Feb. 20, 1968 P. D. BARTLETT 3,369,473

PHOTOGRAPHIC PROCESSING APPARATUS

Filed July 12, 1965 2 Sheets-Sheet 1

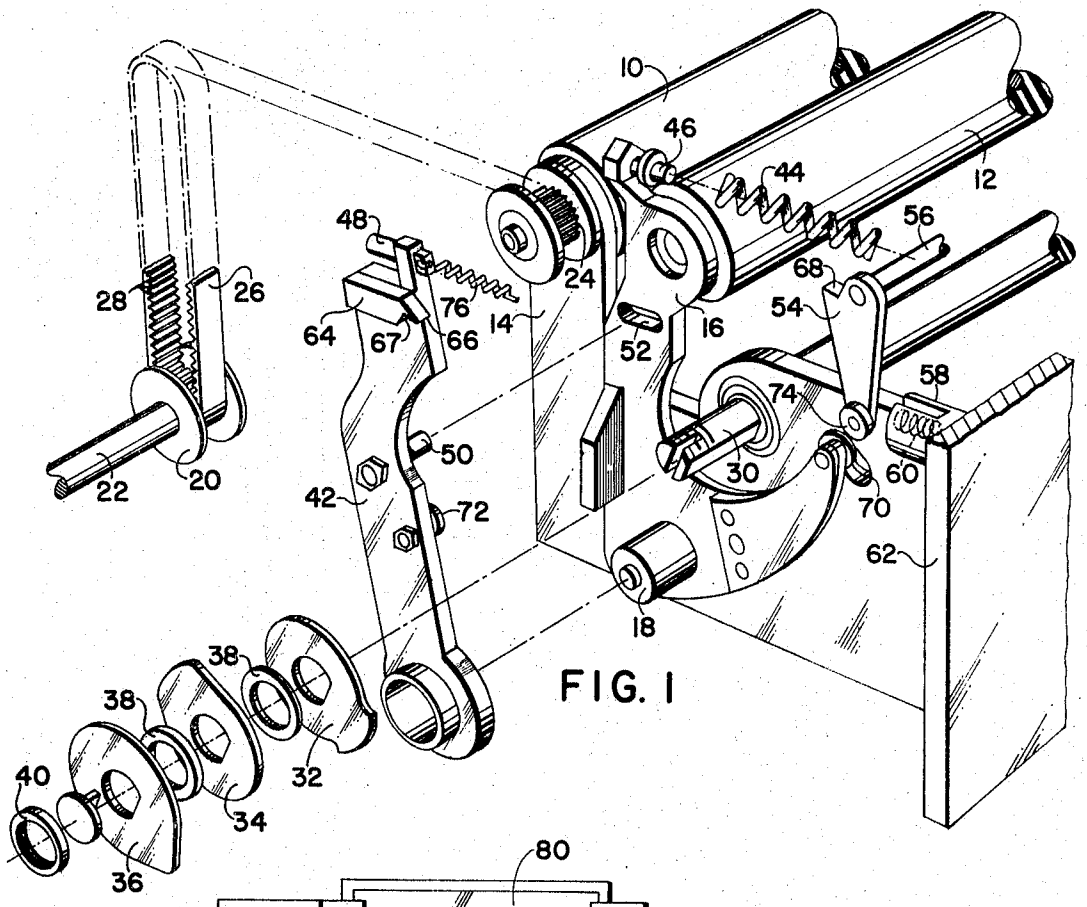


FIG. 1

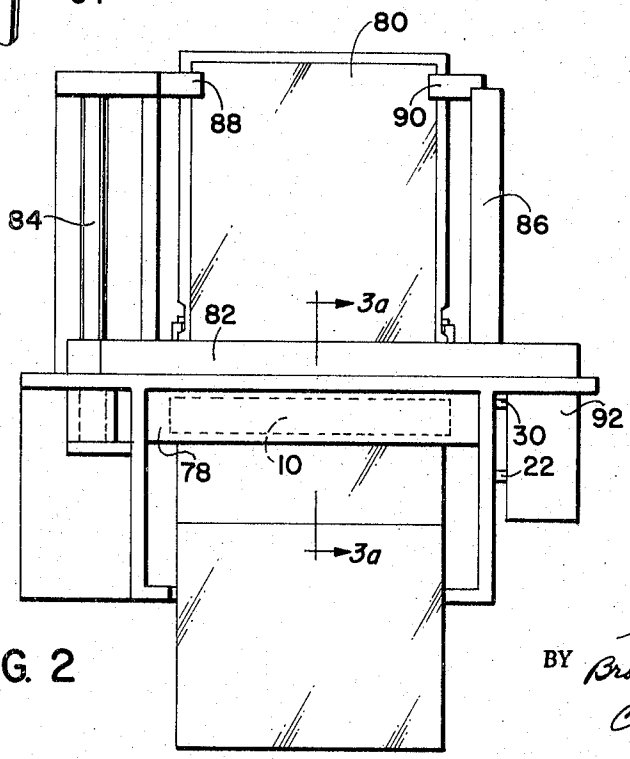


FIG. 2

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PHOTOGRAPHIC PROCESSING APPARATUS

Filed July 12, 1965 2 Sheets-Sheet 2

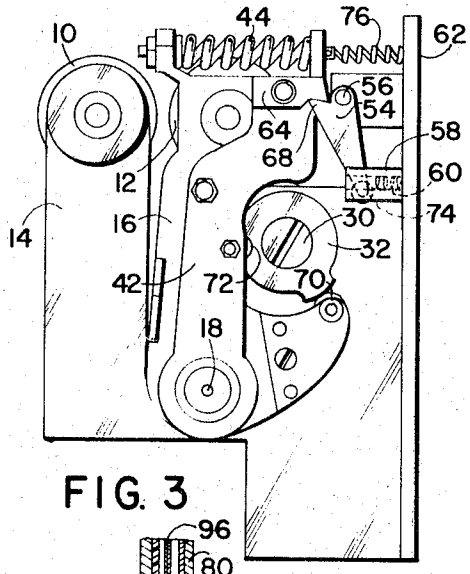


FIG. 3

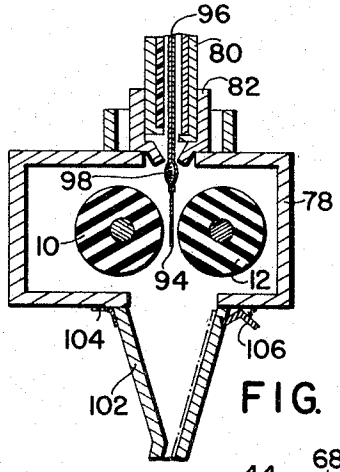


FIG. 3a

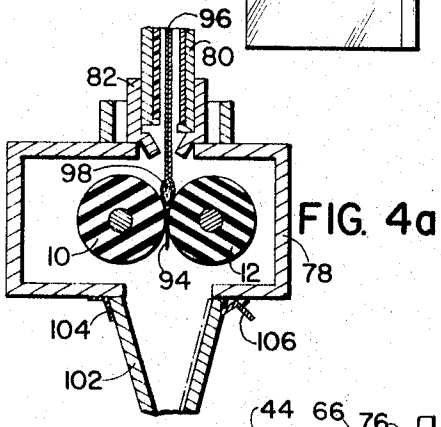


FIG. 4a

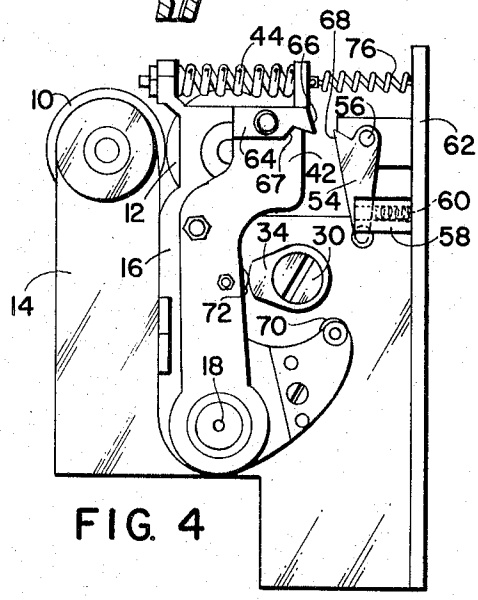


FIG. 4

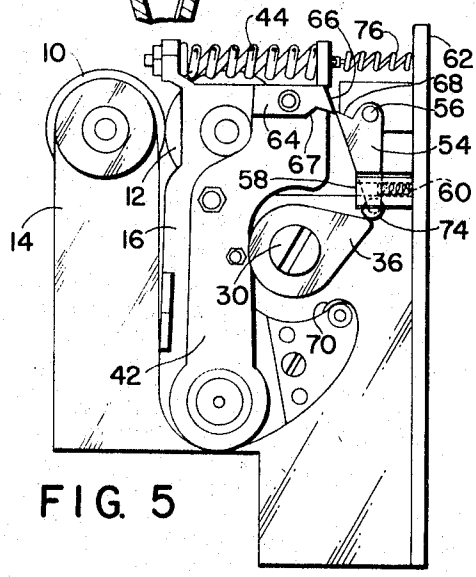


FIG. 5

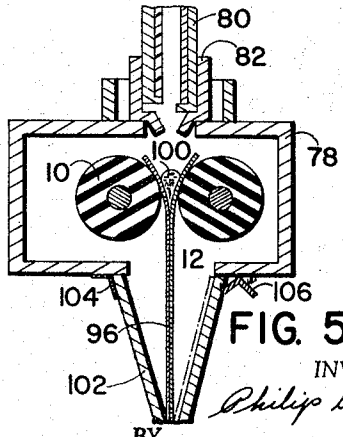


FIG. 5a

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United States Patent Office 3,369,473 Patented Feb. 20, 1968

3,369,473

PHOTOGRAPHIC PROCESSING APPARATUS

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Filed July 12, 1965, Ser. No. 471,314
12 Claims. (Cl. 95—89)

ABSTRACT OF THE DISCLOSURE

The present invention relates to a photographic apparatus for processing a composite film assembly or unit embodying a releasably-contained processing liquid by compressing and thereby releasing and spreading the liquid throughout at least an exposed photosensitive area. More particularly, the apparatus includes a mechanism having a plurality of cams, cam followers, and tensioning springs thereon to vary the compressive force applied to the film assembly or unit and the liquid contained therewith as the photosensitive area is being processed.

This invention relates to processing apparatus for film assemblies of the self-developing type and, more specifically, to apparatus including a pair of pressure-applying members and means for varying the pressure applied thereby during various stages of the advancement of a film unit.

Many forms of photographic processing apparatus are known wherein a compressive force is applied to a film unit as it is advanced between a pair of juxtaposed, rotatably mounted rolls. Some forms of such apparatus include means for exposing a photosensitive portion of the film unit prior to advancement between the pressure rolls, while others are adapted to effect processing of a film unit previously exposed in other photographic apparatus. The present invention is principally concerned with apparatus of the latter type, and with such apparatus wherein drive means, in the nature of a motor or the like, are utilized for imparting rotation to the rolls, as opposed to apparatus wherein the rolls are rotated by grasping and advancing the film unit itself, manually or otherwise. The invention will be illustrated and described in an embodiment directed principally to the processing of a conventional, self-developing film unit of relatively large format, e.g., 10 x 12 inches, such as commonly used in making radiographs. It will be understood, however, that the present invention is not limited solely to employment with film units of this type.

Many commercial embodiments of film units of the self-developing type are in the form of a pair of hingedly attached sheets having a rupturable container of liquid processing composition associated therewith. The first sheet includes a photosensitive layer capable of having a latent image formed therein by exposure to actinic radiation, and the second sheet preferably includes means for receiving a positive image from said photosensitive layer when processed according to the well-known diffusion transfer process. Processing is effected by moving the two sheets in superposed relation through a pair of pressure-applying members to rupture the aforementioned container, releasing the liquid contents thereof, and distributing the liquid in a thin, uniform layer between the sheets. Specific examples of such film units are those designated Types 3000X and TLX Radiographic Packets and others commercially manufactured and sold by Polaroid Corporation of Cambridge, Mass.

It has been found expedient to provide the pressure-applying members of the processing apparatus in the form of rotatably mounted pressure rolls, urged together by a biasing force, to effect rupturing of the frangible container

and distribution of the liquid processing composition between the sheets of the film unit. Due to the nature of the processing operation, the compressive force applied by the rolls to the film unit should be carefully controlled to insure optimum results. It is also sometimes desirable to apply a compressive force of different amounts at various stages of the advancement of the film unit, and to separate the rolls from engaging relationship before or after the spreading operation is performed.

The present invention has as a principal object the provision of processing apparatus including a pair of rotatably mounted pressure rolls, wherein the compressive force applied by said rolls is varied with respect to the position of a film unit advanced therethrough within closely controlled limits.

A further object is to provide means for moving two pressure rolls into and out of engagement, and for varying the force by which the rolls are urged toward engagement, in a programmed manner as a film unit is advanced through the rolls for processing.

Another object is to provide processing apparatus having a pair of pressure rolls and drive means for imparting rotation to the rolls while at the same time moving means for controlling the force by which the rolls are urged toward engagement or spread apart.

A still further object is to provide novel apparatus for processing a self-developing film unit in an improved manner.

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 fragmentary, exploded, perspective view of the principal elements affecting operation of the processing apparatus according to the present invention;

FIG. 2 is a somewhat diagrammatic, front elevational view of the processing apparatus with a film holding cassette positioned thereon;

FIGS. 3–5 are a series of side elevational views of some of the elements of FIG. 1 with certain elements removed in each figure to show the operation and movement of various other elements; and

FIGS. 3*a*–5*a* are a series of diagrammatic, side sectional views showing the various positions of a film unit with respect to the pressure rolls of the apparatus when the elements are in the positions shown in the corresponding FIGS. 3–5.

Referring now to the drawings, the processing apparatus of the invention includes, according to the usual practice, a pair of cylindrical pressure rolls **10** and **12** which may be constructed, for example, of metal, plastic, rubber, or other materials including a composite of materials such as a rubber sheath on a metal core. Although only single end portions of rolls **10** and **12**, and elements associated therewith, are shown in FIG. 1, it will be understood that this construction is duplicated as required for proper operation at the opposite ends of the rolls. Roll **10** is mounted by suitable spindle and bearing means for rotation about a fixed axis extending through portion **14** of the frame of the apparatus, and on a similar frame portion at the other end of the roll. Roll **12** is likewise mounted for rotation upon end portions of a pair of arms, one of which is shown and indicated by the reference numeral **16**. Arm **16** is pivotally mounted on fixed

pin 18 extending from frame portion 14, whereby the axis of rotation of roll 12 is laterally movable when arm 16 is moved about its pivotal mounting.

Gear 20 is mounted on the end of shaft 22 and gear 24 is connected to the spindle or other mounting means of roll 10. Endless belt 26 passes around both gears 20 and 24 and includes evenly spaced lugs 28 on the inner surface thereof for engaging the teeth on the gears. Thus, it may be seen that rotation of shaft 22 is imparted to roll 10. Shaft 30 is rotatably mounted on suitable bearing means on a portion of the fixed frame. Secured on the end of shaft 30 are rotary cams 32, 34 and 36, in predetermined relationship. Appropriate separating means 38 and retaining means 40 are provided for the cams.

Arm 42 is pivotally mounted for rotation coaxially with arm 16. Spring 44 is compressed between pins 46 and 48 on end portions of arms 16 and 42, respectively, urging the arms toward rotation in opposite directions, and fixed pin 50 extends from arm 42 through slot 52 in arm 16, limiting the amount of relative travel between the two arms. Lever 54 is fixedly mounted at one end on rotatable shaft 56. An edge of lever 54 extends through an axial slot in hollow stud 58 to bear against spring 60, disposed within the hollow portion of the stud. Stud 58 extends from fixed wall portion 62, which limits movement of spring 60 as the edge of lever 54 urges the spring toward the wall. Arm 42 includes fixed block 64 having edge portion 66 and surface 67, adapted to cooperatively engage extending lip 68 of lever 54, as explained more fully hereinafter. Cam follower 70 is provided on an extension of arm 16. Follower 70 is engaged and moved by the cam surface of cam 32, in a manner explained later. Follower 72 is provided on arm 42 for cooperation with cam 34, and follower 74 is provided on an end portion of lever 54 for engagement with cam 36. Followers 70, 72 and 74 are all in the form of small diameter rollers for engagement with the rotary cam surfaces of cams 32, 34 and 36. Spring 76 is attached at one end to a portion of the fixed frame and at the other end to arm 42 to urge the latter toward rotation in a direction away from roll 10.

Referring now to FIG. 2, the processing apparatus is shown somewhat diagrammatically with roll 10 enclosed in light-tight housing 78. Cassette 80 is positioned above the pressure rolls for advancement of a film unit from the cassette through the rolls. The edge of cassette 80 from which the film unit is withdrawn is positioned in engagement with movable carriage 82 which is mounted for vertical, sliding movement between fixed guide members 84 and 86. Cassette 80 is guided during movement by fixed guide blocks 88 and 90 which present inwardly disposed channels for engaging the sides of the cassette. It is to be understood that the general construction of the apparatus shown in FIG. 2 is merely one form of many wherein the details of the present invention may be practiced. Further constructional details of processing apparatus such as that shown in FIG. 2 are shown in copending U.S. application Ser. No. 471,091, filed July 12, 1965.

Drive means 92, which may comprise, for example, an electric or spring-powered motor, is provided on one side of the processing apparatus. Shafts 22 and 30, previously described in connection with FIG. 1, comprise output shafts arranged to receive energy transmitted by drive means 92 in any desired, conventional manner. Appropriate gearing means may be provided to adjust the rotational direction and relationship between the two shafts as desired. In the illustrated embodiment, for example, shaft 30 is designed to rotate one complete revolution during the entire advancement of a film unit through rolls 10 and 12, which requires several revolutions of shaft 22. Also, shaft 22 is designed to rotate in a clockwise direction while shaft 30 rotates counterclockwise, as seen in FIG. 1.

Referring now to FIGS. 3–5, the operation of rolls 10 and 12 in conjunction with movement of the cam and follower elements is shown. In FIG. 3, a raised portion of cam 32 is in contact with follower 70, thus rotating arm 16 in a clockwise direction and moving roll 12 out of engagement with roll 10. The relationship between pin 50 and slot 52 (FIGURE 1) is such that as arm 42 rotates clockwise under the bias of spring 76, arm 16 is caused to rotate in a like direction. Such rotation of arm 42 has already been effected as the elements are shown in FIG. 3 and the means by which such rotation is accomplished will be explained later. FIG. 3*a* illustrates diagrammatically the separated position of rolls 10 and 12 when the raised portion of cam 32 contacts follower 70, whereby leader element 94 of film unit 96 may extend from cassette 80 between the rolls.

Cams 32 and 34 are so arranged on shaft 30 that the raised portion of cam 34 engages the follower 72 on arm 42 before the raised portion of cam 32 moves completely out of engagement with follower 70. Arm 42 is rotated in a counterclockwise direction by contact of the raised portion of cam 34 with follower 72, thus compressing spring 44 by a greater amount since arm 16 cannot rotate counterclockwise until the raised portion of cam 32 is moved out of contact with follower 70. Hence, as soon as cam 32 is so moved, arm 16 rotates until roll 12 engages roll 10. At this time, of course, shaft 22 is rotating as well as shaft 30, whereby roll 10 is rotating when roll 12 comes into contact therewith. Thus, leader element 94 will be frictionally engaged between the rolls and film unit 96 will be advanced.

The added compression of spring 44 while the raised portion of cam 34 contacts follower 72, as shown in FIG. 4, urges roll 12 toward engagement with roll 10 by a greater force. At this time film unit 96 has been advanced to a point where rupturable container 98 is just beginning to be engaged between rolls 10 and 12, as shown in FIG. 4*a*. The increased compressive force of the rolls at this time insures complete rupturing of the container along the trailing edge thereof and forcing out of the complete liquid contents by continued advancement between the rolls. The raised portion of cam 34 is of such length, and the cam is so arranged on shaft 30, that the increased roll pressure provided thereby is applied until container 98 has been completely advanced between rolls 10 and 12.

The biasing force of spring 60 on lever 54, tending to rotate the latter in a clockwise direction on shaft 56, places extending lip 68 of lever 54 in position to become engaged with edge 66 of block 64. After shaft 30 has been rotated to a position where, as in FIG. 4, the raised portion of cam 34 is removed from contact with follower 72, arm 42 may again rotate in a clockwise direction under the bias of spring 44, which moves the free end of arm 42 laterally relative to the end of arm 16. Arm 42 rotates in a clockwise direction until edge 66 of block 64 thereon makes contact with extending lip 68 on lever 54. When such contact is made, arm 42 comes to rest at a predetermined position thus establishing a firm base for the biasing action of spring 44 upon arm 16. The arrangement of the elements in the position of FIG. 5 is such that pin 50 is at an intermediate position in slot 52 (FIG. 1).

At the position of the elements shown in FIG. 5, the extending portion of cam 36 is being brought into engagement with follower 74 on lever 54. Further counterclockwise rotation of shaft 30 from this position will cause cam 36 to rotate lever 54 in a counterclockwise direction about an axis through shaft 56 by engagement of the extending portion of the cam with follower 74. As lever 54 is so rotated, lip 68 thereof will be moved to a position out of engagement with edge 66 of block 64. Counterclockwise rotation of lever 54, is of course, against the bias of spring 60, and lever 54 travels in the aforementioned axial slot extending through stud 58.

Movement of lip 68 out of contact with edge 66 allows spring 44 to rotate the unpivoted end of arm 42 away from the opposing end of arm 16 until pin 50 engages

the end of slot **52** (FIGURE 1). Spring **76** is now the only biasing force tending to move arm **42** for rotation about pin **18**. As arm **42** is rotated by spring **76** in a clockwise direction, arm **16** will be likewise rotated due to contact of pin **50** with the end of slot **52**. Thus, arms **42** and **16** are mutually rotated until surface **67** of block **64** contacts lip **68** of lever **54**, thereby moving roll **12** away from engagement with roll **10**.

The relationship of the extending portion of cam **36** with respect to the cooperative degrees of rotation of shafts **22** and **30** is such that arms **42** and **16** are caused to rotate, moving roll **12** away from engagement with roll **10**, when film unit **96** has been advanced through the rolls to a point near the end of its travel. The elements are shown in FIG. 5 just prior to movement of lever **54** to a position allowing the above-described rotation of arms **42** and **16**, while in FIG. *5a* the position of film unit **96** with respect to rolls **10** and **12** is shown just after rotation of the arms to move roll **12** away from roll **10**. At this time, the processing composition has been completely distributed between the areas of the superposed sheets of film unit **96** to be processed. Any excess processing composition, indicated in FIG. *5a* by the reference numeral **100**, will be trapped between trailing end portions of the superposed sheets rather than being forced out of the trailing end of film unit **96**, by separation of rolls **10** and **12**. Imbibition chamber **102** is attached by hinge means **104** to housing **78** and is disposed to receive film unit **96** as the latter is advanced between rolls **10** and **12**. Latch means **106** are provided for holding chamber **102** in lighttight engagement with housing **78**, and are releasable to allow pivotal movement of chamber **102** upon hinge means **104** for removal of film unit **96** at the end of a predetermined processing period.

It will be noted that cam **36** is utilized merely to trip lever **54** and allow rolls **10** and **12** to move apart at the end of advancement of film unit **96** therethrough. Further rotation of shaft **30** brings the lobe of cam **34** into engagement with cam-follower **72**, causing counterclockwise rotation of arm **42** and, through the added biasing force of spring **44**, tends to rotate arm **16** in a like direction, unless means are provided for preventing such movement. Returning now to FIG. 3, the raised portion of cam **32** is arranged to contact follower **70** on arm **16** before cam **34** has been sufficiently rotated to allow the pin **50** on arm **42** to move out of engagement with slot **52** of arm **16**. Thus, contact of the raised portion of cam **32** with follower **70** will prevent counterclockwise rotation of arm **16** to return roll **12** into engagement with roll **10**, although arm **42** may be rotated through the action of cam **34** on follower **72** until pin **50** is moved out of engagement with slot **52**. At this point, the film unit has been completely advanced through the pressure rolls and into the imbibition chamber, whereby the power from drive means **92** to shafts **22** and **30** is cut off. Thus, the elements are stopped in the position shown in FIG. 3 prior to insertion of a new film unit into the apparatus for processing. When rotation is again imparted from drive means **92** to shafts **22** and **30** the elements will be in the initial position of FIG. 3 and the operational cycle described above will be repeated.

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. Processing apparatus of the type having first and second rotatably mounted pressure rolls between which a self-developing film unit may be advanced to effect rupture of a container associated with said film unit and distribution of the liquid contents thereof between a pair of superposed sheets, said apparatus comprising in combination:

(a) fixed frame means;

(b) first means for rotatably mounting a first pressure roll upon a portion of said frame means;

(c) second means for rotatably mounting a second pressure roll with the axis thereof parallel and laterally movable with respect to said first roll;

(d) movable means constructed and arranged to cooperatively engage said second means to effect movement of said second roll into and out of engagement with said first roll and, through a plurality of coacting cam, cam-follower and spring tensioning means, to vary the force by which said second roll is urged into engagement with said first roll in a predetermined program during a cycle of movement of said movable means; and

(e) drive means for simultaneously imparting rotation to said rolls and movement to said movable means.

2. The invention according to claim **1** wherein the amount of movement imparted to said movable means is cooperatively arranged with respect to the amount of rotation imparted to said rolls.

3. Processing apparatus for a self-developing film unit of the type wherein a pair of superposed sheets is advanced through pressure-applying members to effect rupturing of a frangible container holding a processing liquid and distribution of said liquid in a uniformly thin layer between said sheets, said apparatus comprising in combination:

(a) a first cylindrical pressure roll mounted for rotation about a fixed axis;

(b) a second cylindrical pressure roll mounted for rotation between a pair of pivotally movable arms so that its axis is translationally movable with respect to said fixed axis of said first pressure roll;

(c) spring means arranged to urge said second roll toward engagement with said first roll;

(d) first means for moving said second roll into and out of engagement with said first roll;

(e) film input means for positioning a film unit with a leading portion between said rolls when the latter are out of engagement, said means being so arranged with respect to said rolls that a light-tight path is provided for advancement of said film unit through said rolls;

(f) drive means for simultaneously imparting rotation to said rolls and actuating said first means to move said second roll into engagement with said first roll; and

(g) second means movable by said drive means to vary, in accordance with the amount of rotation imparted to said rolls, the force by which said spring means urges said second roll toward engagement with said first roll, said second means comprising cam means engageable with portions of said arms.

4. Processing apparatus for a self-developing film unit of the type wherein a pair of superposed sheets are advanced through pressure-applying members to effect rupturing of a frangible container holding a processing liquid and distribution of said liquid in a uniformly thin layer between said sheets, said apparatus comprising, in combination:

(a) fixed frame means;

(b) a first cylindrical pressure roll rotatably mounted upon said frame means;

(c) arm means mounted for pivotal movement with respect to said frame means;

(d) a second cylindrical pressure roll rotatably mounted upon said arm means for movement, as said arm means is pivoted, toward and away from said first roll with the axes of said rolls parallel;

(e) spring means arranged to exert a biasing force on said arm means tending to move the latter for engagement of said second roll with said first roll;

(f) a shaft mounted for rotation about a fixed axis;

(g) first cam means arranged on said shaft to cause pivotal movement of said arm means in a direction

moving said second roll away from said first roll during a first portion of rotation of said shaft;

(h) second cam means arranged on said shaft to cause pivotal movement of said arm means in a direction moving said second roll toward said first roll and for compressing said spring means to provide a first biasing force on said arm means during a second portion of rotation of said shaft;

(i) said cams being so arranged on said shaft that during a third portion of rotation thereof said spring means provides a second biasing force on said arm means; and

(j) drive means adapted to impart rotation simultaneously to said shaft and said rolls.

5. The invention according to claim 4 wherein said drive means includes two rotary output means, one being said shaft and the other being a rotary member connected to said first roll to impart rotation thereto in response to rotation of said rotary member.

6. The invention according to claim 5 wherein said spring means is arranged between said arm means and a second member pivotally movable about the same axis as said arm means.

7. The invention according to claim 6 wherein said second cam means engages a portion of said second member to cause pivotal movement thereof in providing said first biasing force of said spring means.

8. Processing apparatus for a self-developing film unit of the type wherein a pair of superposed sheets are advanced through pressure-applying members to effect rupturing of a frangible container holding a processing liquid and distribution of said liquid in a uniformly thin layer between said sheets, said apparatus comprising, in combination:

(a) fixed frame means;

(b) a first cylindrical pressure roll rotatably mounted upon said fixed frame;

(c) a first arm mounted for pivotal movement with respect to said frame means;

(d) a second cylindrical pressure roll rotatably mounted upon said first arm for movement, as said first arm is pivoted, toward and away from said first roll with the axes of said rolls parallel;

(e) a second arm mounted for pivotal movement with respect to said frame means and said first arm;

(f) first spring means arranged between said first and second arms to exert a biasing force on said first arm tending to move the latter for engagement of said second roll with said first roll;

(g) a shaft mounted for rotation about a fixed axis;

(h) a movable lever having a portion engageable with said second arm and movable between first and second positions to cause corresponding, pivotal movement of said second arm between first and second positions;

(i) means for pivotally moving said first arm in a direction moving said second roll out of engagement with said first roll in response to movement of said second arm from said first to said second position thereof;

(j) a first cam arranged on said shaft to cause movement of said lever to said second position thereof, thereby moving said first and second arms to move said second roll out of engagement with said first roll, during a first portion of rotation of said shaft;

(k) a second cam arranged on said shaft to prevent movement of said first arm in a direction moving said second roll toward engagement of said first roll during a second portion of rotation of said shaft;

(l) a third cam arranged on said shaft to move said second arm to said first position thereof and compress said first spring means to provide a first biasing force on said first arm during a third portion of rotation of said shaft;

(m) said cams being so arranged on said shaft that during a fourth portion of rotation thereof said first spring means provides a second biasing force on said first arm; and

(n) drive means adapted to impart rotation simultaneously and in predetermined relationship to said shaft and said rolls.

9. The invention according to claim 8 wherein said first, second and third cams are adapted to engage follower means on said lever, said first arm, and said second arm, respectively.

10. The invention according to claim 9 wherein said second and third cams are so constructed and arranged that said third cam engages said second arm to move the latter to said first position thereof while said second cam engages said first arm to prevent movement of said second roll toward said first roll, and said second cam moves out of engagement with said first arm to permit movement of said second roll toward said first roll while said third cam still engages said second arm, thereby providing said first biasing force of said first spring means on said first arm.

11. The invention according to claim 10 wherein said second arm is moved to said second position thereof by second spring means upon movement to said lever to disengage said portion thereof from said second arm.

12. The invention according to claim 11 wherein said lever is moved from said second to said first position thereof by third spring means upon movement of said second arm from said second to said first position thereof.

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