rollers **30** and **32**. The two cutting means mounted at opposite ends of platform **34** are substantially the same and include blades **36** and **38** and anvils **40** and **42** mounted, respectively, adjacent rollers **30** and **32** and at the opposite ends of platform **34**. Platform **34**, when in its normal position, is seated at its ends on portions of anvils **40** and **42** and with its upper surface substantially flush with the upper or support surfaces of the anvils. Each blade includes a pair of disklike elements **44** at its opposite ends and a cutting edge **46** extending between the disklike elements. Blades **36** and **38** are mounted for pivotal movement about axes extending substantially through the central portions of disklike elements **44** and lying substantially in the plane of the upper support surfaces of platform **34** and anvils **40** and **42**. Cutting edges **46** and the cooperating edges of anvils **40** and **42** may, if desired, be so formed as to cut the sandwich with a deckled edge, and sheet **14** may have similar deckled lateral edges if desired to provide a print with a more pleasing appearance. A suitable receptacle may be provided adjacent blade **38** between the latter and the end wall of the housing to receive the end portions severed from the successive sandwiches.

In the upper portion of housing **10**, there is provided a processing chamber generally designated at **48** located above elevator platform **34** and in which each of successive sandwiches formed by rollers **30** and **32** is permitted to remain during a predetermined processing period. Processing chamber **48** is defined by an upper wall **50** of housing **10** and extends from one end of the housing adjacent cutting blade **38** at the end of platform **34** spaced furthest from rollers **30** and **32**, to the opposite end of housing **10** wherein there is provided an exit passage **52** through which processed sandwiches may be ejected. As

vancing sheet 14 from supply spool 18 in a manner which is slower and more continuous than the manner in which it is advanced between rollers 30 and 32. The sheet is advanced by the last-mentioned means into a take-up loop 82 from which it may be drawn suddenly and rapidly between rollers 30 and 32. This sheet-advancing means comprises a pair of feed rollers 84 and 86 mounted in the lower portion of housing 10 below supply spool 18. At the start of a processing cycle, take-up loop 82 is of sufficient length to permit the sudden and rapid advancement of an image-receiving area of sheet 14 with its associated container 20 between rollers 30 and 32, and feed rollers 84 and 86 are preferably already in motion. As a means for controlling the length of sheet 14 advanced into loop 82, there is provided a bearing member 88, located adjacent roller 86, below supply spool 18 and above the path of sheet 14, and having a bearing surface across which sheet 14 is adapted to move. The bearing surface of member 88 is provided with a pair of grooves or slots 90 over which a pair of apertures in sheet 14 are adapted to move in aligned relation, thus permitting a pair of stop pins 92 to project into a pair of apertures in sheet 14 when the apertures become aligned with the pins during movement of the sheet. Pins 92 are so mounted as to be movable by engagement with a pair of apertures in sheet 14, and means responsive to the movement of the pins are provided for arresting the rotation of feed rollers 84 and 86.

The drive and control means described in the aforementioned patent application, Serial No. 491,982, also includes means for withdrawing stop pins 80 and 92 from engagement with apertures in sheet 14 and, in addition thereto, includes means for operating the processing timing rollers, elevator roller, elevator platform and cutting means. Ejection roller 64 is driven continuously and ejection rollers 62 and 64 are so positioned with respect to timing rollers 54 and 56 that one end of a sandwich is engaged by the ejection rollers while the other end of the sandwich is still in engagement with the timing rollers. This structure insures engagement of a sandwich by the ejection rollers and in order to prevent damage to the sandwich or premature withdrawal thereof from between the timing rollers when the ejection rollers suddenly grasp the sandwich, roller 64 is driven through a slip clutch which permits the ejection rollers to stop rotating momentarily or to rotate at the same speed as the timing rollers during the period when the sandwich is engaged at its ends by both pairs of rollers.

In operation, the operative cycle of the camera is substantially automatic and begins with the rotation of loop feed rollers 84 and 86 immediately prior to or during exposure. As rollers 84 and 86 commence to advance sheet 14 into take-up loop 82, which is already of sufficient length to permit a withdrawal of an image-receiving area therefrom, stop pins 92 are withdrawn from the perforations with which they were engaged and move to a position wherein they are capable of being engaged by the next successive pair of perforations to arrest the rotation of rollers 84 and 86. Immediately following the exposure of a frame of photosensitive sheet 12, pressure rollers 30 and 32 are so driven as to superpose a frame of sheet 12 with an image-receiving area of sheet 14 and spread processing liquid from the container 20 associated with the image-receiving area between the frame and area to form a sandwich which is advanced by the rollers into processing chamber 48 onto platform 34. As the sheets are advanced between rollers 30 and 32, stop pins 80 ride on the surface of sheet 14 until they become aligned with a pair of apertures in the sheet whereupon they are engaged by the apertures and are carried forward by the sheet to discontinue the rotation of rollers 30 and 32. The drive mechanism is then effective to so rotate the cutting blades 36 and 38 as to cut the sandwich adjacent the ends of the superposed frame and area and thereby sever the portion of the sandwich containing the frame and area from the end portion of the sandwich, including a ruptured container 20, the remaining portions of the sandwich extending between rollers 30 and 32. Elevator roller 60, timing rollers 54 and 56 and ejection rollers 62 and 64 are driven continuously. Following cutting of the sandwich, elevator platform 34 is pivoted upward to bring the sandwich positioned thereon into contact with roller 60 to advance the sandwich into the bite of timing rollers 54 and 56, whereupon elevator platform 34 is returned to its original position for receiving the next successive sandwich. Timing rollers 54 and 56 rotate at a substantially uniform speed calculated to advance each sandwich through chamber 48 into the bite of ejection rollers 54 and 56 at the end of a predetermined processing period. The ejection rollers immediately eject the sandwhich from the processing chamber whereupon the image-receiving area of sheet 14 is stripped from the frame of sheet 12 with which it is superposed.

Various methods and apparatus may be provided for separating sheets 12 and 14, comprising a sandwich, as the latter is ejected from processing chamber 48 by ejection rollers 62 and 64. In the form shown, this type of apparatus is also adapted to aid in the coating operation performed, preferably, on the image surface of sheet 14, and comprises a pair of endless belts 94 and 96 which are at least as wide as sheets 12 and 14. Each belt is provided with a multiplicity of perforations 98 so that a sheet may be held in contact with the forward surface of each belt by reducing the air pressure on the rear surface of the belt and the surfaces of each belt are formed of a material such as a soft rubber or the like capable of snugly seating a sheet adhered thereto by atmospheric pressure and of generating sufficient friction between the belt surface and the sheet to move the latter in contact with a coating device.

Belt 94 is supported between a pair of support rolls 100 and 102 and belt 96 is supported between support rolls 104 and 106. Rolls 100 and 104 are mounted in juxtaposed relation with their axes parallel and the belts 94 and 96 supported in facing relation and preferably in face-to-face contact. Rolls 100 and 104 are so positioned adjacent ejection rollers 62 and 64 that each sandwich is fed by the last-mentioned rollers between belts 94 and 96 as they pass around and between support rolls 100 and 104. The two belts are moved in superposed relation in the direction of advancement of the sandwich by support rolls 100 and 104 and may, for example, be advanced at the same speed the sandwich is advanced by the ejection rollers.

As a means for reducing atmospheric pressure on the rear surfaces of belts 94 and 96, there are provided vacuum chambers 108 and 110 located between support rolls 100 and 102 with the forward peripheries of their walls in contact with the rear surface of belt 94 and a vacuum chamber 112 located between support rolls 104 and 106 with the forward peripheries of its walls in contact with the rear surface of belt 96. Vacuum chambers 108 and 110 include, respectively, end walls 114 and 116 positioned, respectively, adjacent support rolls 100 and 102 and shaped to conform to the peripheries of the rolls so that the pressure on belt 94 may be reduced at a point as closely adjacent each roller as possible. The two vacuum chambers 108 and 110 have a common dividing wall 118 and a common rear wall 120 which may, in another form of the invention, be so formed at its ends as to snugly engage the surfaces of rolls 100 and 102, obviating the necessity for end walls 114 and 116. The forward edges of the side walls of chambers 108 and 110 are in a plane substantially tangent to the surfaces of support rolls 100 and 102 and a suitable suction means is provided for reducing the pressure in chambers 108 and 110.

a means for controlling the processing time during which each sandwich is permitted to remain within processing chamber 48, there is provided a pair of timing rollers 54 and 56 positioned within chamber 48 above cutting blade 36 and urged toward one another by suitable spring means. The processing time for each sandwich is controlled by the rotation of rollers 54 and 56 at a substantially uniform predetermined speed which is sufficient to advance a sandwich positioned between the rollers through chamber 48 toward passage 52 a distance equal to the accurately predetermined length of the sandwich during the predetermined processing period. In the operation of the camera, the severed end of the sandwich adjacent blade 36 is inserted immediately following cutting into the bite of rollers 54 and 56, the latter being in constant rotation at a speed calculated to advance the sandwich completely between the rollers during the predetermined processing period.

Means are provided for advancing the end of a sandwich into the bite of timing rollers 54 and 56 immediately as the sandwich is cut to a predetermined length and, in the form shown, comprises elevator platform 34 having a curved end portion (not shown) extending beyond cutting blade 38, at which platform 34 is mounted for limited pivotal movement in a clockwise direction (viewing Fig. 1) about an axis adjacent platform 34 and in substantially the same plane as the axis of rotation of blades 36 and 38. Following cutting of the sandwich, platform 34 is pivoted upward in a clockwise direction to elevate the end of a sandwich supported thereon to a position adjacent timing rollers 54 and 56. As a means for feeding the end portion of the sandwich into the bite of the rollers, there is provided an elevator roller 60 positioned slightly above the end of platform 34 adjacent cutting blade 38. Roller 60 is rotated in a clockwise direction, and as platform 34 is rotated upward the sandwich is brought into contact with roller 60 and is propelled thereby into the bite of timing rollers 54 and 56. The elevator platform is then returned to its former position to receive the next successive sandwich as the latter is advanced from between rollers 30 and 32.

Means are provided for ejecting each successive sandwich from processing chamber 48 through exit passage 52 when the predetermined processing period for each sandwich has elapsed. In the form shown, these means comprise a pair of ejection rollers 62 and 64 mounted at the end of chamber 48 adjacent passage 52. Ejection rollers 62 and 64 are resiliently urged toward one another by suitable spring means and are rotated at a more rapid speed than rollers 54 and 56 so as to rapidly advance a sandwich through passage 52 almost immediately as an edge of the sandwich is advanced into the bite of the rollers and engaged thereby. Ejection rollers 62 and 64 are so positioned with respect to the timing rollers 54 and 56 that the leading edge of a sandwich advanced between rollers 54 and 56 is engaged by rollers 62 and 64 just prior to advancement of the trailing edge of the sandwich out of engagement with rollers 54 and 56. In this manner ejection rollers 62 and 64 "grab" the leading edge of each sandwich and then cooperate with timing rollers 54 and 56 to eject the sandwich from chamber 48 at the moment when it is "released" by the timing rollers. A plurality of sandwiches arranged in a stacked relation with the leading edge of each successive sandwich spaced slightly behind the edge of the sandwich immediately above may be advanced between rollers 54 and 56 at the same time and advanced one at a time into the bite of rollers 62 and 64. As a means for guiding a sandwich from rollers 54 and 56 into the bite of rollers 62 and 64, there is provided a support plate 66 extending from adjacent roller 54 to a point adjacent roller 62 and having an upper support surface disposed in a plane substantially tangent to said rollers at their upper surfaces. Additionally, upper housing wall 50 converges toward plate 66 adjacent roller 64 to guide the sandwiches between the latter and roller 62. Means may be provided for rendering passage 52 light-tight and in the form shown comprise curved portions 68 of the walls of housing 10 defining the passage and adapted to conform to the peripheries of rollers 62 and 64. The rollers are mounted closely adjacent curved portions 68 and the latter are provided with pads 70 of a tufted fabric, felt or the like adapted to bear against the surfaces of the rollers and prevent the admission of light between the rollers and portions 68.

The speed at which successive sandwiches are advanced between rollers 54 and 56 is substantially constant and is a function of the predetermined processing time which may vary, for example, from 40 to 120 seconds. On the other hand, the frequency at which successive frames of sheet 12 may be exposed is independent of the time required for processing and may be varied at will. For this reason, when processing requires a relatively long period and successive exposures are made at comparatively rapid frequency, it may be necessary to advance a considerable number of successive sandwiches through processing chamber 48 and between timing rollers 54 and 56 at one time. In order to accommodate a large number of sandwiches in stacked relation and advance the sandwich at a constant predetermined speed, timing rollers 54 and 56 are so mounted as to permit their separation and means are provided for driving both of said rollers at constant angular velocity regardless of the amount of their separation. The last-mentioned means for mounting and driving timing rollers 54 and 56, together with drive and control means for operating the other components of the camera mechanism, are described in detail in copending application Serial No. 491,982, filed March 3, 1955 in the name of Philip D. Bartlett et al. This drive and control means includes means for arresting the movement of the sandwich upon advancement of a predetermined length thereof between pressure rollers 30 and 32 and is so constructed and arranged as to arrest movement of the sandwich when one frame of sheet 12 and an image-receiving area of sheet 14, with which it is registered, have advanced into processing chamber 48 and a frame of sheet 12 is in position for exposure on the surface of guide plate 24.

In order to adapt it for use in the illustrated embodiment, sheet 14 may be provided with regularly spaced pairs of configurations, preferably apertures, the openings in a pair being located at the opposite edges of sheet 14 and one pair being associated with one image-receiving area. The control means includes a bearing member 76 located adjacent rollers 30 and 32 and having a bearing surface across which sheet 14 is adapted to move. The surface of member 76 is provided with a pair of grooves or slots 78 over which the pairs of apertures are adapted to move in aligned relation, thus permitting a pair of stop pins 80 mounted in alignment with groove 78 to project into a pair of apertures in sheet 14 when the apertures become aligned with the pins during the advancement of the sheet. Pins 80 are mounted for limited movement in the direction of advancement of sheet 14 and in a direction substantially perpendicular to the plane of said sheet as it is advanced across bearing member 76. Resilient means are provided for urging pins 80 into contact with sheet 14 and in a direction opposite the direction of advancement of the sheet. As a pair of apertures become aligned with the pins and the latter are moved in the direction of advancement of the sheet, suitable means, responsive to the movement of the pins, are effective to discontinue the rotation of rollers 30 and 32.

Sheet 14 is supplied from spool 18 and is advanced intermittently a substantially rapid rate between rollers 30 and 32 and, because any sudden advancement of this character directly from spool 18 may cause the sheets to be subjected to considerable strain due to the necessity of overcoming the inertia of the spool and the sheet coiled thereon, it is desirable to provide means for ad-

Support rolls **104** and **106** are positioned substantially closer together than are support rolls **100** and **102** and a vacuum chamber **112**, similar in many respects to chambers **108** and **110** but shorter than the other chambers and including end walls **122** and **124** shaped to conform to the surfaces of support rolls **104** and **106** and a rear wall **126**, is positioned between support rolls **104** and **106**. Support roll **106** is so positioned that a plane through the axes of support rolls **104** and **106** is at an angle with a plane through the axes of support rolls **100** and **102**. The forward edge portions of the side walls of chamber **112** are tangent with the surfaces of support rolls **104** and **106** but are so formed as to support a portion of belt **96** adjacent roll **104** in parallel facing relation with belt **94** and to allow the portion of belt **96** adjacent roll **106** to curve away from belt **94**. By virtue of this arrangement, a sandwich comprising sheets **12** and **14** is fed between the parallel portions of belts **94** and **96** and the pressure differential between the front and rear of the belts is effective to hold sheet **14** in contact with belt **94** and sheet **12** in contact with belt **96**. As the belts advance and belt **96** curves away from belt **94**, the two sheets are held in continued contact with the belts and are thereby separated from one another. In the form shown, following separation of the two sheets, sheet **12** is guided around roll **106** by a curved guide member **128** and sheet **14** is held and advanced in contact with belt **94**. Another form of sheet-separating and washing and coating mechanism, one of the two sheets may be provided with perforations at which the two sheets are severed and the device may include means for engaging the sheets at the perforations for separating the leading edges of the two sheets and guiding them along separate paths, for example, into contact with such means as suction belts similar to those shown and described for performing another operation such as washing and coating on either or both sheets.

To insure that sheet **14** is retained in contact with belt **94** as the belt and sheet are advanced across the forward edge of wall **118**, there may be provided such means as a pair of pad rollers **130** mounted in engagement with the belt at wall **120** so as to bear on the margins of each sheet **14** as it moves past wall **118**. Pad rollers **130** are resiliently urged toward belt **94** at wall **118** and are formed preferably of some yielding material such as rubber or the like so that they are deformed, when in contact with sheet **14**, and thereby provide a greater surface area in contact with the sheet more capable of spanning the edge of wall **120** separating chambers **108** and **110**.

In accordance with the present invention, means are provided for washing and protectively coating the image surfaces of sheet **14** held in contact with and supported by belt **94**. A preferred form of washing and coating means, illustrated in the drawings, includes a multiplicity of applicators generally indicated at **132**, each being capable of washing and protectively coating the image surface of a photographic print when rubbed in frictional contact with the image surface. Each applicator includes an absorbent element **134** of an absorbent material charged with and capable of retaining a quantity of liquid washing and coating composition. Each absorbent element **134**, in the form shown, is generally parallelepiped in shape and at least equal in length to the width of the image surface to be washed and coated. The absorbent element may be formed of a suitable sponge, for example of cellulose acetate, or of cotton or wool such as woven or nonwoven fabric or felt, and is preferably a nonwoven cotton fabric sold by Kendall Mills under the trade name "Webril." The absorbent element is preferably of such proportions as to be capable of absorbedly retaining a volume of the liquid washing and coating composition sufficient only to wash and coat the image surface of a single photographic print. It is contemplated that each element will be employed to wash and coat a single print and, in view of its inexpensive construction, will be discarded following use.

A multipilicity of absorbent elements **134** are secured at regularly spaced intervals to an elongated support web **136** of an inexpensive sheet material such as paper. At least the portions of the surface of web **136** underlying each element **134** are provided with a coating which is substantially impervious to the washing and coating liquid absorbedly carried by the elements. To protect each absorbent element **134** from the atmosphere and prevent evaporation of the liquid composition with which it is charged, there is provided another elongated web **138** substantially equal in width to web **136** and which cooperates with web **136** to provide a sealed container for each absorbent element. To provide a container for each absorbent element, web **138** is secured in facing relation to web **136** transversely between each absorbent element and longitudinally along the margins of the two webs. Web **138** may also be of paper and at least the portion of web **138** comprising the walls of each container is rendered impervious to the liquid composition carried by the absorbent element. The two webs may be sealed together by any suitable adhesive or bonding material capable of forming a liquid-impervious seal surrounding each absorbent element and permitting the two webs to be stripped apart.

The transverse seals or adhered portions of the two webs may extend completely between successive coating elements or the two webs may be adhered together at transverse areas immediately adjacent each absorbent element and indicated on the drawings by brackets designated as **140**. The surface portions of webs **136** and **138** comprising the walls of each container and secured or bonded together to define each container may be rendered impermeable to the washing and coating liquid by providing them with a coating of a suitable thermoplastic material such, for example, as polyvinyl butyral or polyvinyl acetal, which is preferably capable of being bonded with itself by the application of heat and/or pressure. The thermoplastic material not only serves to render the container walls impervious to the liquid composition carried therein but acts as a material for securing the two webs together transversely and longitudinally to define the containers.

To make a liquid-impregnated absorbent element **134** available for washing and coating a photographic print, the portion of web **138** comprising the container wall covering the element is stripped from web **136**. The absorbent element secured to web **136** is then rubbed in frictional contact with the surface to be coated. Means are provided for stripping the two strips apart and for positioning each element for rubbing in contact with the surface of a print advanced by belt **94**. The last-mentioned means includes a roll **142** positioned with its surface adjacent belt **94** and with its axis extending transversely of the belt and parallel to the belt surface. Web **136** extends around roll **142** between the latter and the belt, the roll being so positioned with respect to the belt that an absorbent element secured to web **136** and positioned between roll **142** and belt **94** would be held in firm contact with the surface of a photographic print advanced by the belt past the roll. To insure a more uniform contact of the entire area of the absorbent element with the print surface, roll **142** may include at least a surface portion formed of a pliant material such as soft rubber which may be deformed by pressure in such a manner as to provide a substantially flat backing for the absorbent element. A backing member **144** may be provided in chamber **110** against the rear surface of belt **94** in alignment with roll **142** for supporting the belt against roll **142**. Backing member **144** preferably includes a flat support surface in contact with belt **94** at least as wide as the absorbent element and which may be provided with

grooves and/or holes permitting the atmospheric pressure to be reduced on the portion of the belt moving across the support surface of the backing member.

A supply of applicators **132** comprising webs **136** and **138** and a succession of liquid impregnated absorbent elements **134** attached to web **136** and carried in containers comprising the two webs may be supplied on a conventional spool from which web **136** is drawn. Web **136** extends around roll **142** to a suitable take-up means such as a conventional spool on which the web carrying expended absorbent elements is coiled. As the leading end of a photograph to be washed and coated is advanced by belt **94** between the latter and roll **142**, the take-up spool for web **136**, together with roll **142**, are rotated sufficiently to move an absorbent element into position between roll **142** and belt **94** wherein it is capable of washing and coating a print. Then, as the trailing end of the print is advanced by belt **94** from between the latter and roll **142**, the take-up spool and roll **142** are again rotated sufficiently to move the applicator from between roll **142** and belt **94** so that it cannot contact the belt. The spacing between successive absorbent elements **134** is so related to the diameter of roll **142** and the extent of the last-mentioned rotation of roll **142** and the take-up spool that this rotation is not sufficient to advance the next successive absorbent element into contact with belt **94** between the latter and roll **142**. The next successive absorbent element is moved into coating position by another rotary movement of roll **142** and the take-up spool when the leading end of the next successive photographic print is advanced between roll **142** and belt **94**.

As a means for stripping web **138** from each absorbent applicator element **134** as the latter is moved into coating position, there is provided such means as a conventional take-up spool on which web **138** is coiled as it is stripped from web **136**. The take-up spool for web **138** is driven in synchronism with roll **142** so as to strip web **136** from an applicator element just prior to movement of the latter into contact with a photographic print. To insure that stripping of web **138** occurs at the proper place and not prematurely, there is provided a curved guide member **146** positioned adjacent roll **142** and belt **94** with just sufficient space between the guide member and the roll for the two webs and an absorbent element to pass therebetween. Thus, web **138** is advanced between roll **142** and guide member **148** around the end of the guide member adjacent belt **94** and to the take-up spool on which it is coiled.

As a means for controlling the rotation of the take-up spools and roll **142**, there is provided at least one follower member, preferably a roller **148**, located between pad roller **130** and roll **142**. Follower roller **148** is adapted to ride on the forward surface of belt **94** in position to engage the margin of a print advanced by the belt. Roller **148** is mounted on a pivotal arm **150** comprising, for example, the grounded contact of a switch in a circuit to electrical drive means for causing the rotation of the take-up spools and roll **142**. Arm **150** is so biased that roller **148** is held in contact with belt **94**, or the margin of a print positioned thereon, and the other contact of the switch is so positioned that deflection of arm **150** due to roller **148** riding over the added thickness of the leading end of a photographic print is sufficient to close the switch and cause the rotation of roller **142** and the take-up spools for moving the absorbent element into contact with the advancing print. The switch or electrical circuit may be so arranged that the return movement of arm **150** permitted by the advancement of the trailing end of the print from engagement with roller **148** is effective to again cause the rotation of roll **142** and the take-up spools so as to move the absorbent element from contact with the print. If it is so desired, a second roller **148** mounted on a pivotal arm **150** may be provided in position to ride on the opposite margin of each print and perform this last-mentioned function of causing the movement of an absorbent element from contact with a photographic print.

Each liquid-impregnated absorbent element is moved into position between roll **142** and belt **94** as the leading end of a photographic print passes under the roll and is held in contact with the print surface until the trailing edge of the print advances from under the roll. In this manner, residual processing reagents are removed from the print surface and adhered to the absorbent element and a layer of liquid coating protective composition is applied to the print surface. To facilitate drying and hardening of the protective coating composition, means such as tubes **152** may be provided adjacent belt **94** for directing streams of air onto the surface of a print advanced by the belt in order to promote drying of the surface coating. Tubes **152** extend transversely of the path of the print and include a plurality of holes or nozzles for directing air onto the print surface.

As heretofore mentioned, during washing and coating of a print surface the coating element becomes charged with residual processing reagents and the protective coating composition on the absorbent element becomes depleted and tends to dry and harden on exposure to the atmosphere. For these reasons, it is desirable to use an absorbent element for coating only one print and while, in the form shown, each absorbent element is provided in a charged condition with the liquid washing and coating composition absorbedly retained thereby, in another form of the invention a series of absorbent applicator elements may be provided in a dry condition not requiring that they be stored in sealed containers. For example, a plurality of absorbent elements may be secured to web **136** at regularly spaced intervals as shown and may be charged with some of the ingredients of the washing composition in a dry form. This arrangement obviates the necessity for the other web **138** and the stripping of web **138** from web **136**. A suitable nozzle may be provided at the position now occupied by guide **146** for ejecting water or some other solvent, or combination of solvents, or the liquid washing and coating composition onto the dry absorbent element immediately prior to or during movement of the absorbent element into contact with a print surface. Or, if it is desired, the liquid washing and coating composition may be ejected directly onto the print surface at a position on the opposite side of roll **142** so that the absorbent element acts to retain residual processing reagents and spread the coating liquid uniformly. Following use of an absorbent element for washing and coating a print surface, the next successive element would then be moved into position opposite the nozzle for being charged either with water or with some or all of the liquid ingredients of the coating composition.

If additional washing of each photographic print is desired, belt **94** can be extended and another washing and coating means may be provided, or, in another form of the invention, provision can be made for causing repeated reversal of movement of belts **94** and **96** so as to effect the reciprocating movement of each print in contact with an applicator. Suitable means may be provided for delivering each photographic print following washing, coating and drying to the exterior of the photographic apparatus or, if desired, for stacking successive prints.

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. Apparatus for treating photographic sheet material with a fluid, said apparatus comprising, in combination, gripping means for supporting a photographic sheet, means for so moving said gripping means as to advance

said sheet along a predetermined path, means for positioning an absorbent liquid coating applicator charged with a coating liquid adjacent said path, means responsive to the movement of said sheet along said path for moving said liquid coating applicator into a position in said path of movement of said sheet as said sheet approaches the position of said applicator, means responsive to the movement of said sheet for stripping a cover element from said applicator during movement of said applicator into position in said path, said gripping member comprising means for moving said sheet along said path past said applicator while so supporting a surface of said sheet in engagement with said applicator that the latter applies a fluid to said surface of said sheet, and means responsive to the movement of said sheet from engagement with said applicator for removing said applicator from its position in said path.

2. Apparatus for treating successive photographic prints with a fluid, said apparatus comprising, in combination, gripping means for supporting each of said prints, means for so moving said gripping means as to advance said prints in succession along a predetermined path, means mounted adjacent said path and responsive to the movement of a print along said path for moving an absorbent liquid applicator charged with a coating liquid into a position in said path as a print approaches the position of the last-mentoned means, means responsive to the movement of said print along said path for stripping a cover element from said applicator during movement of said applicator into said position in said path, said gripping means comprising means for moving said print along said path past said applicator while so holding a surface of said print in engagement with said applicator that the latter applies a fluid composition to said surface of said print, and means responsive to the movement of said print from engagement with said applicator for removing said applicator from said position in said path and moving another applicator into the position adjacent said path previously occupied by the first-mentioned applicator.

3. Apparatus for treating a photographic print with a fluid, said apparatus comprising, in combination, a perforated web, means for mounting and advancing said web along a predetermined path, means for reducing the atmospheric pressure on one surface of said web so as to cause a photographic print to be held in contact with the other surface of said web, support means mounted adjacent said web for positioning an absorbent liquid applicator charged with a liquid adjacent said web, means responsive to the movement of said print by said web along said path for moving said applicator into a position in said path between said support means and said web as said print approaches the location of said support means, means for stripping a cover element from said applicator during movement of said applicator into said position in said path, said perforated web comprising means for advancing said print along said path while so holding a surface of said print in engagement with said applicator that the latter applies fluid to said print surface, and means responsive to the movement of said print from engagement with said applicator for moving said applicator from said position in said path.

4. Apparatus for treating successive photographic prints with a fluid, said apparatus comprising, in combination, gripping means for supporting each photographic print, means for mounting said gripping means and so moving the latter as to advance said prints along a predetermined path, support means located adjacent said path for positioning a portion of an elongated support web to which is secured a plurality of absorbent coating applicators each charged with a liquid, means for sensing the movement of a print along said path and so moving said web around said support means as to first position one of said applicators adjacent said path and then position said applicator in said path as said print approaches the position of said applicator, means for stripping a cover web from said applicator during movement of said applicator into said position in said path, said gripping means providing means for advancing said print along said path past said applicator and so supporting a surface of said print in engagement with said applicator that the latter applies a fluid to the surface of said print, said means for sensing the movement of said print from engagement with said applicator, moving said support web so as to remove said applicator from its position in said path and moving the next successive applicator into the position adjacent said path previously occupied by the first-mentioned applicator.

5. In apparatus for processing protographic sheet material, means for substantially automatically separating two superposed sheets and treating the surface of one of said sheets with a liquid composition, said means comprising a pair of members for gripping and supporting said sheets, means for moving said gripping members from a position adjacent one another along divergent paths, means for feeding said superposed sheets between said gripping members into engagement therewith, support means for positioning an absorbent liquid coating applicator charged with a liquid adajcent the path of movement of one of said sheets supported by one of said members, means responsive to movement of said sheet along said path for moving said support means so as to position said applicator in the path of said sheet as said sheet approaches the position of said applicator, means responsive to the movement of said sheet by said one member along said path for stripping a cover element from said applicator during movement of said applicator into position in said path, one of said gripping members comprising means for moving said sheet past said applicator element and so supporting a surface of said sheet in engagement with said applicator that the latter applies said liquid composition to said surface of said sheet, and means responsive to the movement of said sheet from engagement with said applicator for so moving said support means as to remove said applicator element from said position in said path.

6. In apparatus for processing photographic sheet material, means for substantially automatically separating successive pairs of superposed sheets and treating one of the sheets of each pair of said sheets with a liquid composition, said means comprising a pair of members for gripping and supporting a pair of said sheets, means for feeding each successive pair of superposed sheets between said gripping means into engagement therewith, means for moving said gripping members from a position adjacent one another along divergent paths so as to separate said pair of sheets and advance said sheets along separate paths, support means for positioning an absorbent liquid coating applicator charged with said liquid composition adjacent the path of movement of one of said sheets mounted on one of said gripping members, means responsive to the movement of said one sheet by said one gripping member along said path for moving said support means so as to position said applicator in said path of movement of said one sheet as said one sheet approaches the position of said applicator, means for stripping a cover element from said applicator during movement of said applicator into said position in said path, said one gripping member comprising means for moving said one sheet past said applicator element and so supporting a surface of said one sheet in engagement with said applicator that the latter applies said liquid composition to the surface of said one sheet, and means responsive to the movement of said one sheet from engagement with said applicator for moving said support means so as to remove said applicator from said position in said path and advance another applicator into said position adjacent said path previously occupied by the first-mentioned applicator.

7. In apparatus for processing photographic sheet material, means for substantially automatically separating

successive pairs of superposed sheets and treating one of the sheets of each pair of sheets with a liquid composition, said means comprising a pair of endless perforated webs, means for mounting said webs with portions of their surfaces in superposed relation and for advancing said portions of said webs along predetermined divergent paths, means for feeding a pair of superposed sheets between said superposed portions of said webs, means for reducing the atmospheric pressure on the surfaces of said webs so as to cause each of the superposed sheets to be held in contact with one of said webs, means for continuously advancing said webs so as to separate said pair of sheets as the paths of said perforated webs diverge, support means for positioning an absorbent liquid coating applicator charged with said liquid composition adjacent one of said webs in the path of movement of one of said sheets supported on said one web, means responsive to the movement of said one sheet in engagement with said one web for so moving said support means as to position said applicator in the path of movement of said one sheet as it approaches the position of said support means, said support means being so constructed and positioned with respect to said one web as to hold said applicator in engagement with a surface of said one sheet during movement thereof past said applicator for applying a liquid to said surface of said one sheet, means for stripping a cover element from said applicator during movement of said applicator into the path of said one sheet, and means responsive to the movement of said one sheet by said one web from engagement with said applicator for so moving said support means as to remove said applicator element from its position in the path of said one sheet and moving another applicator into the position adjacent said one web previously occupied by the first-mentioned applicator.

8. Apparatus for treating photographic sheet material with a fluid, said apparatus comprising, in combination, holding means for supporting a succession of photographic sheets, means for so moving said holding means as to advance said sheets along a predetermined path, a support roll formed of yielding material, means mounting said support roll for rotary movement with its surface closely adjacent said path of movement of said sheets, means for mounting a supply of absorbent fluid applicators each charged with said fluid mounted a predetermined distance apart on a first elongated web in containers defined by a second web secured to said first web in surrounding relation to each of said fluid applicators, said first web extending from its supply around said support roll, means for so rotating said support roll as to position one of said applicators in a container adjacent said path, means responsive to the movement of one of said sheets by said holding means along said path for rotating said support roll so as to position said applicator in said path in engagement with the leading end portion of said one sheet between the latter and said support roll, means for stripping said second web from said first web and said applicator during movement of said applicator into said position in said path, said holding means comprising means for supporting and advancing a surface of said one sheet in engagement with said applicator so as to apply a fluid to said surface of said one sheet, and means responsive to the movement of said sheet for rotating said support roll so as to move said applicator from said position in said path between said support roll and said one sheet as the trailing end portion of said one sheet moves therebetween and for moving the next successive applicator in a container into the position adjacent said path previously occupied by the first-mentioned applicator in a container.

9. The apparatus of claim 8 wherein said means for stripping said second web form said applicator and said first web includes a guide member positioned adjacent said support roll and said path and so positioned with respect to said support roll as to provide a passage therebetween in which an applicator in a container may be positioned adjacent said path, and means for advancing said second web around said guide member between the latter and said path for stripping said second web from said first web and said applicator during movement of said applicator into said path.

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UNITED STATES PATENT OFFICE

CERTIFICATION OF CORRECTION

Patent No. 2,963,953 December 13, 1960

Donald R. Bishop et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 9, line 28, for "Another" read -- In another --; column 10, line 5, for "multipilicity" read -- multiplicity --; column 14, line 13, for "protographic" read -- photographic --; line 24, for "by" read -- on --; column 16, line 16, before "sheet" insert -- one --; line 24, for "form" read -- from --; line 42, list of references cited, for "Bernemann" read -- Bornemann --.

Signed and sealed this 25th day of July 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

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