June 2, 1964 A. J. CERASANI ETAL 3,135,179

XEROGRAPHIC APPARATUS

Original Filed April 2, 1959 6 Sheets-Sheet 1

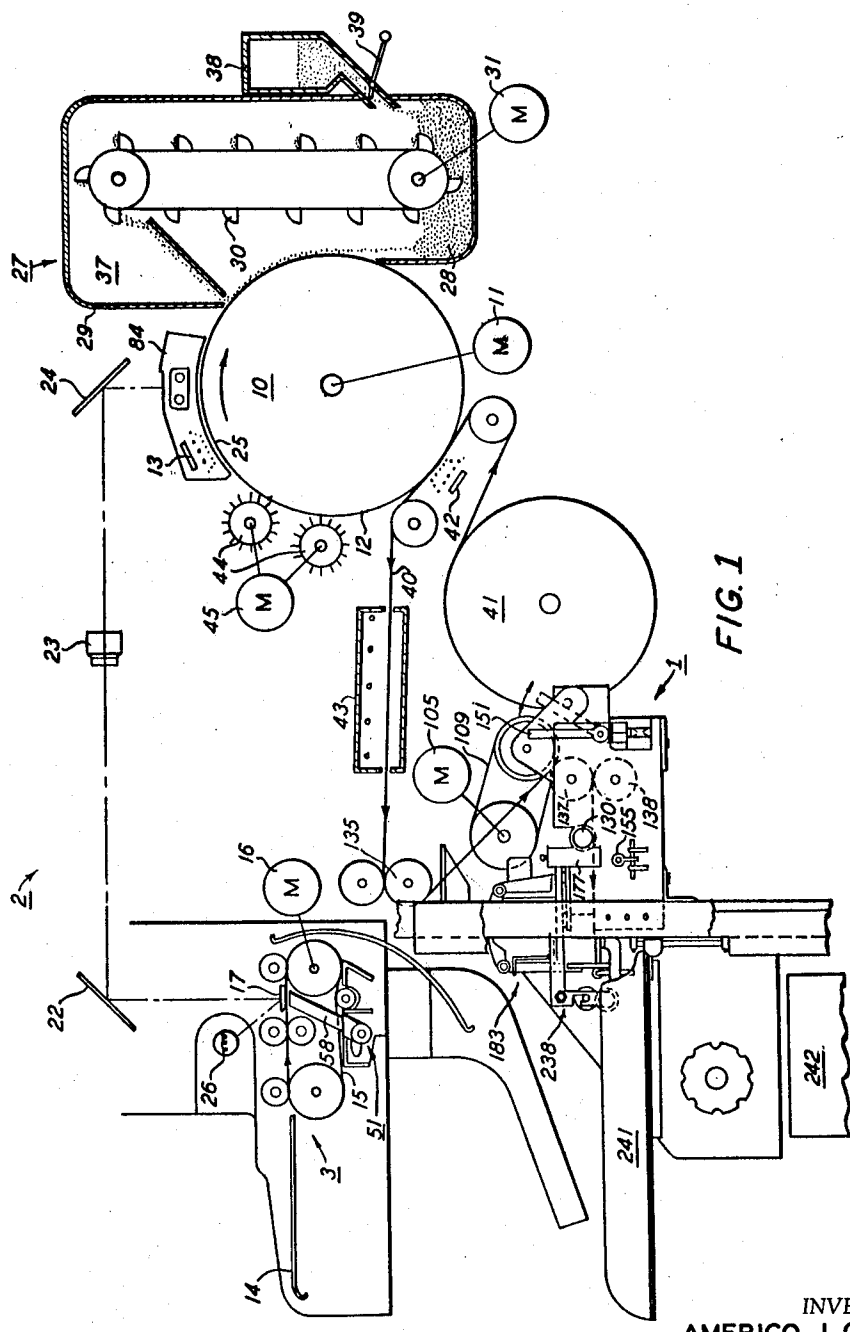


FIG. 1

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XEROGRAPHIC APPARATUS

Original Filed April 2. 1959 6 Sheets-Sheet 2

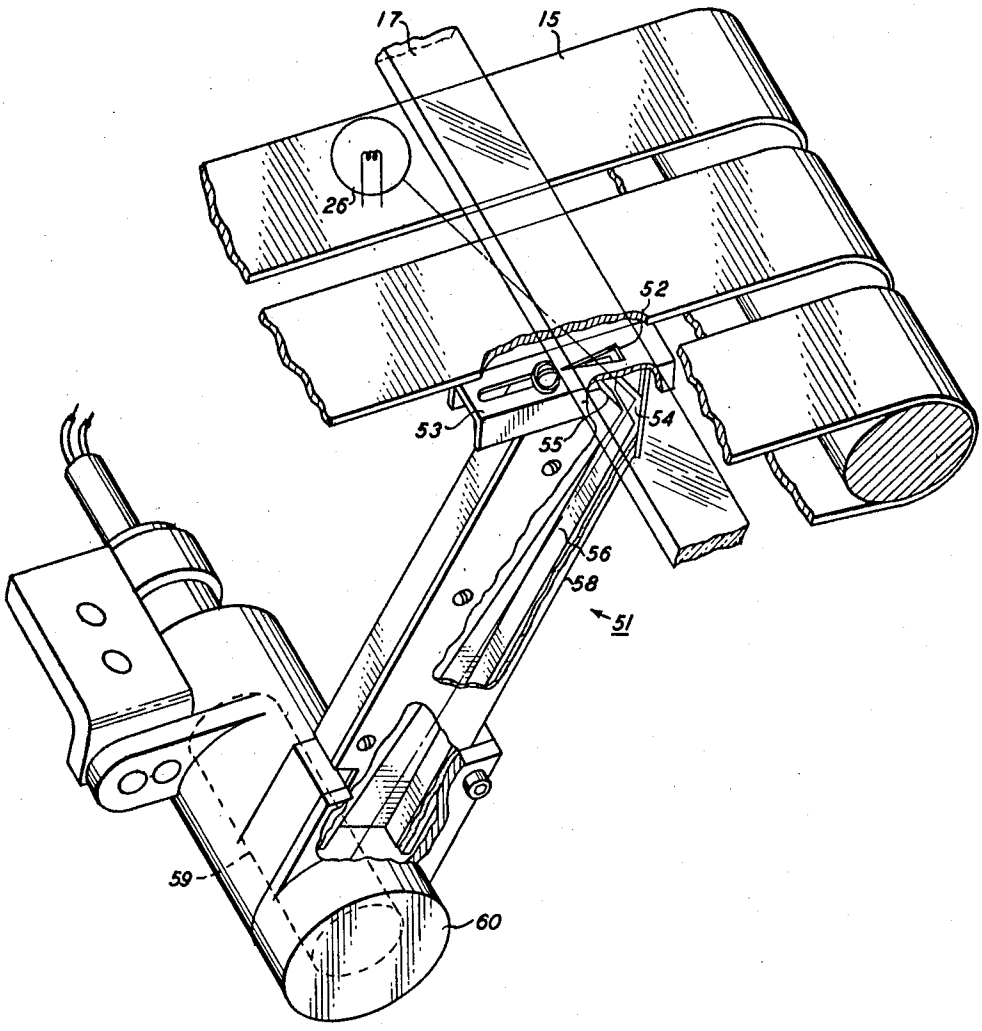


FIG. 2

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XEROGRAPHIC APPARATUS

Original Filed April 2. 1959 6 Sheets-Sheet 3

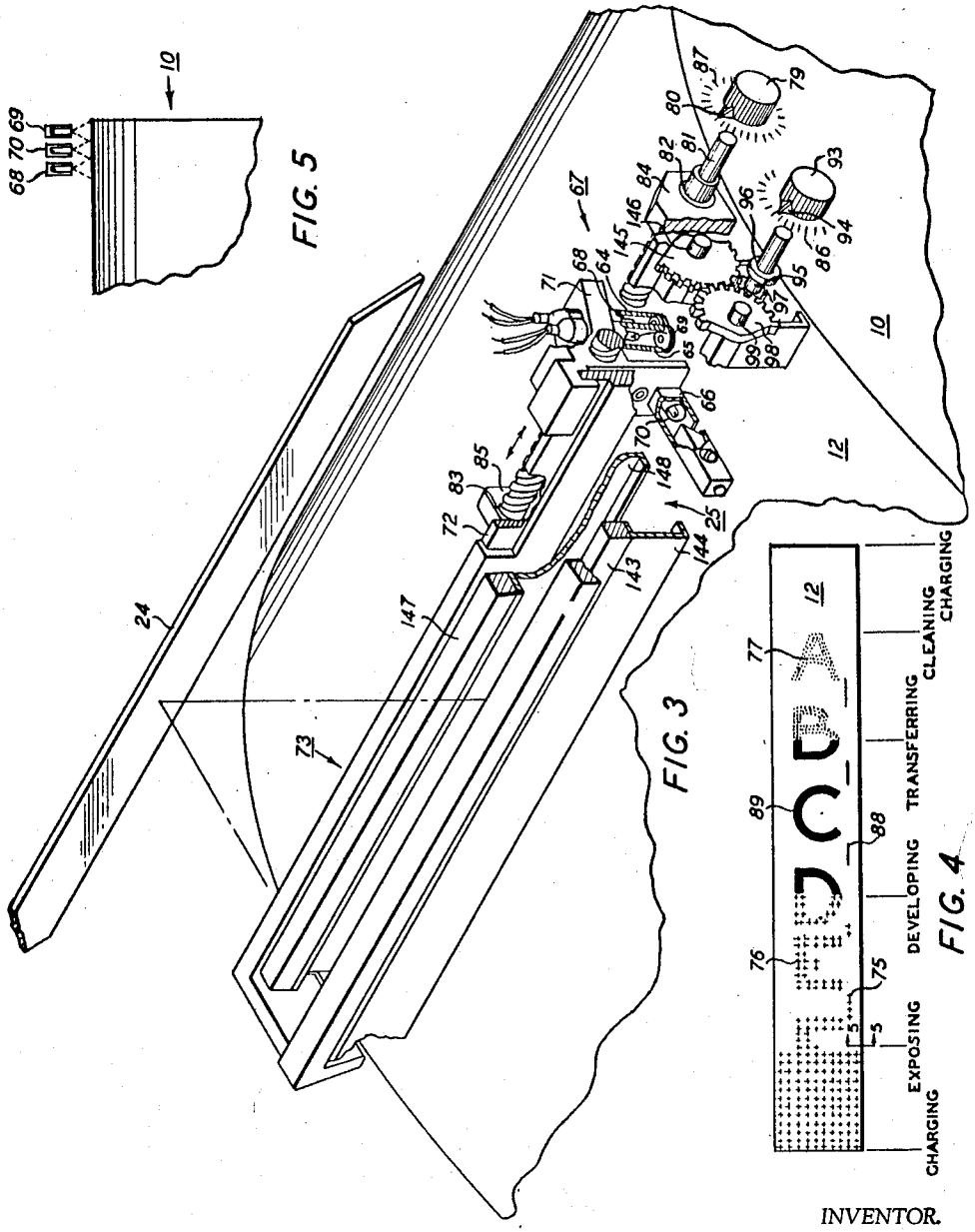


FIG. 5

FIG. 4

FIG. 3

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XEROGRAPHIC APPARATUS

Original Filed April 2, 1959 6 Sheets-Sheet 4

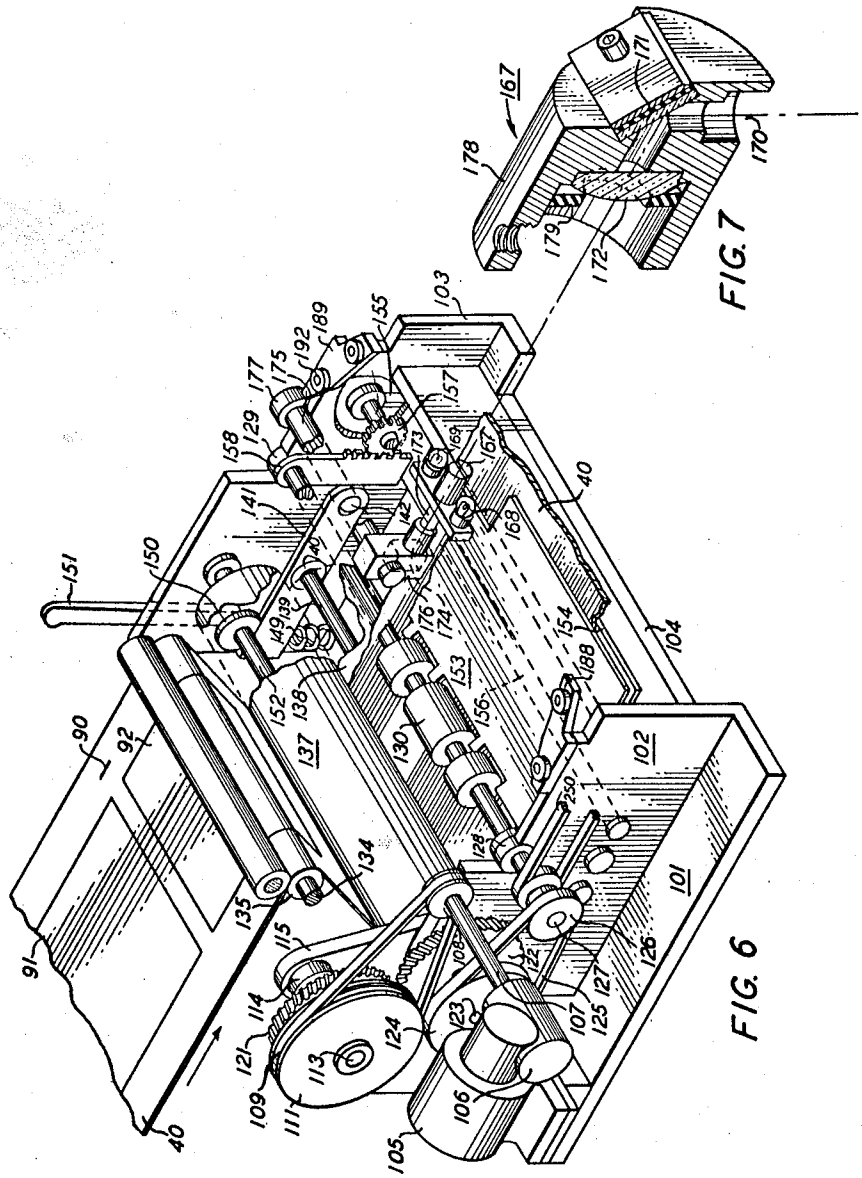


FIG. 6

FIG. 7

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XEROGRAPHIC APPARATUS

Original Filed April 2. 1959 6 Sheets-Sheet 5

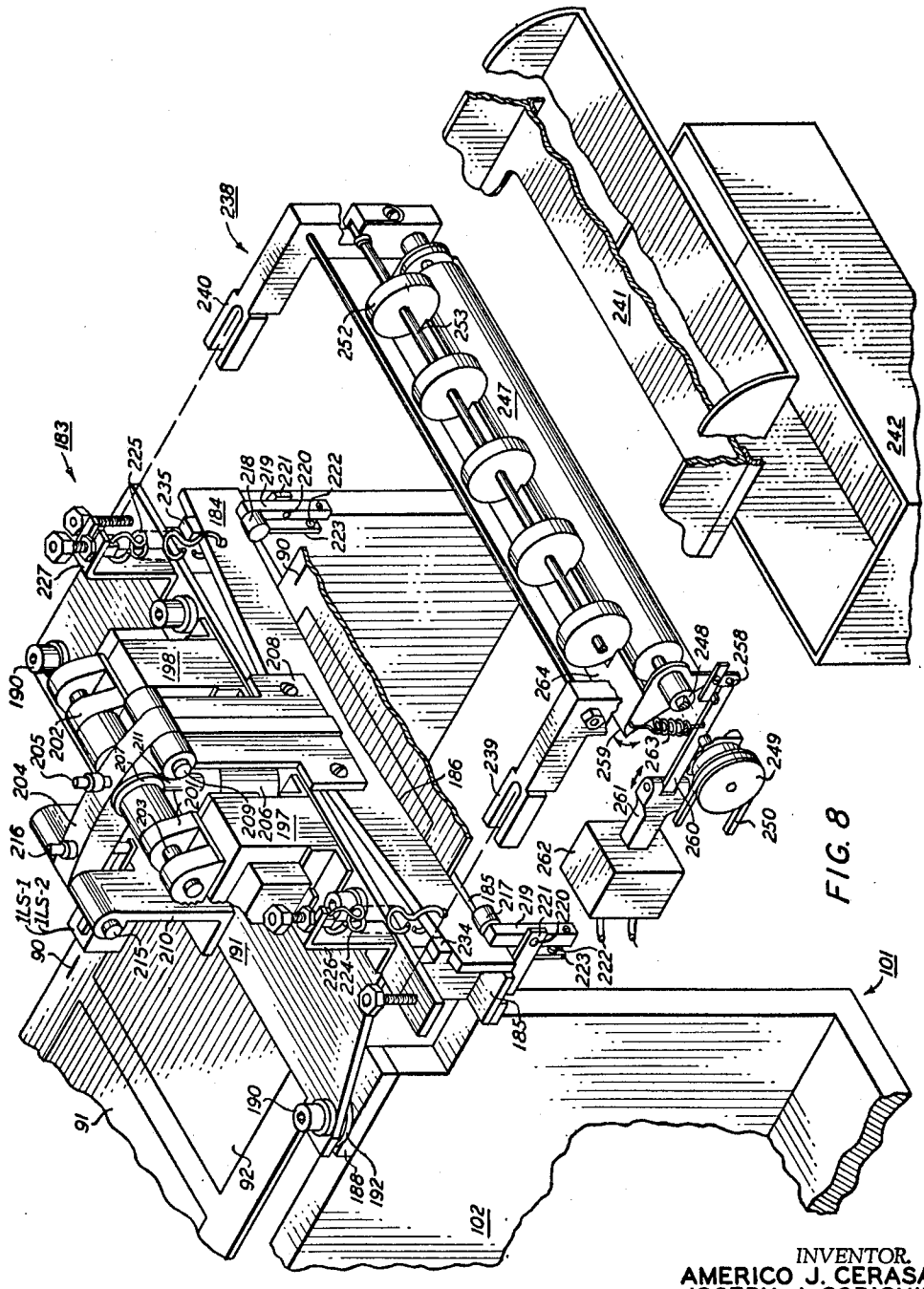


FIG. 8

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XEROGRAPHIC APPARATUS

Original Filed April 2 1959 6 Sheets-Sheet 6

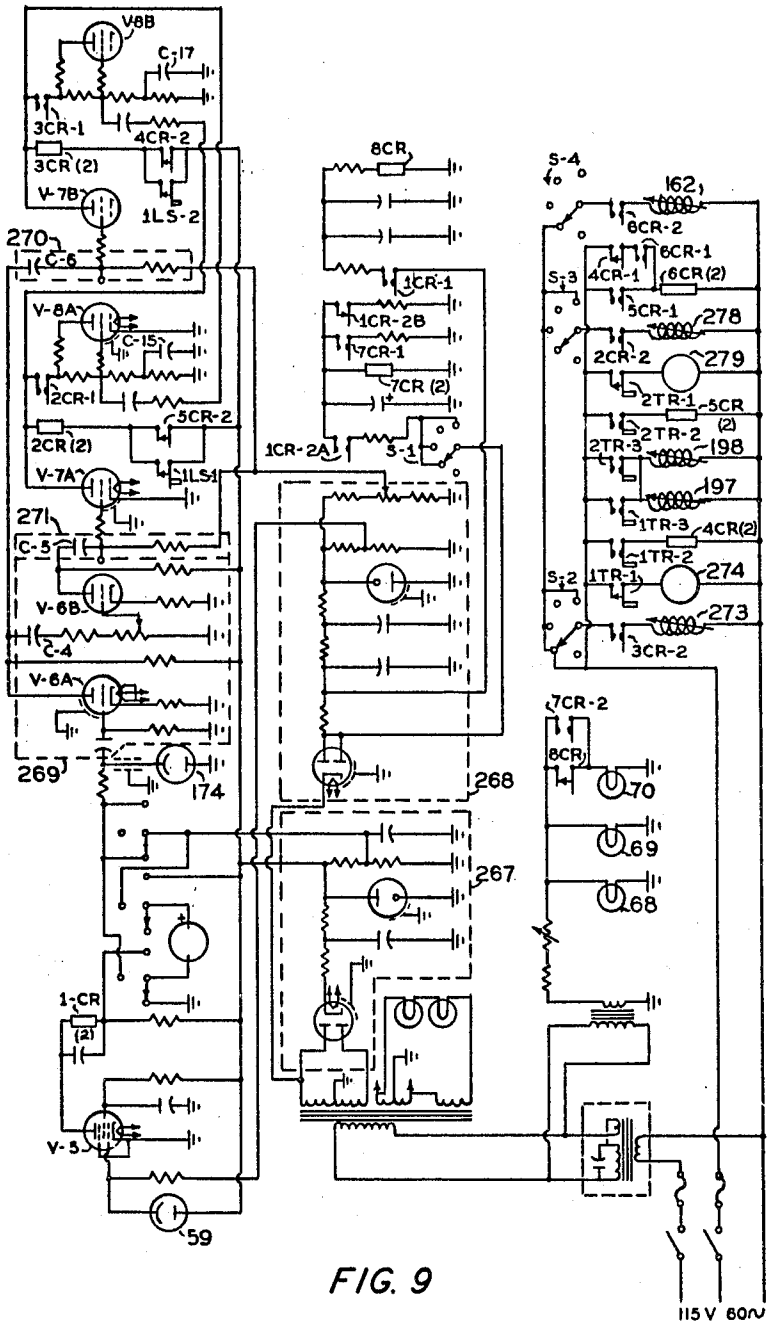


FIG. 9

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United States Patent Office 3,135,179 Patented June 2, 1964

3,135,179
XEROGRAPHIC APPARATUS

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Original application Apr. 2, 1959, Ser. No. 803,800. Divided and this application July 2, 1962, Ser. No. 206,719

4 Claims. (Cl. 95—1.7)

This invention relates to improvements in xerographic reproduction apparatus and particularly to improved apparatus for xerographically recording the relative location of the leading and trailing edge of original copy being scanned and to record a control pattern indicative of the absence of original copy in the scanning system. This is a divisional application of our copending application S.N. 803,800, filed April 2, 1959.

In the process of xerography, for example, as disclosed in Carlson Patent 2,297,691, issued October 6, 1942, a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the radiation intensity that reaches them, and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely divided material such as an electroscopic powder that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic later image. Thereafter, the developed xerographic powder image is usually transferred to a support surface to which it may be fixed by any suitable means.

It is the practice on automatic xerographic printers of types such as disclosed in copending application S.N. 796,561, entitled "Xerographic Reproducing Apparatus," filed March 2, 1959, in the name of Sten R. Johanson, now Patent No. 3,049,968, to operate a continuously moving paper web support surface from a supply roll to take-up roll inbetween which xerographic reproductions are printed thereon. Since the original from which the reproduction is formed, may vary in dimension, can be reproduced by the xerographic apparatus in magnified relation, or can be fed to the xerographic apparatus in untimed relation, a wide variance of spacing between successive prints may result. Blank paper occurring on the web between xerographic prints, exclusive of border width for the prints, is scrap for disposal. Since it is the usual practice to move the paper web at a constant rate of approximately 20 feet per minute (4 inches per second), a continued absence of reproduction causes a sizable accumulation of scrap paper on the take-up roll; as, for example, one minute's hesitation on the part of a human operator between feeding successive originals to the apparatus effects approximately 20 feet of scrap paper. On the other hand, accurately timed successive feeding of originals for 11½-inch reproductions results in approximately 20 xerographically printed reproductions in the same web length.

Heretofore, the usual practice has been to periodically remove the takeup roll with the paper web wound thereon to another location whereat the paper was unwound and with a manually operative cutter, cut the web so as to effect an approximate border on the leading and trailing edge of each xerographic print. Scrap resulting therefrom was then disposed of. By these former cutting means, considerable delay was incurred in effecting availability of the xerographic reproduction and furthermore

required the services of additional personnel employed for this specific function.

Because of the variable occurrence of the cut on the moving web, a cutter mechanism to be effective must be responsive to a reference means on the web. In order for the cutter to respond in spaced relation to the reproduction the reference means must emanate from relation of the original to be reproduced whereby this relation is carried forth to the reproduction on the support surface. When, as here, it is intended to cut the web in relation to both the leading and trailing edge of a reproduction, the reference means must be associated with its respective edge and be distinguishable in order that the cutter be made to respond accordingly, that is, to cut the web in advance of a leading edge and after a trailing edge.

Because of the unwieldly length of scrap that might otherwise accumulate, it is also desirable to simulate reference means on scrap paper at regulated intervals in the absence of xerographic reproductions to which the cutter responds to cut the scrap into prescribed lengths. Since, in the direction of movement, the portion of web following the trailing edge of a reproduction constitutes scrap, whereas the portion of web following the leading edge of a reproduction constitutes a xerographic print, association of reference with the respective cut permits operation of apparatus to separate scrap and reproductions. Therefore, the simulated reference means on scrap paper is distinguishable by the cutter mechanism similarly as a trailing edge. Also, the situation occasionally occurs with untimed feeding where two or more originals are fed in too close succession, i.e., where the leading edge of a follower original is too closely spaced to the trailing edge of the previous leading original. In such a situation, a minimum or insufficient border width is available for both reproductions such that only one cut is possible and because both are reproductions the reference means is to be distinguished by the cutter mechanism as a leading edge to effect proper separation and disposition of both.

It is important, therefore, in the combination of situations mentioned above, that a cutter be responsive to a reference means, that the means be effective to distinguish between leading and trailing edges and between xerographic reproduction and scrap and have means of taking into account the close spacing of successive reproductions.

The principal object of this invention is to improve xerographic reproduction apparatus for recording the location of the leading and trailing edge of original copy to be reproduced.

A further object of this invention is to improve xerographic recording apparatus to provide a predetermined control pattern in the absence of original copy.

It is a further object of this invention to form electrostatic latent image control patterns on a photoconductive surface in spaced relation to electrostatic latent images of copy to be reproduced.

It is a further object of this invention to form reference control patterns on a support surface in spaced relation to xerographic reproductions thereon.

These and other objects of the invention are attained by means of a photosensitive device and a light source separated by the passage of original copy into the machine and a light source positioned adjacent to the photoconductive surface of the xerographic machine to discharge the electrostatic charge on the photoconductive surface in response to signals received from the photosensitive device.

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic side elevation of an automatic

xerographic printer employing the apparatus of the invention;

FIG. 2 is an isometric view of the detection apparatus of the invention over which the transport means of the xerographic unit moves an original to be reproduced;

FIG. 3 is an isometric view of the exposure slit and marking apparatus of the invention for forming electrostatic latent image control patterns on a xerographic drum;

FIG. 4 is a developed surface of a xerographic drum through the cycle of charging, exposing, developing, transferring and cleaning;

FIG. 5 is a sectional view taken substantially on the line 5—5 of FIG. 4 illustrating the marker apparatus of the invention in relation to a xerographic drum;

FIG. 6 is an isometric view of the drive assembly and the reference scan apparatus taken from the opposite side of FIG. 1;

FIG. 7 is a sectional isometric view taken through the scan apparatus illustrated in FIG. 6;

FIG. 8 is an exploded isometric view taken from the opposite side of FIG. 1 illustrating the relation of the knife assembly and the scrap deflector; and

FIG. 9 is a wiring diagram.

Referring to FIG. 1, the paper cutter assembly of the invention, generally designated as **1**, is shown in operative relation to a xerographic unit, generally designated as **2**, which includes a xerographic plate in the form of drum **10** mounted in suitable bearings in the frame of the machine and is rotative at constant rate by motor **11**. The drum comprises a photoconductive surface **12** on a conductive backing that is sensitized prior to exposure by means of a screened corona charging device **13**, which may be of the type disclosed in Walkup Patent 2,777,957, that is energized from a suitable high potential source.

Exposure of the drum to the light image discharges the photoconductive layer in the areas struck by light, whereby there remains on the drum an electrostatic latent image corresponding to the light image projected. To project an opaque original onto surface **12**, projection apparatus **3** is employed which may be of a type disclosed in above-cited copending application entitled "Xerographic Reproducing Apparatus." An original to be reproduced is manually fed from support tray **14** onto endless belts **15** which are continually moved at constant rate proportional to the rate of moving web **40** by drive motor **16**. As an original moves on the belts, it passes under glass **17** whereat an optical path is established from which the image on the original is reflected from mirror **22**, thence through an objective lens **23** to mirror **24** through variable width exposure slit **25** so as to be exposed normal to a first axial portion of surface **12**. Lamp **26** serves to illuminate the original under glass **17** and also serves to emit light to copy detection device **51** in the absence of originals to be reproduced as described below.

For controlling exposure, the aperture width of exposure slit **25** (see also FIG. 3) can be varied by dial **93** having a pointer **94** which indicates the width opening from scale **86** inscribed on the side wall of support **84**. Dial **93** is secured to shaft **95** which is rotatably supported in bearing means **96**. Also secured to **95** is pinion **97** meshing with gear **98** secured to rotatable shaft **99** which is an extension of support bar **143** and to which leaf **144** is secured. Gear **98** meshes with gear **145** secured to rotatable shaft **146** which is an extension of support bar **147** and to which leaf **148** is secured. Rotation of dial **93** thereby varies the aperture width of slit **25**.

After exposure the image is developed by developing apparatus **27**, which may be of the type disclosed in copending application S.N. 393,058, filed November 19, 1953, now abandoned, in the names of Mayo et al., in which a two-component developer material **28**, which may

be of a type disclosed in Walkup Patent 2,638,416, is cascaded over the drum surface. The developer material is stored at the bottom of housing **29** wherefrom conveyor **30**, driven by motor **31**, scoops the material and releases it over chute **37** permitting it to slide down and cascade over electrostatic latent image **76** (see FIG. 4) forming thereon a powder image **89**. As toner component of material **28** is consumed, it is replenished from dispenser bottle **38** at a rate controlled by variable adjustment **39**. After developing, the powder image is electrostatically transferred to a paper web support surface **40** by means of a second corona generating device **42** similar to corona generating device **13** mentioned above.

The support surface is obtained from supply spool **41** and is fed over suitable guide and tensioning rolls and directed into surface contact with the drum in the immediate vicinity of generating device **42**. After transfer, the supported surface is separated from the drum surface and guided through a suitable heat fuser **43**, which may be of a type disclosed in Crumrine et al. Patent 2,852,651 whereby the powder image is permanently affixed to the support surface. Subsequent to the transfer of the image, residual image **77** on surface **12** is removed by brush cleaning with brushes **44** driven by motor **45**. Web **40** then proceeds through cutter **1** as described below.

For detection of reference points on original copy and for effecting a first electrostatic latent image control pattern **75** on surface **12** therefrom, copy detection device **51** (see FIGS. 2, 3, 4 and 5) has a member **53** with a triangular slit **52** arranged between adjacent belts **15** and below glass **17** with the top surface of **53** substantially horizontal. In the absence of original copy transporting on belts **15**, the light emitted from lamp **26** forms an illumination path to photocell **59** by reflecting light from inclined mirror surface **54** down through slot **56** of enclosure **58**. Light thereby transmitted is realized by light-sensitive photocell **59** housed in enclosure **60**, which is characterized by emitting a variable electrical signal on the realization of light wherein the magnitude of the signal varies in accordance with the intensity of illumination realized. In the preferred arrangement, the signal emitted decreases in order of magnitude when there is an obstruction of the illumination path, and increases in order of magnitude when no obstruction exists. As original copy moves on belts **15** at least a portion thereof effects a temporary obstruction of the illumination path causing cell **59** to emit discrete changes in signal output at the incipience of obstruction and unobstruction.

Electrostatic latent image control patterns **75** are formed on a second axial portion of surface **12**. To produce the pattern, marker assembly **67** is operated by the detection device **51**. The marker assembly includes lamps **68**, **69** and **70**, each enclosed in housings **64**, **65** and **66**, respectively, secured to support bracket **71** in turn slidably secured on a rail portion **72** of marker support frame **73**. Each of the lamps are in spaced relation to surface **12** and are staggered along the axial length of the drum so that each emits a narrow light beam through apertures of their respective housing wherein the beam emitted by lamp **70** is on a peripheral path of surface **12** substantially between the beams of **68** and **69** (see FIG. 5). Lamps **68** and **69** are continuously illuminated, whereas lamp **70** is illuminated when the electric circuit components shown in FIG. 9 react in response to the proper order of signal change emitted by photocell **59** or when energized by other circuit means in the absence of originals to be reproduced, as described below. When all of the lamps are simultaneously illuminated they effect a dissipation of electrostatic charge in a peripheral band on the second axial drum portion. However, with lamp **70** extinguished, a narrow band on surface **12** normally dissipated by the illumination effect of lamp **70** retains its electrostatic charge and subsequently is developed by apparatus **27** are hereinbefore described (see FIG. 4). By alternate

operation of lamp **70** at variable frequency of operation and duration dependent upon the obstruction period effected by the moving copy, an electrostatic latent image control pattern **75** is formed on surface **12** in spaced relation to electrostatic latent image **76** corresponding in spaced relation to reference points on the original having caused obstruction and unobstruction of the illumination path.

As may be more readily seen in FIG. 4, where the obstruction and unobstruction of the illumination path has been caused by the leading and trailing edges, respectively, of copy to be reproduced, the electrostatic latent image control pattern **75** thus formed bears a spaced relation to the edge of electrostatic latent image **76**. It may also be seen that, in the preferred manner of the invention, the successive peripheral line charges which constitute control pattern **75** occur in the direction of drum rotation between successive electrostatic latent images commencing with the trailing edge of one image and terminating with the leading edge of the succeeding image.

To effect lateral positioning of the control pattern in relation to the edge of drum **10** (see FIG. 3), control knob **79** is secured to the end of rotatable lead screw **81** and has a pointer **80** integral thereof by which the relative lateral position of marker assembly **67** is indicated from scale **87**. Lead screw **81** is supported in suitable bearing means **82** and **83** of stationary supports **84** and **85**, respectively, whereby lead screw **81** engages bracket **71**, such that on rotation of knob **79** it effects lateral movement of bracket **71** and the lamps secured thereto.

In addition to forming a first electrostatic latent image control pattern in spaced relation to an electrostatic latent image of copy to be reproduced, it is desirable, in the absence of copy to be reproduced, to effect a second electrostatic latent image control pattern since the portion of web **40** which will contact that portion of the drum will in its entirety constitute scrap. The second control pattern so established forms a signal to which a cutter responsively operative therefrom cuts the scrap into prescribed lengths. The components for effecting this second control pattern are more particularly described in the operational sequence to follow herein, but, in general, is accomplished by electric circuit means which illuminate lamps **70** in the absence of original copy, at predetermined frequency of operation and for a predetermined period of operation.

Another situation frequently occurs wherein two successive originals are too closely spaced, i.e., the leading edge of a following original is within a prescribed minimum distance of the trailing edge of the leading original and to which the cutter must effect proper response. In this instance if obstruction of the illumination path were relied on, the control pattern effected would be too short in length for subsequent detection and for that reason electric circuit means, as are more described in the operational sequence below, precludes less than a minimum extinguishment period of lamp **70** so as to result in pattern mark **90** on web **40** of at least ½-inch in length.

By the marker apparatus thus described electrostatic latent image control patterns are formed on a xerographic plate which subsequently are developed and transferred to a support surface and translated therefrom as a signal to effect subsequent cutter operation. Whereas the signal produced is described herein with particular reference to effect operation of a cutter apparatus, it is apparent that the marker apparatus could be employed to effect marking signals for other purposes, as, for example, to fold, punch, or other related operations in reference to a point on the web, or xerographic reproduction. Furthermore, although particular emphasis is placed on effecting control patterns in spaced relation to the leading and trailing edges of xerographic reproductions, variations in apparatus arrangement would permit effecting control patterns in any relation thereto.

For cutting the web, the cutter is supported on frame **101** (see FIGS. 6, 7 and 8) having side supports **102** and **103** and bottom support **104**. Web **40** is continuously drawn from supply roll **41** and advanced through the paper cutter by the motive force furnished from motor **105**. The force therefrom is transmitted through speed reducer **106** to shaft **107** secured thereto thence to pulley **108** secured thereon. Nonslip belt **109** transmits the motion therefrom to pulley **111**, secured to shaft **113**, which is rotatably secured to bearing means **114** of side bracket **115** supported from side wall **102**. Also secured to shaft **113** is gear **121** which meshes with gear **122** secured to rotatable shaft **123** supported in suitable bearing means of side walls **102** and **103**. This effects driving of pulley **124**, also secured to shaft **123**, and wherefrom belt **125** transmits the driving force to pulley **126** secured to rotatable shaft **127** supported in suitable bearing means **128** and **129** and to which is secured platen rollers **130**. The web passes over idler roller **135** and then between rollers **137** and **138**, of which roller **137**, being secured on shaft **123** is rotative therewith. This frictionally drives roller **138** secured on rotatable shaft **139** and supported at opposite ends in bearing means **140** of pivot supports **141** (one shown) which are pivotally secured to side support **102** and **103** by pins **142**. Roller **138** is urged to frictionally engage against roller **137** by the resilient spring action of springs **149** (one shown) secured between **104** and **141**. For threading purposes, **138** can be spaced away from **137** by the action of cams **150** (one shown) when rotating handle **151** is secured to shaft **152** so that the rearward end of each **141** depresses against springs **149**, lowering roller **138**. There from web **40** when passing between horizontal guides **153** and **154** is moved by platen roller **130** thereagainst. The pressure of **130** applied on web **40** is adjustable by rotation of handle **155** secured to shaft **156** such that pinion **157** also secured thereon and engaging rack **158** effects a raising or lowering of shaft **127**.

As the web passes below detector means **167** the area thereof on which pattern marks **90** appear is illuminated by side lights **168** and **169**. At the incipient detection of a leading edge of mark **90** passing into view under opening **170** of housing **178** it is reflected from mirror **171** through lens **172** held by retainer ring **179** into tube **173** to photocell **174** which immediately emits a discrete change in electrical signal through electric circuit means shown in FIG. 9. which constitutes a trailing edge signal. At the incipient detection of the mark passing out from under opening **170**, another discrete change in electrical signal is emitted by **174** constituting a leading edge signal. Detector means **167** is supported in relation to the web **40** in block **176** supported by shaft **175** in turn secured at opposite end in stationary bracket **177**.

As the web emerges from between guides **153** and **154** it moves between knife member **184** in ineffective position and bed plate **185** of the knife assembly generally designated as **183** (see FIG. 8). The table plate **191** is secured by bolts **190** to shock support plate **188** secured to support walls **102** and **103** of support frame **101**. Secured between table plate **191** and the shock support plate are resilient shock mounts **192** which absorb vibration induced by cutter operation. Solenoids **197** and **198** are each mounted on table plate **191** with their plunger elements secured to journal supports **201** and **202**, respectively. Shaft **203** secured in and between journals **201** and **202** is rotatably extended through bearings **207** of yoke **204**. At the forward end of **204**, as viewed on FIG. 8, rotatable pin **209** supports bracket **208** which in turn supports knife member **184**. Rear support bracket **210** has a rotatable pin **215** extending through it to maintain the rear of **204** substantially horizontal as solenoids **197** and **198** are actuated to descent knife **184**. Bolt **216**, extending vertically through **204**, on its descent opens microswitch normally-closed contacts **1LS–1** and **1LS–2**. As knife member **184** descends, its rearmost edge is main-

tained slidably in contact against bed plate **185** by rollers **217** and **218** each rotatably secured to a pivot arm **219**, in turn pivotally secured by pins **220** to side brackets **221** supported from the bed plate. Bolt **222**, secured between leaf spring **223** and **219** urges the rollers firmly against the knife. For dampening the end of the descending stroke, cylinder **206** includes a rubber plug (not shown) which is compressed at the end of stroke by a piston **211** and adjustment knob **205** permits variable setting of the stroke.

After the knife has descended to cut the web, the circuit of solenoids **197** and **198** are de-energized as is described in the operational sequence below, and springs **224** and **225** secured at their upper end to respective brackets **226** and **227** and at their lower end to the knife immediately hoist the knife restoring it to ineffective position established by stop blocks **234** and **235**.

After cutting the web, it is desired to separate the reproduction from scrap. For effecting the separation, scrap deflector assembly generally designated as **238** is secured to the knife assembly by means of bifurcated support brackets **239** and **240** such that xerographic reproductions are sorted into document bin **241** and scrap paper accumulates in scrap bin **242**. Platen roller **247** is secured to shaft **248** which is rotatably supported in suitable bearing means of supports **239** and **240** and is rotated at constant rate by pulley **249** secured thereto and driven by belt **250** driven by pulley **251** secured on shaft **127** (FIG. 6). Wheel rollers **252** are secured on shaft **253** which is rotatably supported in bearing means of supports **239** and **240** wherein rollers **252** are rotated by the frictional action thereagainst of platen roller **247**.

Deflector **259** is mounted so as to be pivoted on shaft **248** and is secured at its lower end by pin **258** to lateral arm **260** in turn secured to plunger **261** of solenoid **262**. Energizing of the solenoid **262** moves arm **260** so as to partially rotate deflector **259** in a manner obstructing entrance of web cuttings between rollers **247** and **252** as to deflect them to scrap bin **242**. With solenoid **262** de-energized, spring **263** retracts arm **260** and the deflector as to render the deflector in a horizontal plane to guide reproductions thereover into and between rollers **247** and **252** emerging into document bin **241**.

In operation, all the components of xerographic unit **2** are operative. Corona generating device **13** is continually applying a uniform electrostatic charge on surface **12** and in the absence of copy a first axial portion thereof is substantially dissipated by the exposure of continuous light from lamp **26** being reflected from mirror **22** to lens **23**, mirror **24** and through aperture **25**. Developing apparatus **27** is continually cascading powder **28** over surface **12** and web **40** is continuously moved between corona generating device **42** and surface **12**, through fuser **43** and through cutter assembly **1** as aforesaid. Lamps **68** and **69** are illuminated and photocell **59** realizes an intense illumination from lamp **26**.

Referring to FIG. 9, positive rectified direct current is obtained from the part of the circuit generally outlined as **267** and negative rectified direct current is obtained from the part of the circuit generally designated as **268**. Switches S–**1**, S–**2**, S–**3** and S–**4** are selectively set to coincide at any of five optional positions whereby the first position is "off" and the cutter apparatus **1** is de-energized. In the remaining switch positions, the cutter apparatus responds to effect operation as (1) cut on leading and trailing edges of copy and operate scrap deflect, (2) cut on leading edge only, (3) cut on trailing edge only, and (4) cut on leading and trailing edge only. For discussion purposes, it is assumed that all of the switches have been set to effect cutting on the leading and trailing edge of xerographic reproductions and also operate the scrap deflector assembly **238**. Referring therefore to all figures, copy to be reproduced is first fed from support tray **14** onto moving belts **15**. As the copy is moved thereon the leading edge of copy encroaches on slit **52** such that when the leading edge effects an obstruction of the illumination path between lamp **26** and detection device **51**, photocell **59** realizing the decrease in illumination, effects a discrete change in electrical signal activating pentode V–**5** to a bias below cut-off so as to de-energize relay **1CR**. This has the effect of de-energizing relay **8CR** from contact **1CR–1** and permitting normally closed contact **8CR** to close energizing lamp **70**. After exposure of the original at the instant the trailing edge of the copy has passed over slit **52** so as to re-admit light from lamp **26** to cell **59**, the discrete change of signal emitted by photocell **59** activates the grid of pentode V–**5** above cut-off, energizing relay **1CR** and energizing relay **8CR** therefrom so as to effect opening of normally closed contact **8CR** and extinguishing lamp **70**. While lamp **70** is extinguished a peripheral path on a second axial portion of surface **12** between the illumination of lamps **68** and **69** retains its electrostatic charge. As succeeding originals are fed into belts **15** at a rate between each original in excess of a prescribed minimum time, each leading edge in obstructing the illumination path from lamp **26** to photocell **59** again effects energizing of lamp **70** so as to commence dissipating the path of electrical charge affected by its illumination. The alternating operation of lamp **70** effects an electrostatic latent image control pattern **75** commencing and terminating in spaced relation on surface **12** to the trailing and leading edge respectively of successive electrostatic latent images **76**. These latent images and latent image control patterns are then xerographically developed, transferred and fixed in the same spaced relation onto support web **40** as aforesaid.

Since mark **90**, which constitutes control pattern, is intended as a signal from which a subsequent operation is dependent, the mark must be of sufficient length for its detection. When successive originals are closely spaced such that less than a minimum mark would be otherwise effected between the trailing edge of the leader print and the leading edge of the follower print, relay **8CR** which has been selected having a characteristic release time of approximately ⅛ second delays energizing of lamp **70** for ⅛ second. On a web moving at the rate of 4 inches per second this produces a minimum pattern mark thereon of ½ in. in length.

In the event there is a prolonged absence of originals supplied to the xerographic apparatus for reproduction while it is operative, the web consumed constitutes scrap and it is desirable to effect a pattern mark from which a cutter in response thereto cuts the web into prescribed scrap lengths. With each energizing of relay **1CR** (absence of original) relay **7CR** is energized in addition to relay **8CR**. However, relay **7CR** is characterized by an operating delay of approximately 2 seconds so as to permit effecting a pattern mark **90** of approximately 8 inches before the normally open contacts **7CR–2** energize lamp **70**. When relay **7CR** becomes operative, capacitor **C–11** is discharged so as to release **7CR** in its charcateristic release time of approximately ⅛ second, thereby energizing lamp **70** for ⅛ second and effecting ½ inch interruption of pattern mark. With a continued absence of originals, this cycle is repeated effecting 8 inch bordermarks and ½ inch interruptions. In the event copy to be reproduced are fed to the apparatus in the interim, the illumination path obstruction effects de-energizing relay **1CR** and consequently relay **7CR**. After emerging from the xerographic apparatus 2, web **40**, bearing xerographically reproduced image **91** and control pattern mark **90**, moves into paper cutter assembly **1**. The surface area on web **40** occupied by the xerographic control pattern mark **90** is continually illuminated by lamps **168** and **169**, and at the incipience of a pattern mark detection or detection of its termination sensed by detector means **167**, a discrete change in electrical signal is emitted by photocell **174**. On incipient detection of a border mark, or a decrease in illumination at photocell **74**, the discrete change of signal emitted decreases in order of

magnitude and corresponds to a trailing edge signal whereas on incipient detection of border mark termination, or increase in illumination at photocell **174**, the discrete change of signal emitted increases in order of magnitude and corresponds to a leading edge signal.

On detection of a leading edge signal, the signal of **174** is transmitted through amplifier circuit **269** and differentiating circuit **270** and through triode V–7B to energize relay 3CR through normally closed contacts of 1LS–2 and 4CR–2 thereby closing contacts 3CR–1 and 3CR–2. Contact 3CR–1 closes to form a holding circuit through triode V–8B whereas 3CR–2 energizes timing clutch **273** of timer **274** to start the timing cycle. When timer **274**, having a preset time delay, energizes, contacts 1TR–2 and 1TR–3, relay 4CR and solenoids **197** and **198** are simultaneously operated thereby opening contact 4CR–2 and descending knife **184** to cut web **40** in spaced relation to a leading edge of a xerographic reproduction. As the cutter completes its downward strike, bolt **216** strikes microswitch 1LS–1 and 1LS–2 opening their normally closed contacts. Since 4CR and the solenoids are energized by timer **274**, the contacts of 4CR–2 are open as the knife completes its downward stroke and the holding circuit of relay 3CR is opened by opening 1LS–2 to de-energize clutch **273**, restoring timer **274** to its original position, and de-energizing the solenoids and releasing relay 4CR. As solenoids **197** and **198** are de-energized, springs **224** and **225** instantly hoist the knife to ineffective position.

On detection of a trailing edge signal, a pulse applied to the grid of triode V–7A from photocell **174**, is transmitted through amplifier circuit **269** and differentiating circuit **271** to effect energizing of relay 2CR through normally closed contacts of 1LS1 and 5CR2. Contact 2CR1 of relay 2CR is closed to form a holding circuit through triode V8A, whereas contact 2CR–2 energizes clutch **278** of timer **279** having a preset time delay to start the timing cycle. When timer contacts 2TR2 and 2TR3 are energized they operate relay 5CR and solenoids **197** and **198** of the cutter descending the knife to cut web **40** in spaced relation to a trailing edge of a xerographic reproduction. As the cutter completes its downward stroke, bolt **216** strikes microswitch 1LS–1 and ILS–2 opening their normally closed contacts. Since 5CR and the solenoids are energized by timer **279**, the normally closed contacts 5CR2 are open as the knife completes its downward stroke and the holding circuit of relay 2CR is opened by 1LS–1 to effect release. Opening then of 2CR–2 de-energizes clutch **278** restoring timer **279** to its original position and de-energizing relay 5CR and the solenoids. As solenoids **197** and **198** are de-energized, the knife is restored to ineffective position as before. To operate scrap deflector **259**, energizing of relay 5CR on the trailing edge signal energizes relay 6CR from contact 5CR–1 closing contact 6CR–1 to hold the circuit closed while 6CR–2 is closed to energize solenoid **262** and effect scrap deflector operation. Solenoid **262** remains so energized until a leading edge signal is received energizing relay 4CR so as to open contact 4CR–1.

If, however, as stated previously, two successive originals have followed closely so as to effect a minimum ½-inch border mark between separate reproductions, it is desired to effect a single cut to separate the two reproductions whereby the cut is characaterized by a leading edge signal to result in both reproductions being disposed into document bin **241**. After triode V–8A has formed a holding circuit with relay 2CR on a trailing edge signal, and a leading edge signal is received by triode V–7B within a maximum prescribed time after V–7A has received the trailing signal, the signal of V–7B has the effect of lowering the grid bias of V–8A below cut-off opening the holding circuit of 2CR and eliminating the trailing edge signal. If, however, the signal to V–7B has been received beyond the maximum prescribed time after receipt of signal by V–7A, the voltage across capacitor C–15 will have amassed capacity whereby the signal of V–7B imparted to triode V–8A is insufficient to lower the grid bias of V–8A below cut off.

An analogous situation occurs wherein a ½-inch interruption in pattern mark is detected in the case of extended scrap length. However, in this situation, the first signal received is equivalent to a leading edge signal and the second signal is equivalent to a trailing edge signal. Again, as before, when successive signals are received within a prescribed maximum time, it is desired to give effect to the second signal and negate or eliminate the first thereby to effect a cut in this instance characterized by a trailing edge signal so as to operate the scrap deflector **259** in conjunction therewith and direct scrap into bin **242**. After triode V–8B has formed a holding circuit with relay 3CR on a leading edge signal and then a trailing edge signal is received by triode V–7A within a maximum prescribed time after V–7B has received its signal, the signal received by V–7A has the effect of lowering the grid bias of V–8B below cut off opening the holding circuit of 3CR and eliminating the leading edge signal. However, where the signal to V–7A has been received beyond the maximum prescribed time after receipt of signal by V–7B, the voltage across capacitor C–17 will have amassed capacity whereby the signal of V–7A imparted to triode V–8B is insufficient to lower the grid bias of V–8B below cut off.

In the preferred arrangement of the apparatus with detector means **167** located approximately two inches from knife member **184**, it is readily conceivable that a trailing edge control pattern and leading edge control pattern following in relatively close succession will produce two cut signals before the cutter operates. Contacts 4CR–2 and 5CR–2 are operatively opened only on a leading or trailing edge cut respectively to assure that each of the signals effect their separate cut.

By the apparatus thus described there is disclosed apparatus for marking and cutting a web type surface on which xerographic reproductions are formed. There is also disclosed apparatus for forming electrostatic latent image control patterns on a xerographic drum in spaced relation to an electrostatic latent image of copy to be reproduced and apparatus to cut a continuous web in spaced relation to the leading and trailing edges of a xerographic reproduction printed thereon at variable spacing. Additional means are disclosed for effecting separation of xerographic reproductions from scrap.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a xerographic reproducing apparatus a marking device for effecting a first electrostatic latent image control pattern on a xerographic plate in spaced relation to an electrostatic latent image of copy to be reproduced and a second electrostatic latent image control pattern in the absence of copy to be reproduced wherein the xerographic apparatus includes a xerographic plate moving at constant rate, charging means for applying a uniform electrostatic charge on the plate surface, means to move copy at constant rate past an exposure means to expose the copy to a first portion of the plate surface forming an electrostatic latent image thereon; said marking device comprising in combination

a light-tight enclosure having an opening therein whereby light can enter,

a first light source arranged to project light into said opening and which is obstructed by at least a portion of copy moving between the first light source and the opening,

a light-sensitive device within said enclosure which emits discrete changes of electrical signal at the in-

cipience of obstruction and unobstruction of said light,

a second light source arranged to illuminate a second portion of the plate surface,

electric circuit means distinguishably responsive to the order of said discrete signal changes thereby to alternately illuminate and extinguish said second light source to form a first electrostatic latent image control pattern on the plate,

said electric circuit means including means in the absence of copy to be reproduced to effect periodic operation of said second light source,

said last means including

means to control the frequency of said period

and means to control the duration of said operation thereby to effect a second electrostatic latent image control pattern on the plate.

2. In a xerographic reproducing apparatus a marking device for effecting successive electrostatic latent image control patterns on a xerographic plate in spaced relation to successive electrostatic latent images of copy to be reproduced wherein the xerographic apparatus includes a xerographic plate moving at constant rate, charging means for applying a uniform electrostatic charge on the plate surface, means to move copy at constant rate past an exposure means to expose copy to a first portion of the plate surface forming electrostatic latent images thereon; said marking device comprising in combination

an enclosure having an opening therein whereby light can enter,

a first light source arranged to project light into said opening and which is obstructed by at least a portion of copy moving between the first light source and the opening,

a light-sensitive device within said enclosure which emits discrete changes of electrical signal at the incipience of obstruction and unobstruction of said light,

a second light source arranged to illuminate a second portion of the plate surface,

electric circuit means distinguishably responsive to the order of said discrete signal changes thereby to alternately illuminate and extinguish said second light source,

said circuit means including means to effect control patterns of minimum dimension corresponding to greater than the space between unobstruction and obstruction caused by successive copies to be reproduced.

3. In a xerographic reproducing apparatus a marking device for effecting a first electrostatic latent image control pattern on a xerographic plate in spaced relation to an electrostatic latent image of copy to be reproduced and a second electrostatic latent image control pattern in the absence of copy to be reproduced wherein the xerographic apparatus includes a xerographic plate moving at constant rate, charging means for applying a uniform electrostatic charge on the plate surface, means to move copy at constant rate past an exposure means to expose the copy to a first portion of the plate surface forming an electrostatic latent image thereon; said marking device comprising in combination

an enclosure having an opening therein whereby light can enter,

a first light source arranged to project light into said opening and which is obstructed by at least a portion of copy moving between the first light source and the opening,

a light-sensitive device within said enclosure which emits discrete changes of electrical signal at the incipience of obstruction and unobstruction of said light,

a second light source arranged to illuminate a second portion of the plate surface,

electric circuit means distinguishably responsive to the order of said discrete signal changes thereby to alternately illuminate and extinguish said second light source to form a first electrostatic latent image control pattern on the plate,

said electric circuit means including means to effect a control patern of minimum dimension corresponding to greater than the space between unobstruction and obstruction caused by successive copy to be reproduced,

and means in the absence of copy to be reproduced to effect periodic operation of second light source,

said last means including

means to control the frequency of said period

and means to control the duration of operation thereby to effect a second electrostatic latent image control pattern on the plate.

4. In a xerographic reproducing machine containing an image receiving web type surface, apparatus for recording the location of reproduced images on the web type surface consisting of

an optical scanning system for transferring a light image of the copy being reproduced to a photoconductive surface,

means to carry original copy past said optical scanning system,

a light sensitive device positioned on one side of said carrying means and a light source positioned on the opposite side of said carrying means directed to impinge light on the light sensitive device in the absence of original copy,

electrical circuitry connected to said light sensitive device and adapted to translate discrete changes in light intensity received by the light sensitive device into an electrical signal,

a photoconductive surface containing a uniform electrostatic charge,

one or more light sources positioned adjacent the photoconductive surface and connected to said electrical circuitry whereby the light sources are intermittently illuminated by the electrical signal in response to changes in light intensity received by the light sensitive device,

and additional electrical circuitry connected to said light sources to provide a predetermined pattern of intermittent illumination in the absence of electrical signal from the light sensitive device.

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