

June 2, 1964

P. B. MASON ET AL  
PHOTOGRAPHIC APPARATUS WITH AN EXCESS  
DEVELOPER DISCHARGE MEANS

3,135,187

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3 Sheets-Sheet 1

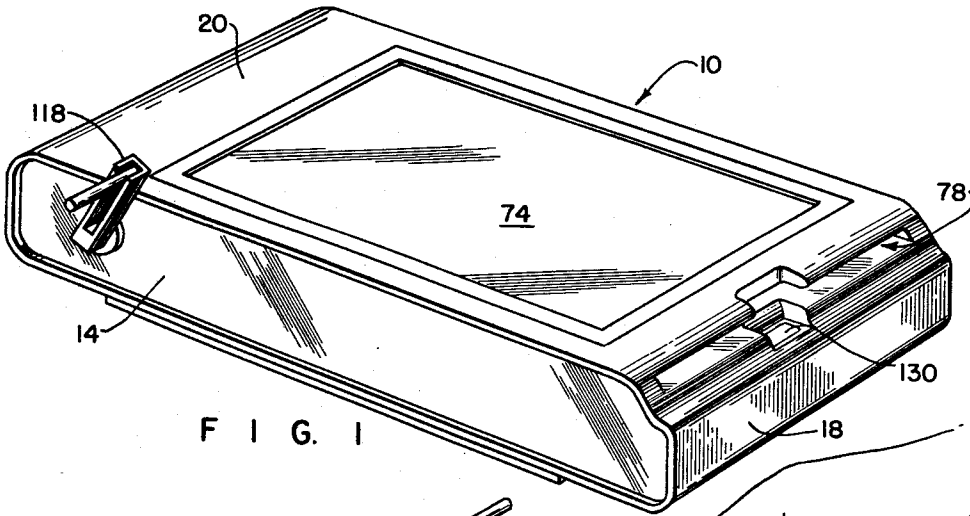


FIG. 1

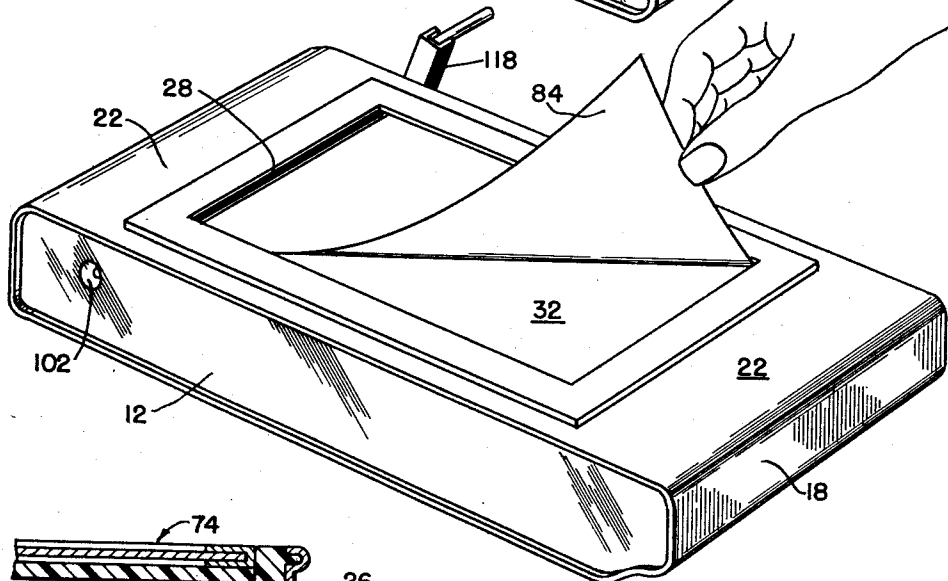


FIG. 2

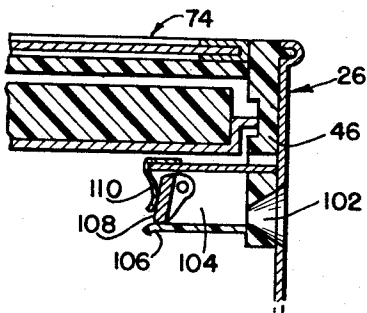


FIG. III

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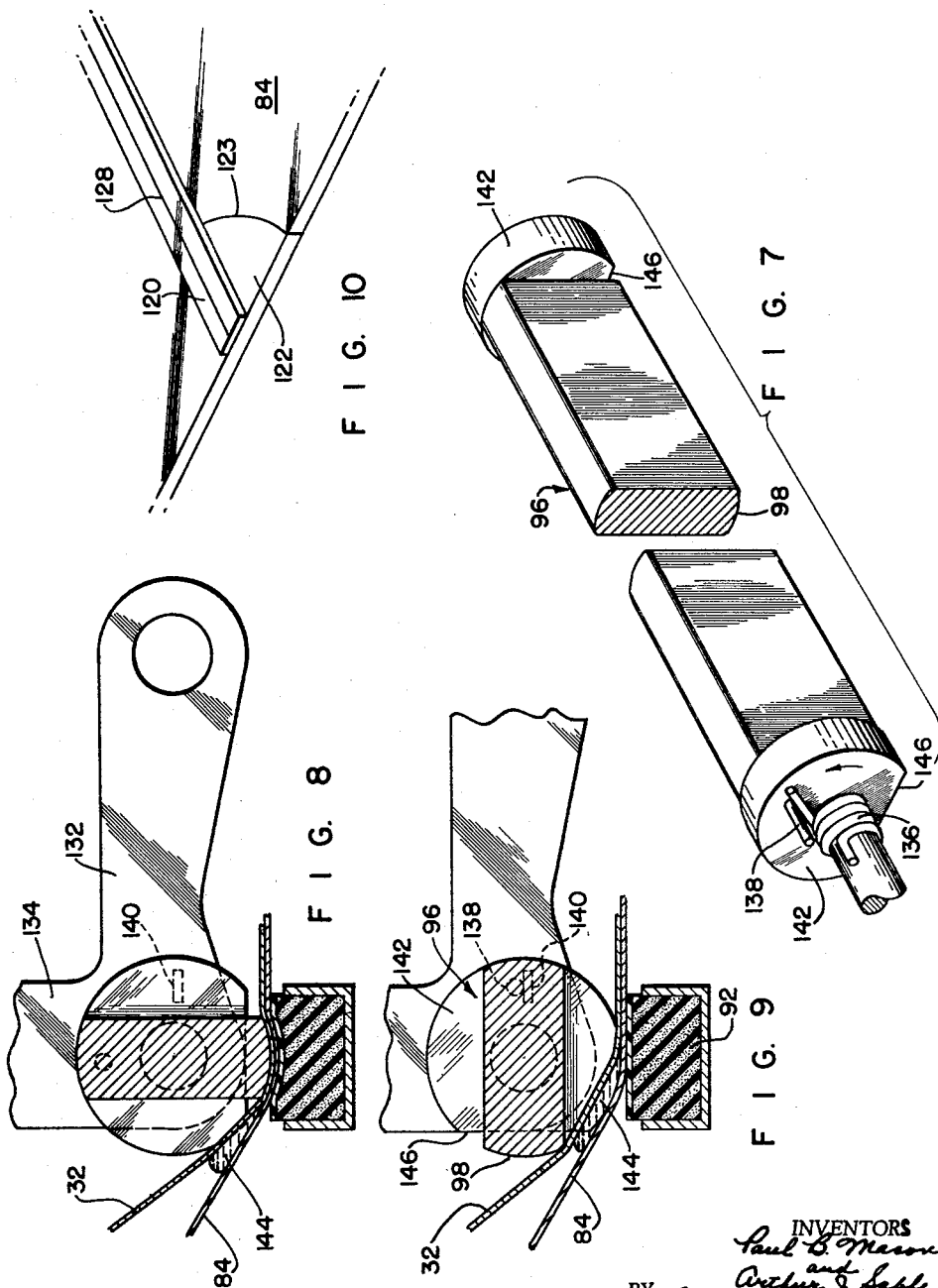
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3 Sheets-Sheet 3



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3,135,187

**PHOTOGRAPHIC APPARATUS WITH AN EXCESS DEVELOPER DISCHARGE MEANS**

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11 Claims. (Cl. 95—39)

This invention relates to photographic apparatus and particularly to apparatus in which a processing liquid is distributed between a pair of superposed sheets.

The apparatus of the invention is designed for incorporation in photographic apparatus such as cameras and particularly document-copying devices, in which successive areas of an image-recording sheet are exposed to produce an image therein, are superposed with areas of a second sheet, and a liquid-processing composition is distributed between each pair of superposed areas of the sheets. The processing liquid, in a preferred embodiment, effects the formation of a transfer image on the second sheet preferably by a silver halide diffusion-transfer reversal process such as is described in U.S. Patent No. 2,662,822 issued December 15, 1953 in the name of Edwin H. Land. The successive areas of the sheets are superposed and the processing liquid distributed therebetween by moving the sheets between a pair of juxtaposed pressure-applying members; and, in the particular form of apparatus with which the present invention is concerned, a quantity of the processing liquid is provided for each pair of superposed areas to be treated. The processing liquid provided for treating each of the areas of the image-recording sheet is usually in excess of that required so that a mass of the liquid remains between the sheets following distribution of the liquid in contact with each of the areas of the image-receptive sheet to be treated.

An object of the invention is to provide in photographic apparatus of the character described, novel and improved means for collecting and retaining between a pair of superposed sheets any excess processing liquid distributed beyond the trailing ends of superposed areas of the sheet so that the excess liquid is not distributed in contact with the next succeeding pair of superposed areas.

Another object of the invention is to provide apparatus as described in which the means for collecting and retaining excess processing liquid comprises the means for distributing the processing liquid and is coupled with the means for exposing the image-recording sheet so that the latter controls the operation of the liquid-spreading and collecting and retaining means.

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

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

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

FIGURE 1 is a perspective view of a document-copying apparatus embodying the invention;

FIG. 2 is a perspective view of the apparatus of FIGURE 1 shown in an inverted position;

FIG. 3 is a fragmentary sectional view of the apparatus of FIGURE 1 taken substantially midway between the sides;

FIGS. 4, 5 and 6 are fragmentary sectional views taken respectively along the lines 4—4, 5—5, 6—6 of FIG. 3, illustrating details of the construction of the apparatus;

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FIG. 7 is a perspective view partially in section illustrating a component of the apparatus;

FIGS. 8 and 9 are fragmentary sectional views of components of the apparatus illustrating the operation thereof;

FIG. 10 is a fragmentary perspective view of a portion of a sheet incorporated in the apparatus; and

FIG. 11 is a fragmentary sectional view taken along the line 11—11 of FIG. 3 illustrating the construction of a component of the apparatus.

The present invention is incorporated in document-copying apparatus designed to be expendable following its use to make a predetermined number of copies. Reference is now made to FIGS. 1 through 3 of the drawings wherein there is illustrated document-copying apparatus of this type embodying the invention. The apparatus comprises a generally parallelepiped shaped housing 10 having side walls 12 and 14, end walls 16 and 18, an upper wall 20 and a lower wall 22, it being understood that the expressions "upper" and "lower" are used for the purposes of description and not in a limiting sense to denote the position in which the apparatus must be disposed during operation. The housing may take the form shown in which the side walls are formed of material such as sheet metal having substantial structural strength and designed to support a majority of the operating elements and materials of the apparatus. The upper, lower and end walls on the other hand are not required to have the structural strength of the side walls and are formed of a less expensive material, such as cardboard, which is joined to the side walls by crimping the edges of the side walls in engagement with the edges of the upper, lower and end walls.

The upper wall 20 of housing 10 is formed with a rectangular opening having an area at least equal and preferably slightly greater than the originals which the apparatus is designed to copy. This opening in upper wall 20 is designated 24 and the upper wall is provided with a rectangular supporting frame 26 disposed in surrounding relation to the opening. The frame is formed, for example, of an organic plastic material and is provided for purposes which will be described hereinafter. Lower wall 22 is also formed with an opening, designated 28, at least coextensive in size with the copies to be produced in the apparatus. A rectangular frame 30, formed of a pliant material such as foam rubber, is secured to the outer surface of lower wall 22 in surrounding relation to opening 28 at the borders of the opening, and provides a lighttight seal between the lower wall and any generally flat surface on which the apparatus is supported during operation.

A supply of such image-recording sheet material, herein designated 32, is provided on a conventional spool 33 supported at its ends on side walls 12 and 14 intermediate the ends of the housing adjacent the end of opening 24 nearest end wall 16. Image-recording sheet 32 is approximately equal in width to the width of the original documents which the apparatus is designed for copying and has a length which is many times the length of such documents so that the apparatus is capable of producing, with the materials with which it is initially loaded, a predetermined large (e.g., 100) number of copies. Image-recording sheet 32 comprises a photosensitive image-recording material such as a gelatino silver halide emulsion carried on a suitable support sheet such as paper.

Ambient light for exposing the image-recording sheet is admitted to the housing through opening 24, and the apparatus includes means for controlling the admission of light into the housing and means for positioning successive areas of the photosensitive sheet for exposure in superposition with original documents to be copied. The apparatus disclosed is designed to produce "direct" copies,

that is, copies made by exposing the image-recording sheet to light transmitted through the original, and accordingly the layer of photosensitive material is provided on the surface of sheet 32 which faces upper wall 20.

Opening 24 is provided with a light-transmitting window 34 supported in frame 26 which may be formed of an organic plastic material and is provided with a groove for engaging the edges of window 34. The window, which may be transparent or translucent, is capable of transmitting light actinic to the image-recording sheet and comprises a relatively stiff or rigid sheet material such as glass or a suitable organic plastic material such as one of the acrylics. In this regard, it is noted that both the frame and the window may comprise a single element formed of an organic plastic material with the frame portion of this element rendered opaque, for example, by the provision of an opaque coating on its surfaces.

Means are provided for supporting successive areas of sheet 32 within the housing in position for exposure underlying window 34. In the form shown, these means comprise a rectangular tray 36 having a bottom wall 38 at least coextensive with window 34 and upstanding end and side walls designated 40 each formed with an outwardly projecting flange 42. Engaged within the end and side walls of the tray and supported on bottom wall 38 thereof is a pad 44 formed of a pliant material such as an elastomeric or polymeric foam. The thickness of pad 44 is such that the upper surface of the pad projects substantially above end and side walls 40 of tray 36. Supporting frame 26 includes side members 46 formed with inwardly facing channels 48 in which flanges 42 on the side walls of tray 36 are engaged and supported for limited movement toward and away from window 34. Coil springs 50 mounted on brackets 52 in turn mounted on side walls 12 and 14 are provided for biasing tray 36 and pad 44 toward window 34. The brackets may be formed of sheet metal as shown and may be attached to the side walls by any suitable method such as resistance welding, riveting, etc.

Means are provided in the housing for preventing exposure of image-recording sheet 32 by light admitted through opening 28 and for guiding the photosensitive sheet from spool 33 into position for exposure between pad 44 and window 34. These means comprise a member in the form of a continuous wall, designated 54, formed of a light-opaque sheet material such as metal to provide a first section 56 extending from forward wall 20 adjacent an end of frame 26 between the latter and end wall 16 toward rear wall 22 to a location adjacent rear wall 22 at an end edge of opening 28; a second section 58 extending from the first section across a portion of opening 28 toward end wall 18 and generally parallel with lower wall 22; a third section 60 generally cylindrical in shape extending toward forward wall 20 and conforming in curvature to the aligning discs on the ends of spool 33; and a fourth section 62 including an end portion disposed within opening 24 adjacent an edge of window 34 and extending toward the opposite edge of the window and generally parallel therewith. Wall 54 is joined at its lateral edges to side walls 12 and 14 and provides, in conjunction with forward wall 20, side walls 12 and 14 and an end portion, designated 64, of support tray 36, a chamber for enclosing a supply of image-recording sheet 32 mounted on spool 33 and having an exit passage 66 defined by end portion 64 of frame 26 and fourth section 62 of wall 54.

On one of end walls 40 of tray 36 is engaged for limited movement in a recess, or recesses, formed in a supporting plate or plates 68 engaged between the third and fourth sections 60 and 62 where the sections join; and the flange 42 at the opposite end of tray 36 is engaged in a channel 70 in a supporting member 72 formed for example of an organic plastic material and supported at its ends on side walls 12 and 14.

The apparatus includes means for preventing the admission of light through window 34 except when it is desired to make an exposure and then for controlling the duration of the exposure. These means comprise a door 74 mounted at one edge on frame 26 for pivotal movement between a closed position in which the door is superposed with window 34 and extends beyond the edges of the window to prevent the admission of light therethrough and an open position displaced from the window to permit the admission of actinic light through the window. The door can be mounted pivotally at any of its end or lateral edges and in the form shown is mounted for pivotal movement at its end closest end wall 16 on end portion 64 of supporting frame 26. A suitable latch (not shown) may be provided for retaining door 74 in the closed position shown in FIGS. 1 through 3.

Exposure of an area of the image-recording sheet to produce a copy of a document is accomplished with the original to be copied disposed between window 34 and an area of sheet 32 supported against the window by pad 44. The exposure is made by opening door 74 for a predetermined period, so that the original must be introduced into the apparatus between the photosensitive sheet and the window while the door is closed and without admitting light to expose the image-recording sheet. During exposure, the image-recording sheet and original superposed therewith are urged into superposition and against window 34 by springs 50, but, between exposures, pad 44 is required to be displaced from window 34 to permit the introduction of an original document into the apparatus between the window and pad. In the form shown, the means for displacing pad 44 away from window 34 comprise engagement members 76 on side walls 40 of tray 36 which extend through openings in side members 46 of supporting frame 26 outwardly beyond the upper and outer surface of window 34. When door 74 is closed, it engages the outer ends of members 76 displacing the members inwardly against the bias of springs 50 and displacing the upper surface of pad 44 away from window 34 to permit the introduction of an original between the pad and the window and the movement of the image-recording sheet therebetween. When the door is open to make an exposure, the pad automatically moves forward under the bias of springs 50 compressing the original and image-recording sheet between the pad and window.

The apparatus is provided with a slot or passage aligned with the space between pad 44 and window 34 through which an original document may be introduced into position for exposure underlying window 34. In the arrangement shown, the housing is provided with a short upper wall 78 joined to end wall 18 and extending to a position adjacent supporting member 72 and underlying end section designated 80 of frame 26. A passage, designated 82, through which the original is introduced is defined by end section 80 and upper wall 78 and is provided with a suitable light-sealing material such as flocking 85 to prevent the admission of light into the housing through passage 82. Since the original may be smaller in size than window 34 yet, during exposure, should be centered with respect to the window, provision is made in the form of means, which are not a part of the apparatus, for introducing the original into the apparatus. These means comprise an envelope formed of a light-transmitting material equal in width to the width of passage 82 and having a length such that a section of the envelope will project from the housing through passage 82 when an original, contained in the envelope, is in position for exposure between window 34 and pad 44. The sheet material comprising the wall of the envelope which is located between the original and the image-recording sheet supported on pad 44 is made preferably as thin as possible in order to locate the original and image-recording sheet in the closest possible relation when the door is opened and the sandwich comprising the

envelope, original and image-recording sheet is compressed between the window and the pad.

As previously noted, the exposed image-recording sheet is treated by a liquid distributed between a sheet and a second or image-recording sheet. The two sheets are advanced into superposition between a pair of juxtaposed pressure-applying members and a quantity of the processing liquid, provided on one of the sheets, is distributed between the sheets to form a sandwich as the sheets are moved relative to and between the pressure-applying members. The apparatus includes a supply of image-receptive sheet 84 which may comprise paper substantially equal in width and length to sheet 32 and coiled upon a conventional spool 86 mounted at its ends on side walls 12 and 14 adjacent end wall 18 and underlying upper wall 78. A guide member 88 formed, for example, of sheet metal is provided between spool 86 and upper wall 78 for guiding sheet 84 from a location adjacent end wall 18 toward the opposite end of the housing in close proximity to the inner surface of upper wall 78 and thence into superposition with image-recording sheet 32 which is guided from between pad 44 and window 34 around supporting member 72 toward lower wall 22 into engagement with sheet 84.

In accordance with the invention sheets 32 and 84 are guided into superposition between a pair of juxtaposed pressure-applying members which perform the functions of superposing the sheets, distributing a processing liquid between the superposed sheets and collecting excess processing liquid following the treatment of each enclosed area of sheet 32 so that the liquid is not distributed in contact with the next succeeding exposed area of the image-recording sheet. The pressure-applying and liquid-collecting means of the invention comprise a pressure-applying member of the type disclosed in the copending U.S. patent application Serial No. 224,644 filed September 19, 1962 in the name of Arthur J. Sable; and, in the form shown, comprise a channel 90 mounted at its ends on side walls 12 and 14 and supporting a resilient deformable member 92 formed of a polymeric or elastomeric foam and having a generally planar upper surface provided with a covering layer 94 of a flexible material, such as polyethylene, which has a low coefficient of friction with respect to the image-receptive sheet. The apparatus includes another pressure-applying member 96 in the form of a rigid bar at least equal in length to the width of the areas of the sheets to be treated with the processing liquid, which width is less than the width of the sheets, and including a sheet engaging surface designated 98 which lies in a straight line and is juxtaposed with the surface of covering layer 94 of deformable member 92. Pressure-applying member 96 is shown in FIGS. 3 and 8 in its operative or pressure-applying position in which resilient deformable member 92 is compressed and the resiliency of member 92 serves to provide the uniformly distributed compressive pressure necessary to distribute a processing liquid between sheets 32 and 84 as the sheets are advanced in superposition between members 92 and 96, the former having a length at least equal to the width of the sheet materials comprising the apparatus.

In order to provide for ease of manufacture, fabrication and assembly of the apparatus and the expendable materials which comprise the apparatus, the processing liquid for each exposed area of the image-recording sheet is provided in a tubular straw-shaped container of the type shown and described in U.S. Patent No. 3,047,387 issued July 31, 1962 in the name of Edwin H. Land. Each container, one of which is shown and designated 100 in FIG. 3, includes a cavity sealed at both ends and filled with a predetermined quantity of the processing liquid sufficient to treat an exposed area of the image-recording sheet. The container includes a seal at one end of the cavity designed to become unsealed in response to the generation of hydraulic pressure within the liquid in the container, and the fluid contents of the container are dis-

charged therefrom by the progressive application of compressive pressure to the container commencing at the opposite end of the cavity as the container is moved lengthwise toward this opposite (or leading) end relative to a surface on which the liquid is to be dispensed. Means are provided for allowing container 100 to be introduced into the apparatus into the position shown in FIG. 3, between sheets 32 and 84 in the region thereof at which the sheets converge into superposed relation, that is, between guide member 88 and support member 72; and for progressively applying compressive pressure to the container as it is withdrawn lengthwise from the housing between and across the sheets in order to dispense the liquid contents of the container as an elongated mass supported on and extending across sheet 84 on an area thereof extending transversely of sheet 84 in the region of the leading edge of the area of sheet 84 which is superposed with an exposed area of sheet 32. These means comprise a funnel-shaped passage 102 leading to a pressure-applying device comprising lateral guide walls 104, a fixed pressure member 106, and a movable pressure member 108. Movable pressure member 108 is mounted for pivotal movement between guide walls 104 toward and away from fixed pressure member 106 and is biased by a spring 110 toward the fixed pressure member. The construction of the pressure members and the spring are such that as container 100 is introduced into the housing through passage 102 between guide walls 104, pressure member 108 will be deflected inwardly against the bias of spring 110 allowing the passage of the container without applying sufficient pressure to the container to cause its rupture. Pressure member 108 is self-actuating in its operation so that when the container is withdrawn the pressure member 108 pivots outwardly in the direction of withdrawal of the container applying compressive pressure thereto sufficient to cause the discharge of the liquid contents of the container from the trailing end thereof onto sheet 84. Pressure member 108 also cooperates with pressure member 106 and guide walls 104 for preventing the admission of light into the housing through passage 102.

As the sheets are advanced between pressure-applying members 96 and 92, the liquid is distributed from the mass in which it was dispensed, between the sheets laminating the sheets to one another to form a sandwich which is advanced within the housing toward the opposite end thereof across opening 28. During the initial processing of the image-recording sheet 32, the sheet remains photosensitive and the sandwich is required to be formed and advanced in a light-free environment. This environment is provided by supporting the apparatus on a generally flat surface with frame 30 in contact with the supporting surface, for example, the top of a table. Frame 30, being resiliently deformable, forms a lighttight seal between lower wall 22 and the supporting surface preventing the admission of light through opening 28 into the processing chamber defined by the supporting surface, side walls 12 and 14, end walls 16 and 18, tray 36, frame 26 and upper walls 20 and 78. The tray and pad 44 cooperate with side members 46, supporting member 72 and wall 54 to maintain this processing chamber lighttight when door 74 covering window 34 is opened.

As means for advancing the sheets through the apparatus, there is provided within the end of the housing between end wall 16 and first section 46 of wall 54 a take-up spool 112 of a conventional design connected through a pinion gear 114 and drive gear 116 to a manually operable crank 118 mounted on the exterior of side wall 14. The apparatus is initially provided with sheet 32 extending from spool 33 between window 34 and pad 44 around supporting member 72 into superposition with sheet 84 between members 92 and 96, and with sheet 84 extending from spool 86 around guide member 88 between the latter and upper wall 78 into superposition with sheet 32 between members 92 and 96 from which the two sheets, or one of the sheets, or a leader attached to one

or both of the sheets, extend across opening 23 into contact with second section 53 of wall 54 and thence into engagement with spool 112 to which the sheets, sheet or leader are attached. Processing of each area of the image-recording sheet to form a positive transfer image in the image-receptive sheet requires that the sheets remain in superposition in a light-free environment during a predetermined minimum processing period which may be several seconds. To insure that this minimum processing period is allowed, spool 112 is driven by crank 118 through drive gear 116 and pinion gear 114 at a speed much less than the speed of rotation of the crank making it virtually impossible to advance the sheets through the apparatus at an unreasonably fast rate. Moreover, crank 118 has a small diameter making it difficult to manually rotate the crank at a rate faster than the rate calculated to provide for a minimum processing period.

At the end of the processing period, the area of the image-receptive sheet containing a positive-transfer image constitutes the copy of the original and is separated from the processed area of the image-recording sheet. To accomplish this, the apparatus is inverted so that the processed sandwich is accessible through opening 23 in lower wall 22, to separate an area of sheet 84 comprising a positive copy from the superposed area of the image-recording sheet which is now considered waste. The area of sheet 84 comprising a copy is severed at its leading edge from the remainder of sheet 84 extending from second section 53 toward spool 112 and remaining laminated with sheet 32. This area of sheet 84 is then stripped from sheet 32 and is again severed at its trailing edge in the vicinity of the pressure-applying members which distribute the processing liquid. To facilitate the severing and stripping operations, sheet 84 is provided on the surface thereof which faces sheet 32 with a succession of strips each secured to sheet 84 at the leading edge of an area of the sheet which is superposed with an exposed area of sheet 32 and is to comprise a finished copy. Strips 120 extend transversely of sheet 84 from edge to edge thereof and are formed of a material having a greater tensile or tear strength than sheet 84. Strips 120 may comprise filamentous elements such as fine threads or wires; or as shown in detail in FIG. 10, the strips may comprise ribbons of a thin, sheet material such as the polymers having relatively high tear strength, polyethylene terephthalate resins being especially well suited for this purpose. Sheet 84 may be grasped at one edge and torn, as shown in FIG. 2, along the edge of strip 120; and to facilitate grasping of the edge of the sheet and initiating tearing thereof, sheet 84 is provided with portions at one edge each precut or at least weakened along a line extending inwardly from the edge toward an adjacent edge of strip 120. In the form shown in FIG. 10, this portion, designated 122, is cut along a line 123 extending from a point on the edge of sheet 84 spaced from the leading edge of strip 120 inwardly and toward the leading edge of strip 120 to a point at said leading edge. Portion 122 may then be grasped between the fingers for tearing sheet 84 along the leading edge of sheet strip 120.

Sheet 84, as it is torn along strip 120 from another portion of sheet 84, is stripped from sheet 32 and withdrawn from the housing through opening 28. To facilitate the severance of this area of sheet 84 at its trailing end, a cutter bar 124 is provided within the housing having a sharpened edge 126 located adjacent the path of movement of the sandwich and member 92. By virtue of this construction, withdrawal and stripping of this area of sheet 84 and severance of the sheet at the trailing edge of this area is accomplished in a single motion, as shown in FIG. 2, when the sheet is drawn against sharpened edge 126.

The sheets are advanced through the apparatus manually and means are provided for indicating to the operator of the apparatus each time a sufficient length of the

sheets have been advanced to process an exposed area of the photosensitive sheet and to move another unexposed area of the photosensitive sheet into position for exposure. In the form shown, these means comprise a reference mark in the form of a line 128 at the leading edge of each area of image-receptive sheet 84 and a window 130 in upper wall 78 through which the reference line becomes visible as sheet 84 is advanced between supporting member 88 and window 30. The reference indicia or line 128 may comprise strip 120, and the reference indicia, window 130, and supporting member 88 are so located that advancement of the sheets is discontinued when the reference indicia becomes visible through window 130.

The processing liquid for each area of the image-recording sheet to be treated is usually provided in a quantity in excess of that required so that following distribution of the processing liquid in contact with an exposed area of the image-recording sheet and a corresponding area of the image-receptive sheet, a mass of the liquid remains between the sheets where the sheets enter between member 92 and 96. Means are provided for preventing this mass of liquid from being distributed beyond the trailing edges of the processed area into contact with the next successive exposed area of the image-recording sheet. These means, termed "trapping" means, comprise means for spacing member 96 away from member 92 during the initial movement of the sheets between the members to effect processing of an exposed area of the image-recording sheet whereby distribution of the processing liquid is temporarily discontinued, and the excess processing liquid remaining at the trailing edge of the processed areas is collected and retained between the sheets rather than being distributed further. In order to trap and retain the excess processing liquid, pressure-applying member 96 is generally rectangular in cross section and is mounted for pivotal movement about an axis located approximately midway between sheet-engaging surface 98 and the opposite surface of member 96 so that sheet-engaging surface 98 can be moved through 90° from the operative or pressure-applying position shown in FIG. 8, to the inoperative or trapping position shown in FIG. 9, at which there is a substantial gap between pressure-applying member 96 and deformable member 92. Pressure-applying member 96 is mounted for pivotal movement about the aforesaid axis on the ends of a pair of arms 132 each mounted for pivotal movement at its opposite end on one of side walls 12 and 14. Pressure-applying member 96 is resiliently biased by a torsion spring 136 into the inoperative or trapping position thereof, spring 136 being engaged at one end in arm 132 and at its other end with a pin 138 projecting axially from the end of the pressure-applying member 96. A tab 140 is turned inwardly from arm 132 and acts as a stop against which pin 138 abuts in the inoperative position of the pressure-applying member.

Means are provided on the ends of pressure-applying member 96 for pivoting the pressure-applying member into its operative fluid-spreading position and in the form shown comprise a pair of sheet engagement members 142 each having a periphery which is cylindrical with respect to the aforementioned axis about which member 96 is pivotable and having a radius approximately equal to the distance between the aforesaid axis and sheet engaging surface 98. Engagement members 142 are positioned for engaging the image-recording sheet at its lateral margins and the cylindrical surface of each of the sheet engagement members is constructed and designed to promote frictional engagement with the sheets. This can be accomplished by knurling or otherwise roughing the cylindrical surfaces of members 142 if the latter are formed of metal, or forming members 142 of material such as rubber having a high coefficient of friction. In the operation of the apparatus, when advancement of the sheets is discontinued and the processing liquid distributed be-



tween and in contact with the adjacent surfaces of an exposed area of sheet 32 and another area of sheet 84, the pressure-applying member 96 is in the operative position shown in FIG. 8 with a mass, designated 144, of the excess processing liquid being located in between the sheets where the sheets converge into superposition adjacent member 96. Rotation of pressure-applying member 96 through 90° to the inoperative position of FIG. 9 is prevented by frictional engagement of members 96 and 142 with sheet 32, and this condition prevails until members 96 and 142 are displaced from member 92 permitting pressure-applying member 96 to pivot under the bias of spring 136 into inoperative position. Arms 132 are pivotable to move sheet engagement members 142 toward and away from member 92 and include control members 134 which extend from the end of the arm on which member 96 is mounted, through openings in side member 46 of the housing beyond the upper surface of window 34. In this construction door 74, in the closed position, engages control members 134 thereby holding pressure-applying member 96 and sheet engagement members 142 against the sheets disposed between members 92 and 96, and in order to permit rotation of member 96 with respect to member 92 out of engagement with sheet 32 when door 74 is moved to its open position in order to expose an area of the image-recording sheet. When door 74 is opened, sheet engagement members 142 are no longer urged or held in engagement with sheet 32 thereby allowing member 96 to pivot into inoperative position during the initial advancement of the sheets for processing the next succeeding exposed area of the image-recording sheet.

When door 74 is closed to terminate the exposure of an area of sheet 32, members 142 are again urged into engagement with sheet 32 so that during the initial portion of the subsequent movement of sheet 32, members 142 and pressure-applying member 96 are pivoted against the bias of spring 136 in a counterclockwise direction (viewing FIGS. 8 and 9), into a position in which sheet engagement surface 98 is engaged with a portion of sheet 32 located between member 96 and member 92 so that continued movement of the sheets continues the rotation of member 96 into the operative position of FIG. 8. During this pivotal movement of member 96 from inoperative to operative position, the mass 144 of liquid left over from producing the previous copy is trapped and retained between portions of the sheets which have been advanced between the pressure-applying members and which are located between successive exposed areas of the image-recording sheet. In order that the sheets may be advanced between members 96 and 92 subject only to frictional engagement with covering layer 94 and sheet engagement surface 98, each of members 142 is relieved at the portion thereof which is closest to member 92 when member 96 is in operative position. Stated differently, in this operative position of member 96, each of members 142 includes a surface portion 146 which is spaced from the pivotal axis of member 96 by a distance substantially less than the distance separating the axis and sheet engagement surface 98.

To operate the document-copying apparatus of the invention, the apparatus is placed on a supporting surface with lower wall 22 facing the supporting surface and frame 30 engaged with the supporting surface. The original document to be copied is introduced into the light-transmitting envelope as previously described and introduced through passage 82 into position for exposure between an area of sheet 32 supported on pad 44 and window 34. Door 74 is then opened for a predetermined period the length of which depends on the brightness of the ambient light thereby permitting the upward movement of pad 44 clamping the original envelope and sheet 32 between the pad and the window during exposure. When the door is opened, member 96, if it had been in operative position, is allowed to pivot under the bias of spring 136 into inoperative position. The door is then

closed displacing pad 44 from window 34 and holding members 142 in engagement with sheet 32. The envelope containing the original document may then be withdrawn from the housing, although this is not necessary, a container of processing liquid is then introduced through passage 102 in the housing and then withdrawn from the housing causing its fluid contents to be distributed as an elongated mass on sheet 84. Crank 118 is then rotated to advance the sheets through the apparatus until line 128 becomes visible through window 130. During the initial advancement of the sheets, pressure-applying member 96 is rotated into its operative position, any excess processing liquid from the previous copy is trapped between the sheets and thereafter the processing liquid, dispensed from the container onto sheet 84, is distributed between the exposed area of the image-recording sheet and a corresponding area of sheet 84 to form a sandwich which is advanced into the processing chamber previously described underlying opening 28. The apparatus is then inverted to provide access to opening 28 so that the operator can grasp portion 122 of sheet 84 and simultaneously tear sheet 84 along the edge of strip 120, separate the portion of sheet 84 comprising the copy from sheet 32 and then tear sheet 84 against sharpened edge 126 of cutter bar 124. The apparatus may then be righted and supported on a support surface with frame 30 in contact therewith and the operation repeated for another copy at any time when such other copy is desired.

The apparatus may be employed to make a copy or copies as often and at whatever intervals are desired and convenient; and inasmuch as the liquid for each copy is provided in a separate container and does not deteriorate with age as is the case in conventional copying apparatus in which the processing liquid for a number of copies is contained in a container through which one or both of the sheets is passed for wetting the sheet. There are no liquids to spill, and the waste materials, with the exception of collapsed containers, are contained within the housing and are discarded along with the housing and operating components of the apparatus when the sheet materials have been expended to make copies. The only materials which are handled by the operator are the containers of processing liquid, which are merely introduced into and withdrawn from the housing, and the finished copies. The process, as previously noted, is substantially dry so that neither the apparatus nor the operator comes into contact with the processing liquid. The construction of this device is quite simple comprising a minimum of elements which are easy to fabricate of inexpensive materials and can be assembled without difficulty.

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. Photographic apparatus for superposing successive areas of a pair of photographic sheets and distributing a processing liquid between and in contact with said areas as said sheets are superposed, said apparatus comprising, in combination:

- a first pressure-applying member having a sheet-engaging portion;
- a second pressure-applying member having a sheet-engaging portion;

means mounting said second pressure-applying member for movement between a first position in which said sheet-engaging portion thereof is juxtaposed with said sheet-engaging portion of said first member for engaging and applying compressive pressure to said sheets to superpose said sheets and distribute a processing liquid therebetween as said sheets are moved relative to and between said members in engagement



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- with said portions thereof, and a second position in which said sheet-engaging portion of said second member is displaced from said sheet-engaging portion of said first member so as not to apply compressive pressure to said sheets;
- resilient means for urging said second pressure-applying member to said second position;
- a drive element coupled with said second pressure-applying member for frictionally engaging one of said sheets during movement thereof between said members for moving said second pressure-applying member against the bias of said resilient means into said first position in response to movement of said sheets between said members;
- support means mounting said drive element for movement between a first position in which said drive element is frictionally engaged with said one sheet for moving said second pressure-applying member into said first position, and a second position in which said second pressure-applying member is free to move under the bias of said resilient means into said second position thereof; and
- means coupled with said support means for urging said drive element into frictional engagement with said one sheet.
2. The photographic apparatus of claim 1 in which said second pressure-applying member is mounted for rotation between first and second positions and said drive element is mounted for rotation in response to movement of said one sheet in frictional engagement with said drive element.
3. The photographic apparatus of claim 2 in which said second pressure-applying member is rotatable through less than 180°.
4. The photographic apparatus of claim 2 in which said second pressure-applying member and said drive element are mounted for rotation about a common axis, said second pressure-applying member has a cross section which is non-circular with respect to said axes and said drive element includes a portion cylindrical about said axis and frictionally engaged with said one sheet.
5. The photographic apparatus of claim 4 in which means are provided for limiting said second pressure-applying member to rotation between said first and second positions.

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6. The photographic apparatus of claim 2 in which said second pressure-applying member and said drive element are mounted on said support means for rotation together about a common axis and means are provided for limiting said second pressure-applying member to rotation between said first and second positions.
7. The photographic apparatus of claim 6 in which said drive element is mounted for engaging a lateral marginal section of said one sheet and said second pressure-applying member is constructed for engaging the medial portion of said one sheet.
8. The photographic apparatus of claim 6 in which said sheet-engaging portion of said second pressure-applying member includes a sheet-engaging surface which is substantially parallel with said axis and is spaced therefrom by a predetermined distance, and said drive element includes a cylindrical sheet-engaging surface portion having a radius at least equal to said predetermined distance.
9. The photographic apparatus of claim 8 in which said drive element includes a second surface portion arranged for juxtaposition with said one sheet in said first position of said second pressure-applying member and spaced from said axes by less than said predetermined distance such that substantial frictional engagement between said one sheet and said drive element does not occur when said second pressure-applying member is in said first position.
10. The photographic apparatus of claim 9 in which said second pressure-applying member and said drive element are rotatable through less than 180°.
11. The photographic apparatus of claim 1 in which said sheet-engaging portion of said first pressure-applying member is constructed for engaging one of said sheets substantially from edge to edge thereof, and said drive element is constructed and arranged in juxtaposition with a section of said sheet-engaging portion of said first pressure-applying member for engaging a lateral marginal portion of the other of said sheets during movement of said other sheet between said first pressure-applying member and said drive element.

## References Cited in the file of this patent

## UNITED STATES PATENTS

2,789,488	Eloranta	Apr. 23, 1957
2,991,703	Eloranta	July 11, 1961