United States Patent [19]

Levy

[11] **3,715,156**

[45] **Feb. 6, 1973**

[54] **IMAGING DEVICE HAVING A PIVOTING PRESSURE PAD FOR ENGAGING AND DISENGAGING A WEB MEDIUM**

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[22] Filed: **March 22, 1971**

[21] Appl. No.: **126,779**

[52] **U.S. Cl.** **355/16,** 355/12, 355/99, 355/113

[51] **Int. Cl.** **G03g 15/00**

[58] **Field of Search**.....355/3, 12, 14, 16, 91, 93, 355/97, 99, 118, 120, 128, 129, 130, 131

[56] **References Cited**

UNITED STATES PATENTS

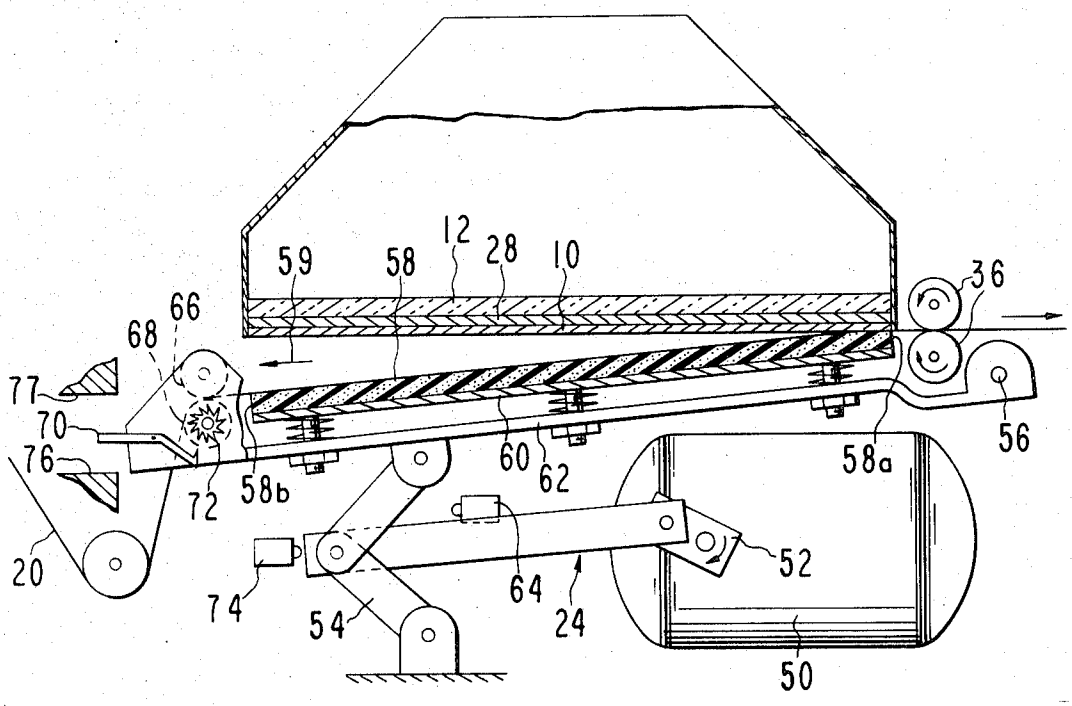
3,510,217	5/1970	Cirimele et al.	355/16
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[57] **ABSTRACT**

The recording web in an electrophotographic apparatus is pressed into engagement with the photoconductive plate by a flexible, resilient, pivoting pressure pad. Due to the positioning of the axis of the pressure pad with respect to the plane of the photoconductive plate, the end of the pressure pad closest to the pivot axis initially contact the web. The area of engagement then increases as the pressure pad is further pivoted against the plate. This progressive engagement action smooths out wrinkles in the web and squeeges or displaces air from between the web and the plate. After full engagement is established, an exposure-imaging cycle is initiated which causes a charge image to be formed on the web. The charge image establishes electrostatic forces which further engage the web to the photoconductive plate. After exposure, the web is disengaged from the plate by pivoting the pressure pad away from the plate. The web is peeled off of the surface of the plate during this disengagement causing the area of engagement to progressively decrease as the pressure pad is pivoted. The pivoting-peeling action requires less disengagement force to overcome the electrostatic engagement force than would be required if the web were disengaged over the entire area of engagement simultaneously. Further minimization of the disengagement force is obtained because the force of disengagement established by the pivoting pressure pad is applied generally perpendicular to the plane of the web-plate engagement. The present minimal disengagement forces remain uniformly minimal throughout the disengagement cycle. Timers and limit switches are employed to automate the pressure pad pivoting, exposure-charge cycle, and web transport cycle.

8 Claims, 4 Drawing Figures



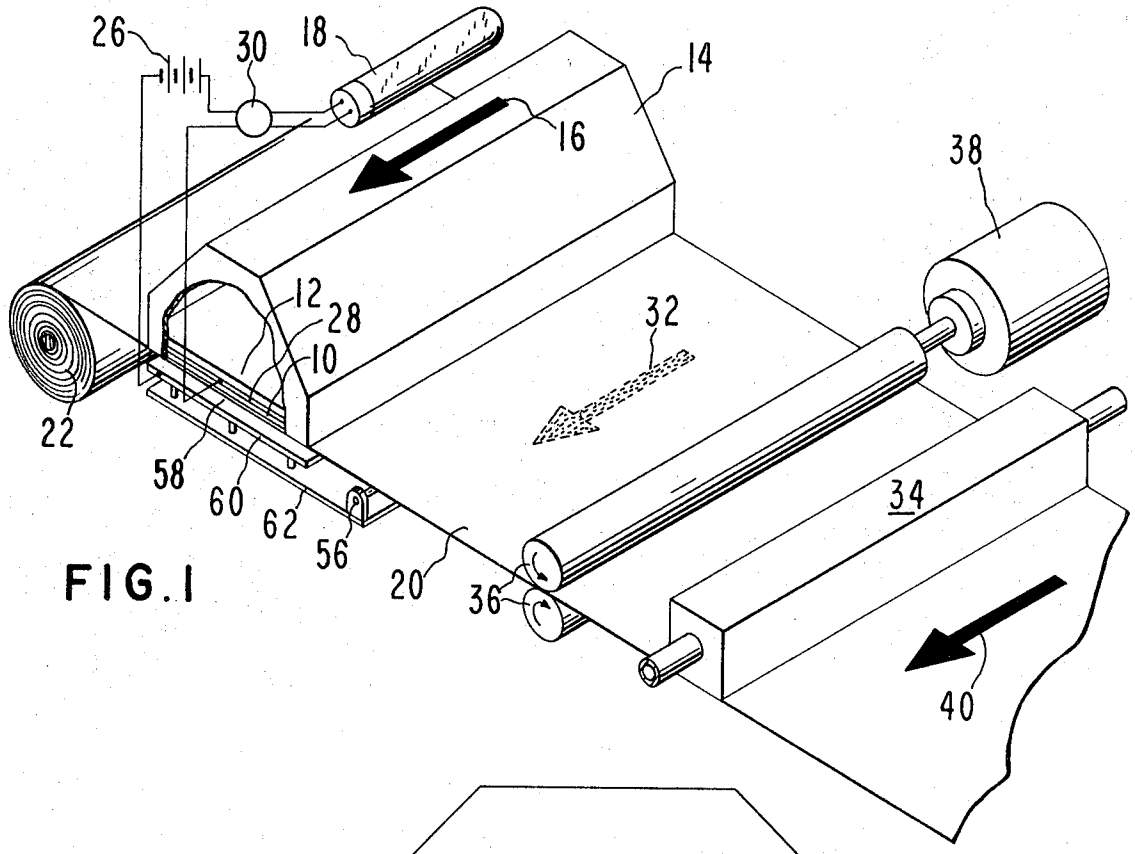
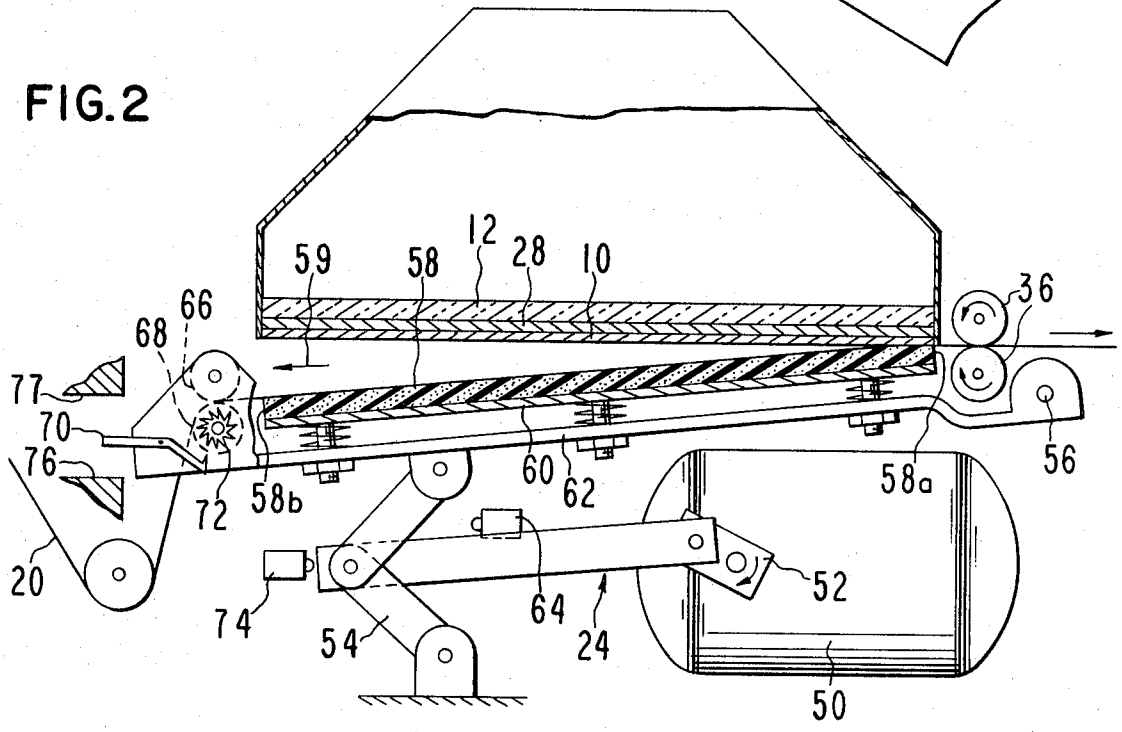


FIG. 1

FIG. 2



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FIG. 3

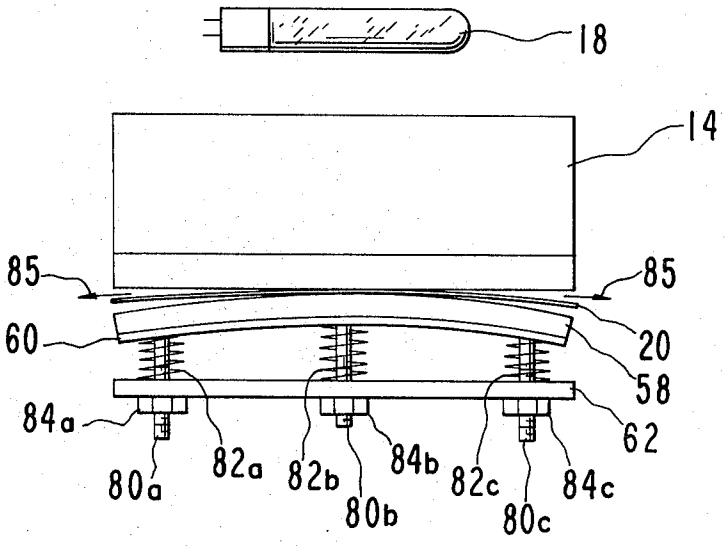
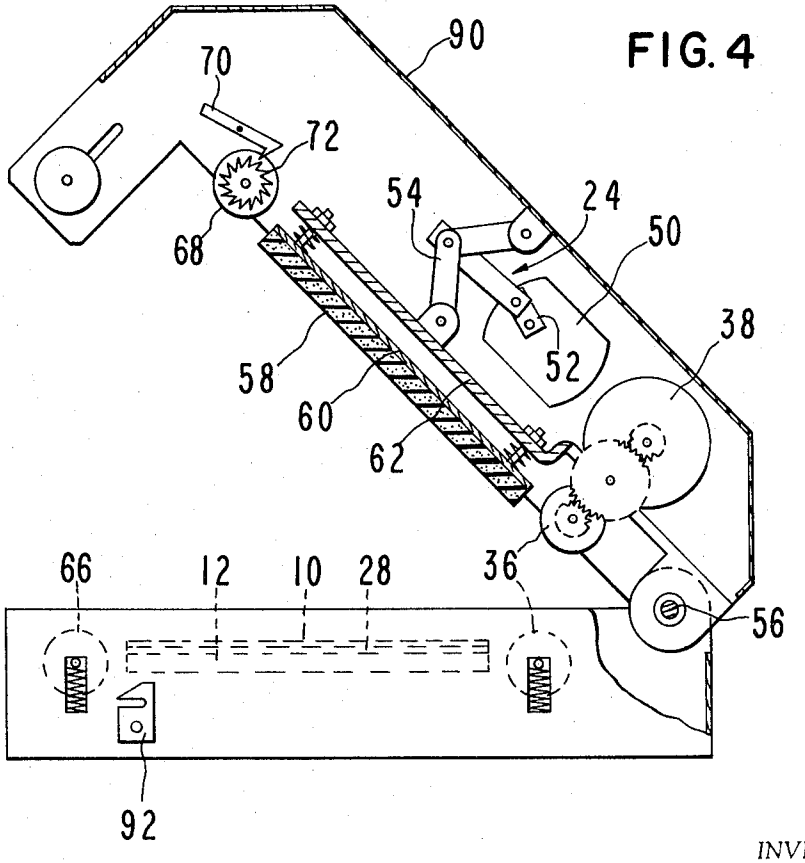


FIG. 4



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IMAGING DEVICE HAVING A PIVOTING PRESSURE PAD FOR ENGAGING AND DISENGAGING A WEB MEDIUM

FIELD OF THE INVENTION

This invention relates to web handling devices and more particularly to such devices which engage and disengage the web against an imaging surface.

DESCRIPTION OF THE PRIOR ART

Heretofore, a crowned flexible pressure pad has been employed in electrophotographic recorders (U. S. Pat. No. 3,510,217). The crowned pad was mounted parallel to the photoconductive plate and the web-plate engagement was initiated at the center of the crown and extended toward the edges thereof smoothing out the web and pushing air out past the edges of the plate.

In U. S. application Ser. No. 7,653, filed Feb. 2, 1970, entitled "Electroduplication Apparatus Employing A Conductive Porous Elastic Pressure Pad For Pressing The Recording Medium Against the Photoconductor", and assigned to the present assignee, a flat porous pressure pad was employed to engage the entire area of the plate simultaneously. The porousity of the pad permitted air between the pad and web to escape through the pad.

Neither of the above prior art structures disclose the present pivoting-peeling technique for removing the charged web from the oppositely charged plate. The charge image electrostatic forces held the web in engagement with the plate. A large web drive motor was required to overcome this web holding electrostatic field. Frequently, the electrostatic holding forces caused the web to tear or to slip with respect to the drive rollers which destroyed the registration between the charge image and the web cutting mechanism. The web drive forces moved the web laterally with respect to the plate, which in the initial stages of disengagement caused abrasion of the photoconductive surface by the relatively rough dielectric surface of the web.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to: provide a web-handling device for engaging a web between an imaging surface and a pressure pad in which the area of engagement is progressively increased to smooth out the web and prevent air pockets from developing; provide a web-handling device for engaging and disengaging a web from between an imaging surface and a pressure pad in which the area of engagement gradually decreases in order to reduce the disengagement forces required; provide a web-handling device for engaging and disengaging a web between a photoconductive surface and a backup electrode in which the disengagement forces are minimal and generally normal to the surface of engagement and remain uniformly minimal throughout the disengagement cycle.

Briefly, these and other objects are achieved by providing an area imaging device having a transparent member such as a plate for displaying an area image, and a web for accommodating the area image by recording or projecting the image. A resilient flexible pressure pad is mounted proximate the transparent plate with the recording web therebetween. The pressure pad and the plate are in pivotal relationship about an axis off one end of the plane of web-plate engagement for causing the pressure pad to initially engage the web and the plate at the end thereof closest to the pivoting axis. The area of engagement gradually increases and extends towards the other end of the pressure pad. This pivoting action and gradual expansion of the area of engagement smooths out the web in the direction of increasing area and causes air to be displaced from between the plate and the pad. Upon disengagement of the web the area of engagement gradually decreases towards the axis end of the pad. The web in effect is peeled away from the transparent imaging surface to minimize the forces required to disengage the web.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages of the web-handling device and the operation of the pivoting pressure pad will become apparent from the following detailed description taken in conjunction with the drawings in which:

FIG. 1 is an isometric schematic view partly in section showing an electrophotographic recorder system employing the pivoting pressure pad;

FIG. 2 is a sectional view showing the pivoting pressure pad and the associated automation structure;

FIG. 3 is a schematic end view of a bowed pressure pad embodiment; and

FIG. 4 is a sectional view of an easy loading embodiment in which the pressure pad and automation structure are mounted over the web and electrophotographic plate.

Referring to FIG. 1 there is shown a photoconductive plate **10** mounted on a glass substrate **12** contained within a dark box **14**. The image to be copied **16** is projected onto plate **10** by an optical imaging system depicted in FIG. 1 as light source **18**. A web **20** from supply reel **22** is pressed into mechanical and electrical engagement with photoconductive plate **10** by pivoting assembly **24**. A voltage source **26** for applying a charging voltage serially across plate **10** and web **20**, has one lead connected to a thin transparent electrode **28** sandwiched between glass substrate **12** and plate **10**, and the other lead connected to pivoting assembly **24** which is conductive. A timer **30** controls the application of charging voltage **26** and the exposure of image **16** by light source **18**. Current flowing through photoconductor **10** in response to this exposure causes a latent charge image **32** (shown in dotted lines) which corresponds to image **16** to be formed on web **20**. Web **20** is disengaged from photoconductor **10** by a peeling process explained more fully in connection with FIG. **2**. Web **20** is then moved to a toning station **34** by a pair of opposed drive wheels **36** activated by a web transport motor **38** where charge image **32** is developed to form visible image **40**.

Referring to FIG. **2**, the automatic cycling, web engaging, and image exposing structure is shown with the pivoting assembly **24** pivoted slightly to partially engaged web **20** against plate **10**. At the beginning of the cycle, pivoting assembly **24** is clear of plate **10**, and web drive motor **38** activates opposed drive rollers **36** to draw fresh copy web into the exposure position directly beneath photoconductor **10**. A gear motor **50**

is then energized to rotate crank **52** and operate toggle linkage **54** in the expanding mode, causing pivoting assembly **24** to pivot about axis **56** and swing toward photoconductor **10**. Pivoting assembly **24** includes a porous resilient conductive flexible pressure pad **58** mounted on a conductive backup electrode **60** which is mounted on pivoting frame **62**. The pivoting action causes pressure pad **58** to initially engage web **20** along leading edge **58a** as shown in FIG. **2**. As the area of engagement expands across pressure pad **58** in the direction of arrow **59** toward lagging edge **58*b***, web **20** is smoothed out toward lagging edge **58*b*** preventing wrinkle formation. The air immediately above web **20** and next to photoconductor **10** is displaced towards the lagging edge **58*b*** and towards the sides of pressure pad **58**. The air immediately under web **20** and next to pad **58** escapes through the pores of pad **58**. As the increasing area of engagement expands to the full area of pad **58** and web **20** becomes fully engaged, toggle linkage **54** approaches full toggle and activates an upper limit switch **64** which stops gear motor **50** and triggers light source **18** to initiate the web exposure-charging cycle. Also, as pivoting assembly approaches full engagement, a pawl **70** contacts upper striker plate **77** and is pushed into engagement with ratchet **72**. This engagement locks a pair of opposed guide rollers **66** and **68** preventing movement of web **20** after web **20** has become fully engaged between pad **58** and plate **10** and the web ironing action is complete.

After exposure period which is determined by timer **30**, gear motor **50** is re-energized and operates toggle linkage **54** in the contracting mode. Pivoting assembly **24** pivots away from photoconductor **10** causing pad **58** to progressively disengage web **20** from photoconductor **10**. Web **20** is peeled away from plate **10** along the boundary of the progressively decreasing area of engagement. The peeling action reduces the disengagement forces required to break the electrostatic bond developed between web **20** and plate **10** during exposure and charging of web **20**. Further minimization of the disengagement force is effected by the generally perpendicular disengagement motion between plate **10** and pad **58**. Heretofore, the web was disengaged by pulling the web laterally with respect to the photoconductive plate. The entire area of engagement was overcome at one time. Web **20** is held at lagging edge **58*b*** during the peeling disengagement by rotably locked opposed guide rollers **66** and **68**. Web **20** is held taunt at leading edge **58*a*** by the gradually decreasing web-plate engagement and further by opposed drive rollers **36**. As the disengagement is completed, toggle linkage **54** approaches full contraction and activates lower limit switch **74** which de-energizes gear motor **50** and activates web drive motor **38**. Meanwhile, the downward movement of pivoting assembly **24** has caused pawl **70** to abutt striker plate **76** and become disengaged from ratchet **72** to release web **20** from between guide rollers **66** and **68** allowing fresh web to be drawn into the exposure position by drive motor **38**. Drive motor **38** and gear motor **50** may be replaced by a single motor with appropriate clutch mechanisms to drive the web and pivot assembly **24**.

The grey scale capabilities of the recorder may be enhanced if during the web peeling action, voltage **26** is continuously applied across plate **10** and web **20**. The presence of this voltage adds to the electrostatic holding force already present between plate **10** and web **20** due to the charge image **32**. This added force of engagement is readily overcome, however, by the peeling and pivoting technique described above.

Referring to FIG. **3**, there is shown a bowed embodiment of the pivoting pressure pad **58**. The pressure pad-backup electrode unit is secured to pivoting frame **62** by a series of threaded studs **80*a***, **80*b*** and **80*c***. Spring spacers **82*a***, **82*b*** and **82*c*** and locking nuts **84*a***, **84*b*** and **84*c*** mounted on each stud permit adjustment of the relative position and alignment between pad **58** and frame **62**. The bowed condition shown in FIG. **3** is obtained by tightening lock nuts **84*a*** and **84*c*** along both sides of frame **62**. Web **20** is smoothed laterally by this bowed configuration as pivoting assembly **24** swings into the web engagement position. Additionally, air is squeezed laterally out of the web engagement area as indicated by arrows **85** in FIG. **3**. FIG. **3** depicts the bowed pad and web partially engaged.

Lateral squeegeeing and smoothing may be accomplished with the planar pressure pad of FIG. **1** by tilting the axis of pivot into a nonparallel orientation with respect to the plane of photoconductor **10**. The squeegeeing action in this tilted structures starts at the corner of initial contact and spreads laterally across the web in one direction in contrast to the bilateral squeegeeing and smoothing of the FIG. **3** bowed embodiment. In both embodiments, however, longitudinal squeegeeing and smoothing is provided by the pivoting action described in relation to FIG. **2**.

Referring to FIG. **4**, pivoting assembly **24** and the associated automation structure are shown mounted over plate **10** in a hinged top housing **90**. Housing **90** is shown raised away from plate **10** in the web loading position. In the loading position, guide rollers **66** and **68** are separated and drive rollers **36** become spaced. Web **20** from a new supply roll **22** is easily loaded by pulling the web over lower guide roller **68** and inserting the web between spaced drive rollers **36**. Housing **90** is then pushed downward into the closed or operating position. Guide rollers **66** and **68** and drive rollers **36** become engaged and housing **90** is secured by frame latch **92**. Housing **90** is preferably hinged on the same pivot axis **56** as pivoting assembly **24**. This assures that the same web engagement and disengagement action occurs when housing **90** is opened as when pivoting assembly **24** is pivoted.

It will be apparent to those skilled in the art that the objects of this invention have been achieved by providing a pivoting pressure pad which smooths the web against the photoconductor. Bowed and tilted modifications augment this smoothing action. Upon disengagement, the pivoting pad peels the web away from the photoconductor by moving generally normally away from the photoconductor.

What is claimed is:

1. An electrophotographic recording device employing a recording medium which is periodically engaged and disengaged from a recording structure, the combination comprising:

a transparent plate for displaying an image of an original to be copied;

a resilient flexible pressure pad having a generally planar surface pivotally mounted with respect to

the transparent plate for engaging and disengaging a recording medium in an area between the plate and the pad, said pressure pad being pivotal about an axis located outside of said area of engagement and in a plane other than the plane of the area of engagement for causing the pressure pad when pivoted to initially engage said plate with a recording medium therebetween at a portion thereof close to the pivot axis and for causing the area of engagement to gradually increase as the pivoting of said pad is increased and to extend toward a portion of the pressure pad remote from the pivot axis, and upon disengagement of the pad from said plate with a recording medium therebetween the pivoting relationship causes the area of engagement to gradually decrease toward the portion of the pressure pad close to the pivot axis;

recording medium holding means affixed to the pressure pad at the end thereof remote from the initially engaged portion between a recording medium and the plate and the pressure pad for retaining a recording medium during disengagement causing a recording medium to peel away from the plate as the area of engagement decreases; and

means for causing the pressure pad to pivot with respect to the transparent plate.

2. The device as specified in claim 1 employing a dielectric coated recording medium, wherein:

a photoconductive layer is provided on the transparent plate adjacent to a recording medium;

an electrode means is provided between the photoconductive layer and the transparent plate;

the pressure pad is electrically conductive;

a voltage source is provided for establishing an electric field between the electrode means and the pressure pad which passes through the photoconductive layer and a dielectric coated recording medium; and

an imaging means is provided to illuminate the photoconductive layer with an image which results in a corresponding charge image on a dielectric coated recording medium.

3. The device as specified in claim 2, wherein a dielectric coated recording medium is normally slightly spaced from the photoconductive layer and is forced into engagement therewith by the pivoting action of the pressure pad.

4. The device as specified in claim 3, wherein drive means are provided for pulling a recording medium into a position slightly spaced from the photoconductive layer; and

switching means are provided responsive to the pivoting of the pressure pad for automating the positioning and engagement of a recording medium and activation of the imaging means.

5. The device as specified in claim 2, wherein the electric field is maintained between the electrode means and the pressure pad during the imaging process and the subsequent disengagement of the pad from the plate with the recording medium therebetween

6. The device as specified in claim 2, wherein the pressure pad is bowed across the dimension thereof which is perpendicular to the direction of increasing and decreasing engagement area.

7. The device as specified in claim 2, wherein a hinged top housing is provided containing the pressure pad and the means for pivoting the pressure pad are mounted in the housing in a position over the photoconductive layer.

8. The device as specified in claim 7, wherein the hinged top housing pivots on the same axis as the pressure pad.

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