Dec. 14, 1965 F. HUNSTIGER 3,223,008

ELECTROPHOTOGRAPHIC APPARATUS

Filed Nov. 30, 1962 7 Sheets-Sheet 1

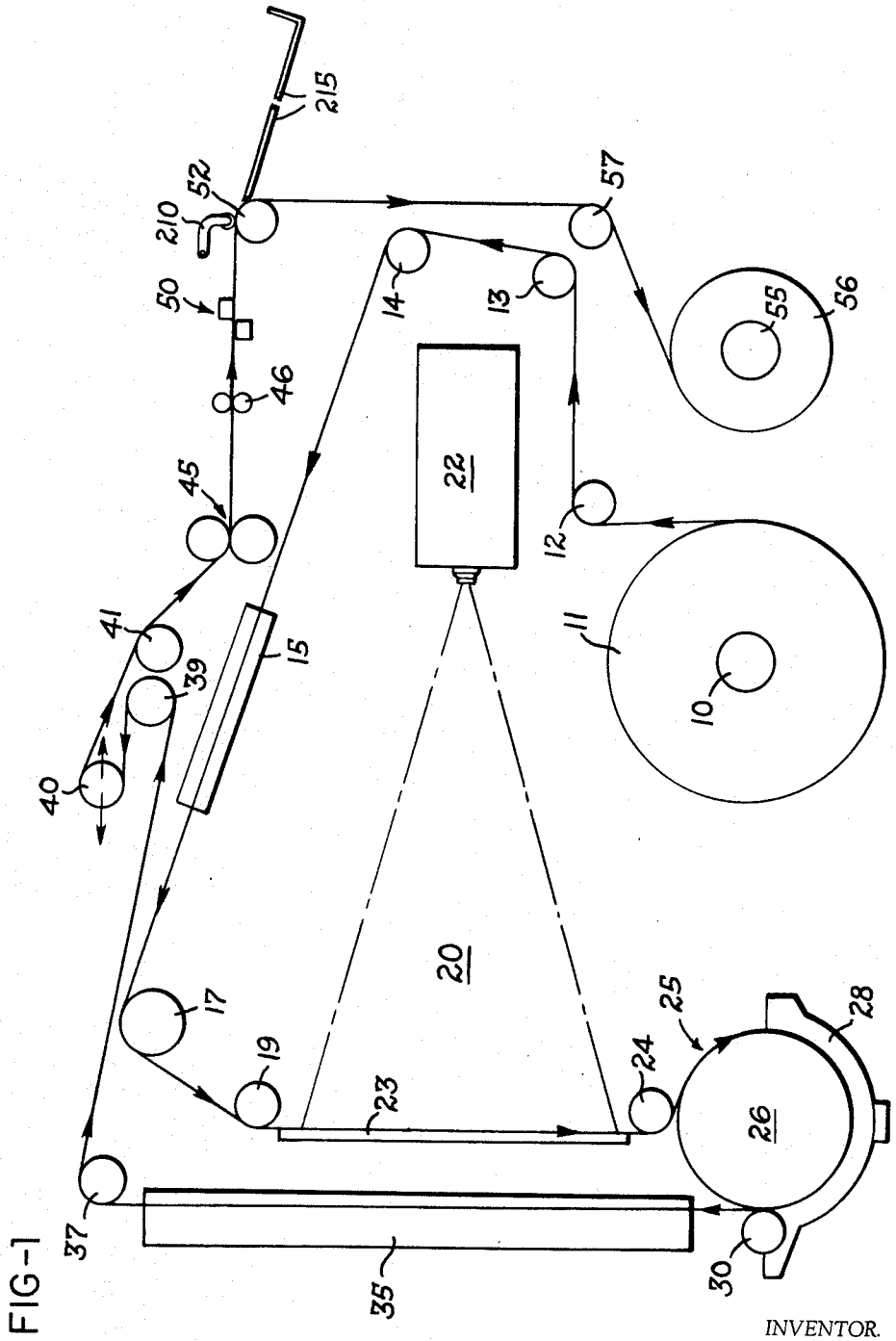


FIG-1

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ELECTROPHOTOGRAPHIC APPARATUS

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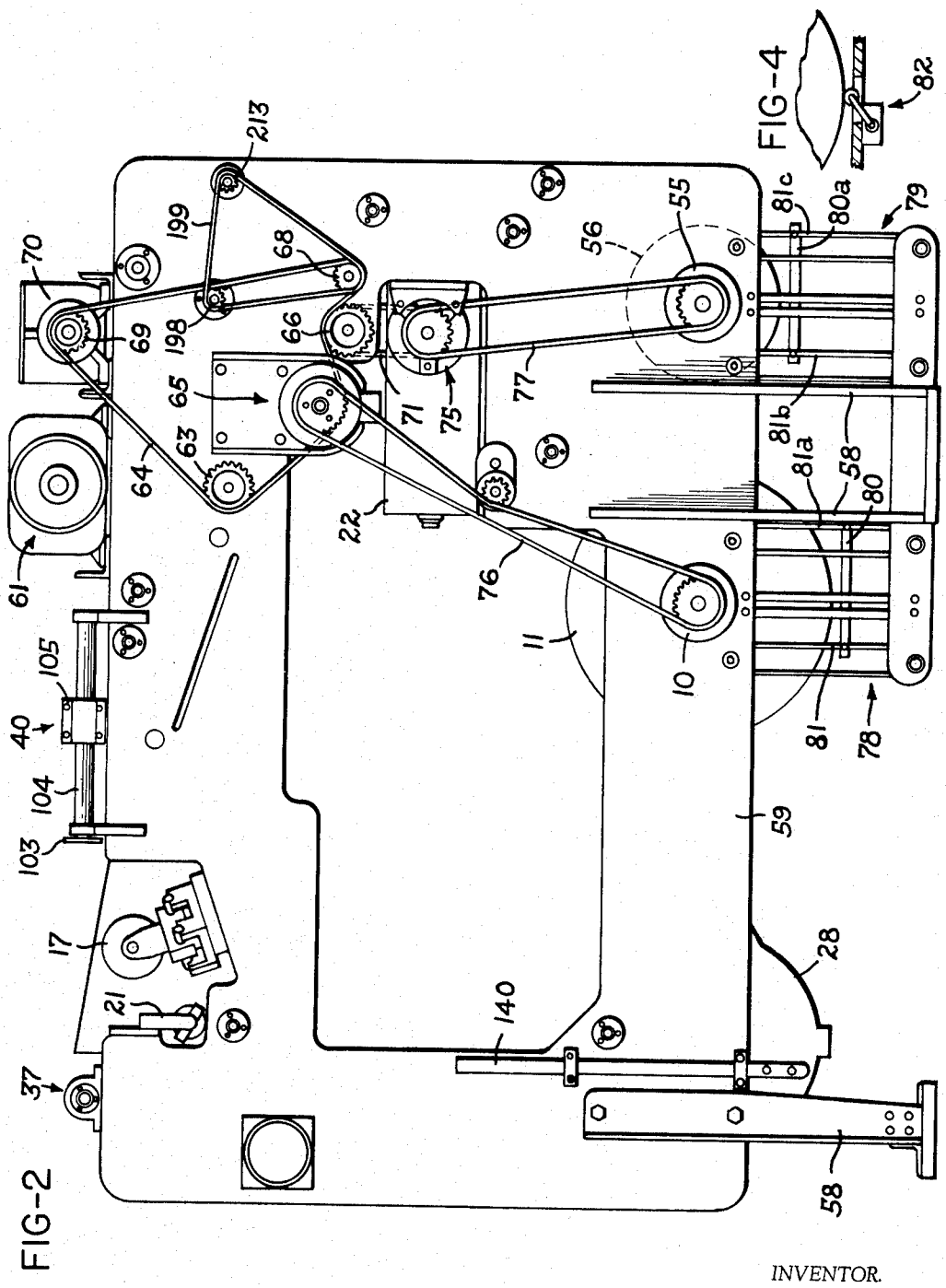


FIG-2

FIG-4

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ELECTROPHOTOGRAPHIC APPARATUS

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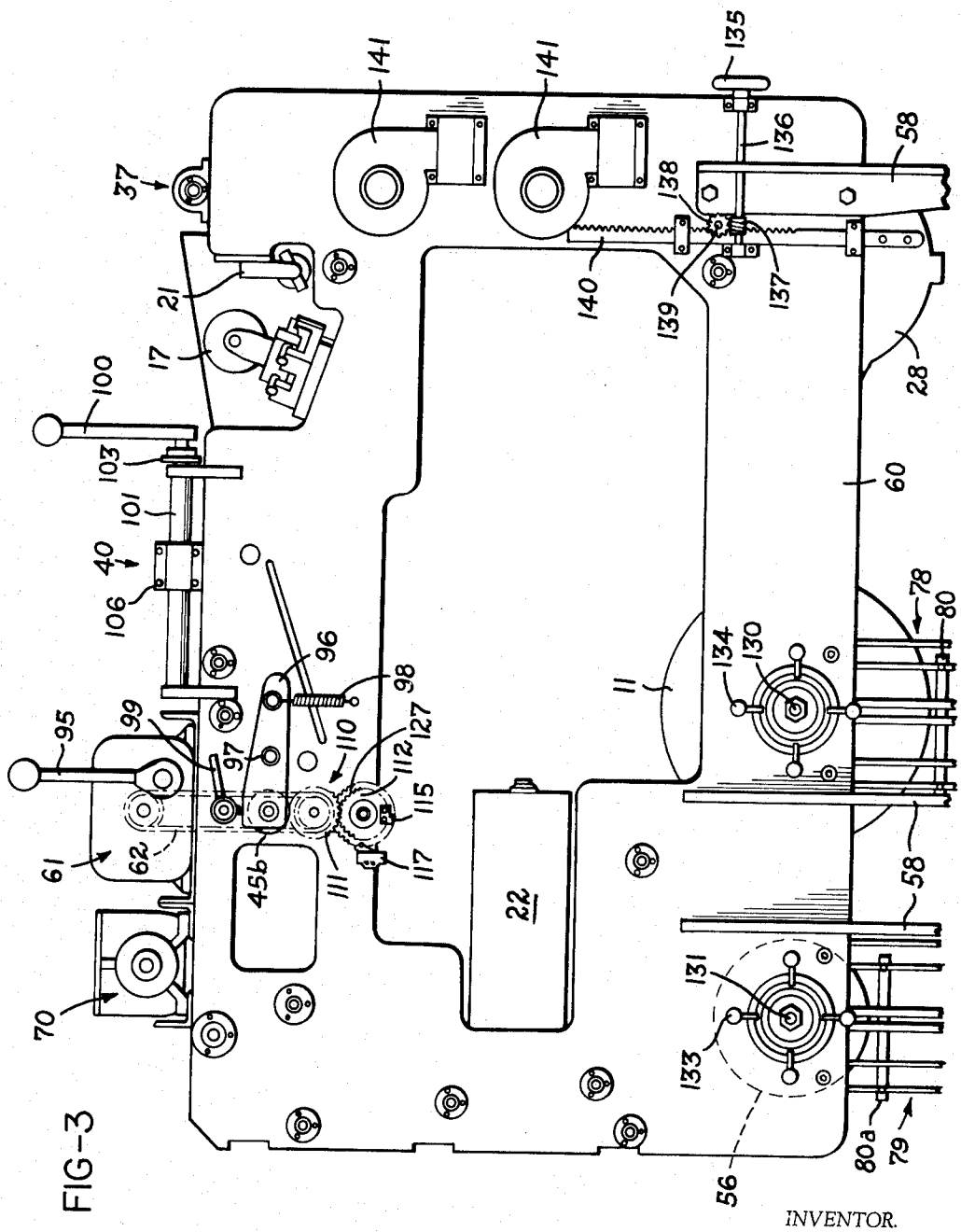


FIG-3

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ELECTROPHOTOGRAPHIC APPARATUS

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FIG-10

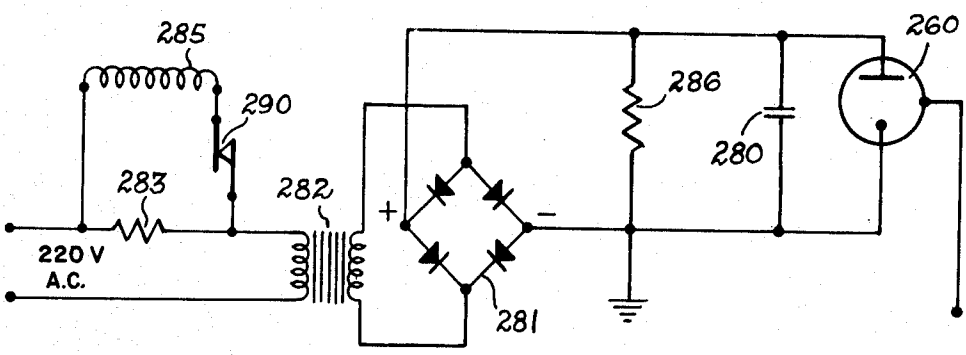
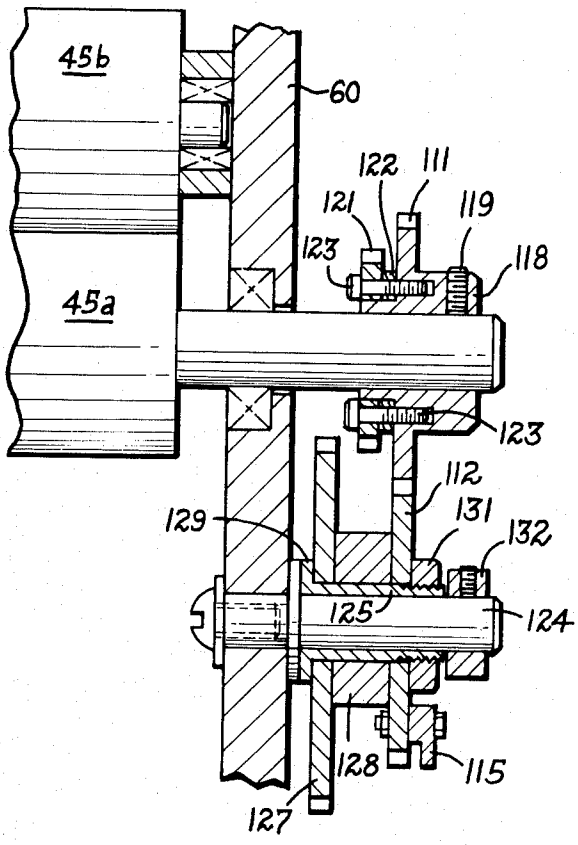


FIG-5



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Dec. 14, 1965 F. HUNSTIGER 3,223,008

ELECTROPHOTOGRAPHIC APPARATUS

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FIG-6

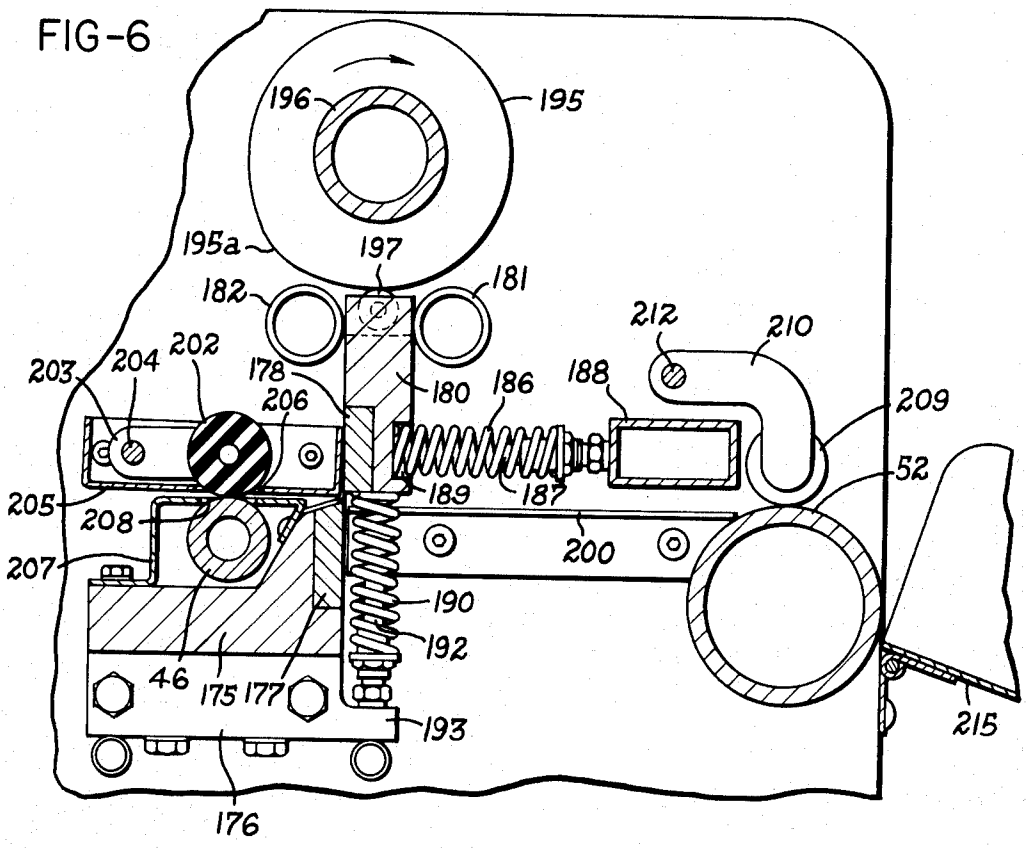
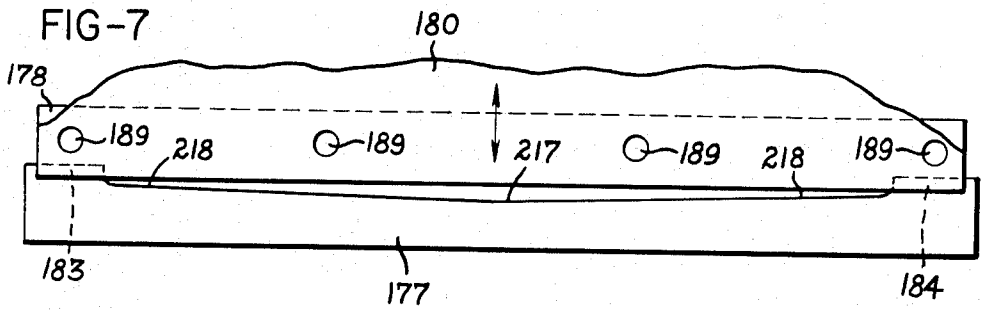


FIG-7



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ELECTROPHOTOGRAPHIC APPARATUS

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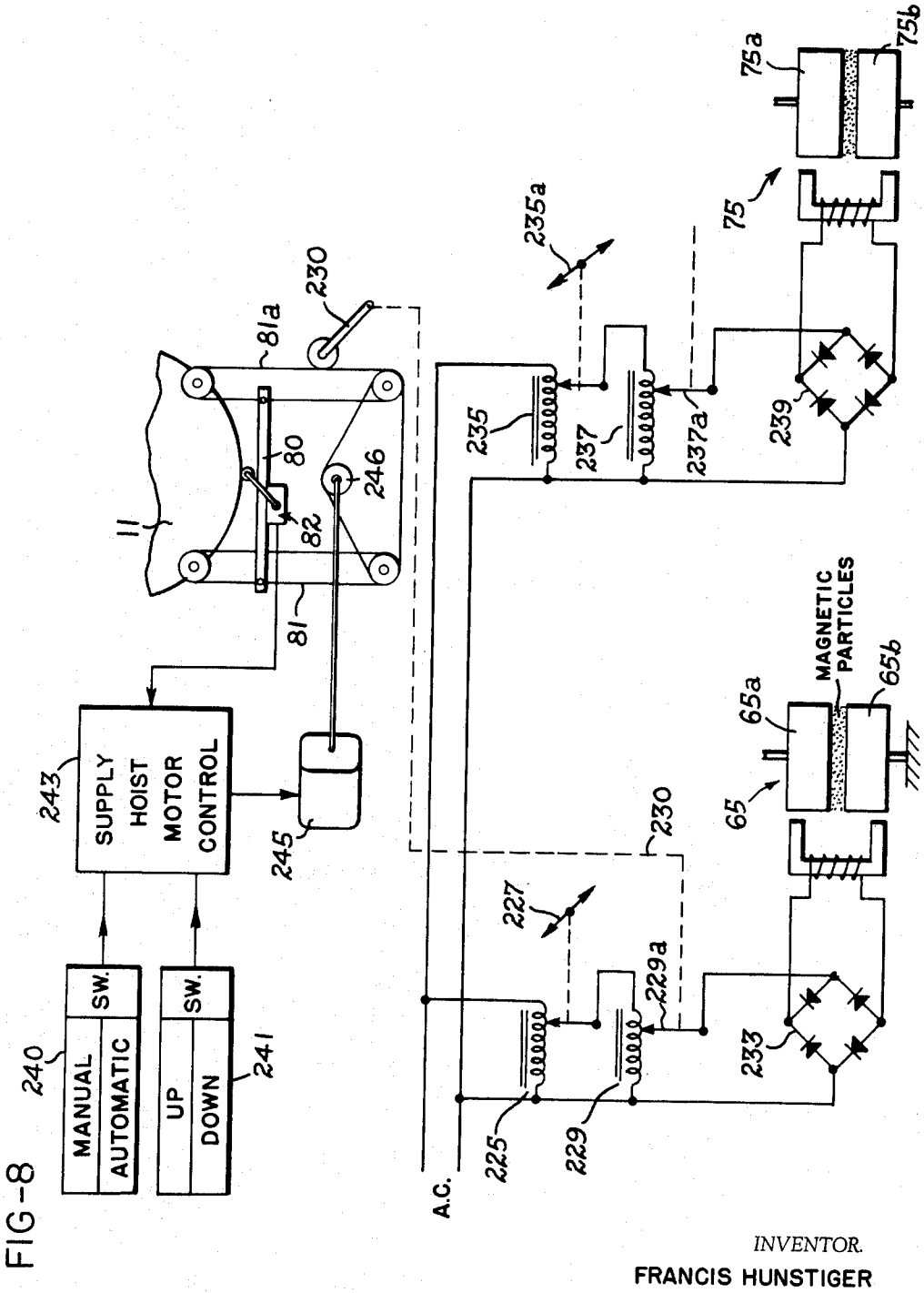


FIG-8

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ELECTROPHOTOGRAPHIC APPARATUS

Filed Nov. 30, 1962 7 Sheets-Sheet 7

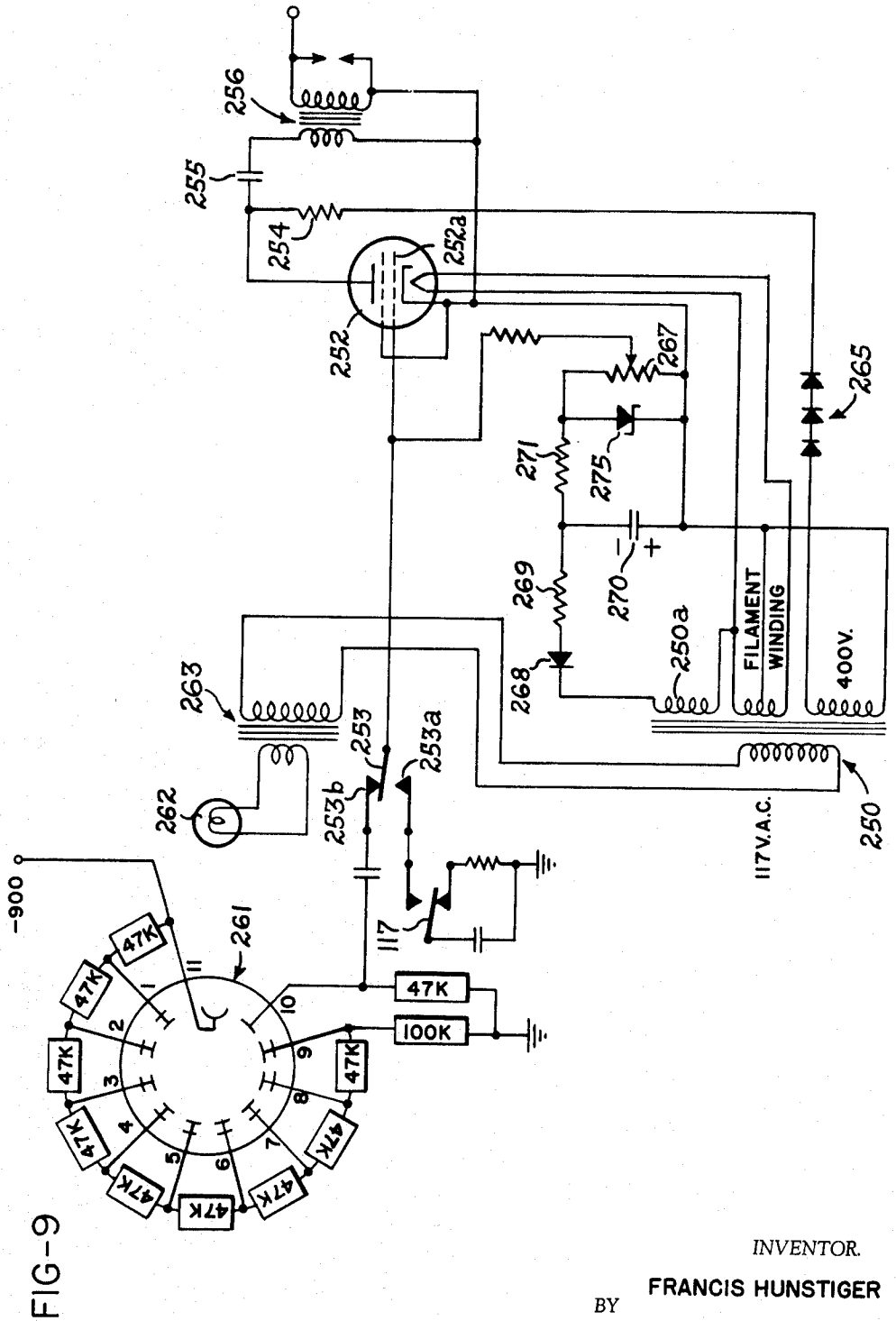


FIG-9

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United States Patent Office

3,223,008

Patented Dec. 14, 1965

3,223,008

ELECTROPHOTOGRAPHIC APPARATUS

Francis Hunstiger, Parma Heights, Ohio, assignor to Harris-Intertype Corporation, Cleveland, Ohio, a corporation of Delaware

Filed Nov. 30, 1962, Ser. No. 241,423

7 Claims. (Cl. 95—1.7)

This invention relates to electrophotographic printing apparatus, and more particularly to an improved apparatus for forming enlarged prints of a micro-sized original, for example microfilm, wherein a web of electrophotographic paper has an electrostatic latent image formed thereon and subsequently developed.

It is a primary object of the present invention to provide a web fed electrophotographic apparatus capable of conveniently and rapidly making copies of a micro-sized original wherein the number of spacing of images on a given length of web may be varied independently of the speed of the web.

Another object of the present invention is the provision of an electrophotographic printing apparatus including a flash light source for exposing the moving web and wherein a sheeting assembly is provided for severing the web between successive images in response to actuation of the flashing light source.

Another object of this invention is to provide an improved web transport and tension control system particularly useful for electrophotographic apparatus.

A further object of the present invention is to provide a web fed electrophotographic printing machine including an improved sheeter assembly which severs the web and removes the severed sheets from the path of web travel to prevent interference between the cut sheet and the leading edge of the web.

It is a further object of the present invention to provide a web fed electrophotographic apparatus wherein the number of images on a given length of web may be varied independently of the speed of the web, and wherein a control assembly is provided for automatically severing the web between successive images.

It is a further object of the present invention to provide an improved sheeter assembly for severing a moving web into sheets, and particularly useful for a single or multicolor electrophotographic apparatus.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings:

FIG. 1 is a diagrammatic view of the web transport system showing the passage of the web through the apparatus of the present invention;

FIGS. 2 and 3 are side elevational views of opposite sides of the machine showing the side frame assemblies and the various drive units, as well as the physical location of the various components of the machine of the present invention;

FIG. 4 is an enlarged fragmentary view of the roll following switch;

FIG. 5 is a view of the gear assembly for varying the number of images on a given length of web;

FIG. 6 is a view partly in section and partly in elevation of the improved sheeter assembly constructed in accordance with the present invention;

FIG. 7 is a view from the right of FIG. 6 showing the configuration of the sheeter blades in accordance with the present invention; and

FIGS. 8 to 10 are wiring diagrams for the electrical components of the machine as constructed in accordance with the present invention.

Referring to the drawings which illustrate preferred embodiments of the invention, FIG. 1 shows the relative position of the several components of the machine which include an unwind reel **10** which supports a roll **11** of electrophotographic paper so that the web is fed over a series of guide rolls **12**, **13** and **14** to a charging unit **15**. From the charging unit **15** the paper passes around a cambering roll **17** and a guide roll **19** to an exposure station generally designated **20** wherein a latent electrostatic image is formed on the charged light sensitive surface of the paper. The cambering roll **17** operates to prevent lateral displacement of the web and is controlled by a conventional web edge position sensing assembly **21** (shown in FIGS. 2 and 3) which detects the position of the web and supplies a signal to correct the web position, if correction is needed. The cambering roll and assembly **21** form part of an automatic web guiding equipment available commercially from the Fife Manufacturing Company. In the exposure station, there is located a microfilm projector **22** and a paper supporting table **23**. The paper with the latent image thereon is advanced over a guide roll **24** to developer station **25** including a developer roller **26** positioned transversely of the path of web travel in a developer tank **28** which receives a liquid developer. On the upward turning side of the developer roller is positioned a squeegee roller **30** for removal of residual developer liquid.

As the paper leaves the developer station **25** it is passed through a dryer unit **35** and around idler rolls **37** and **39** and over a compensating roll **40**. From the compensating roll **40**, the web moves over an idler roll **41** and through a pair of pull rolls **45** and over an accelerating roll **46** through a sheeting assembly generally designated **50** which includes a pair of rolls **52** which function as delivery rolls if the sheeter is being utilized, or which may function as idler rolls in the event the web is being wound on a take-up reel **55** which supports delivery roll **56**. From the rolls **52** the web is passed over idler roll **57** and to the take-up reel **55**.

Referring to FIGS. 2 and 3, the frame elements are shown including legs **58** which support side frames **59** and **60**, the latter acting as supporting elements for the various rolls and stations previously described. The unwind reel and take-up reel assemblies are mounted in side by side relationship on the lower portion of the machine and between frames **59** and **60**, with the web being threaded through the machine as indicated in FIG. 1. Mounted on the top of the machine is a variable speed drive assembly **61** connected by a chain **62** to drive roll **45***a* of the drive rolls as shown in FIG. 3. Sprocket **63** is mounted on the end of roll **45***a* and from the roll to chain **64**, which in turn is coupled to the rotatable member of an electromagnetic brake **65** during rewind and which idles on the rotatable member of the brake during normal operation. The chain **64** passes over a sprocket **66** and around sprocket **68** to drive sprocket **69** of indexing clutch **70** which in turn operates the sheeter assembly **50**, as will be described more fully hereinbelow. Sprocket **66** is mounted on the outer end of a short shaft journaled into the frame **59** and is provided with a second sprocket, not

shown, mounted on the inner end thereof which drives chain 71. This chain provides input power for an electromagnetic clutch assembly 75.

The brake 65 may be of the type commercially available under the name Vickers Magnebrake 6–1–1, while the clutch 70 may be one of the type available under the name Hilliard I.D.U. A suitable electromagnetic clutch may be of the type commercially available under the name Vickers 622–A. A chain 76 couples the brake 65 to the reel 10 and braking is accomplished in response to a voltage applied to the brake coil. A chain 77 couples the output shaft of clutch 75 to the sprocket of the take-up roll 55. During rewind the input member of clutch 75 is disconnected from the drive and rigidly connected to the frame 59 and the clutch then acts as a brake.

The machine includes two lift assemblies 78 and 79, one for the unwind reel and one for the take-up reel whose functions are to raise the rolls into position when setting up the machine, and which operates as roll follower assemblies to sense the roll diameter during operation of the machine. Each assembly includes a reversible lift motor (not shown) operatively connected to platforms 80 and 80*a* by drive chains 81*a*, *b* and *c* whose function is to raise and lower the platform depending on the direction of rotation of the lift motor. The drive ratios are such that the motors cannot be driven by the load. Each platform carries a follower switch assembly 82 (FIG. 4) whose function during operation of the machine is to sense the outer periphery of the roll and provide an electrical signal for operating the lift motor and move the corresponding platform in a direction which tends to keep the switch in contact with the outer periphery of the corresponding roll.

When a new roll is being mounted on the unwind reel 10 or a roll removed from the take-up reel 55, the switches are electrically by-passed so that the motors may be operated independently thereof to lift a roll into position or remove a roll out of its operating position. Once the paper rolls are in operating position, the platform may be automatically moved into position closely adjacent the corresponding roll so that the respective switches are in the proper position to sense the roll diameter. Each platform is mechanically connected to the movable element of a variable transformer, the output of which varies the electromagnetic force on the friction elements of the clutch and brake assemblies 65 and 75 respectively, and whose input is obtained from another variable transformer which is manually adjusted for tension.

These settings determine tension in the portion of the web between drive rolls 45 and the unwind reel 10. The desired preset tension is maintained substantially constant by the follower switch and platform cooperating with the corresponding variable transformer to vary the electromagnetic force on the brake as a function of the diameter of roll 11. In similar fashion, tension in that portion of the web between drive rolls 45 and take-up reel 55 is initially obtained by manual setting of a variable transformer forming part of a second pair of variable transformers which applies an electromagnetic force to the electromagnetic clutch assembly. The desired preset tension is maintained substantially constant by the take-up reel follower switch and platform cooperating with the second variable transformer of the second pair to vary the electromagnetic force on the electromagnetic clutch assembly 75 as a function of the diameter of the delivery roll 56. The input member during normal operation of the clutch turns at an angular velocity somewhat greater than that required to wind the web on a core having a minimum diameter.

As shown in FIG. 3, the variable speed drive 61 may be controlled manually by operating handle 95, which is shown in the stop position. Rotation of the operating handle 95 in a counterclockwise direction approximately 45° from the position shown will vary the speed from zero to maximum. Roll 45*a* is a rubber covered drive roll while roll 45*b* is a metal idler roll which is movable vertically to bring the web into or out of pressure or driving contact with roll 45*a*. Roll 45*b* is mounted at its ends in levers 96 pivoted on pins 97 and biased by a spring 98 to move roll 45*b* out of driving contact with roll 45*a*. Upward movement of roll 45*b* is limited by stops at each side of the machine on a common shaft and journaled into the side frame, and which may be turned by handle 99 to move the stops into and out of engagement with the levers 96 to establish or break the driving relationship of roll 45*b*.

Associated with the compensating roll 40 is a handle 100 affixed through a reversible ratchet connection to a threaded shaft 101 which in turn is connected by a chain assembly 103 to drive a second threaded shaft 104 (FIG. 2) in unison therewith. Compensating roll 40 is mounted on threaded bearing blocks 105 and 106 which are mounted on and moved by threaded shafts 101 and 104. In this way, operation of the ratchet handle 100 operates to turn the threaded shafts to vary the position of roll 40 while maintaining it in proper parallel relationship with the remaining rolls for increasing or decreasing the effective length of the web between the exposure station 20 and the sheeter assembly 50, for reasons which will be described more fully hereinbelow.

Driven by roll 45*a* of the driving rolls 45 is a gear assembly generally designated 110 and including gear 111 which engages gear 112, the latter driving a trigger cam 115 which in turn operates a switch 117 once for each revolution the cam makes. Various gears providing different ratios may be substituted for gears 111 and 112, to provide a wide variation of the number of separate images for a given length of the web. For example, assuming that drive roll 45*a* has a diameter of D inches, the periphery thereof would be D Pi inches, and allowing X inches between images, the relationship of the gears 111 and 112 would be $D\ \mathrm{Pi}/L+X$, where L is a length of the projected image.

A convenient arrangement for providing readily changeable gears is shown in FIG. 5 wherein like reference numerals have been employed to identify parts previously described. Mounted on the shaft of roller 45*a* is a hub 118 fixed to the roller shaft by a locking screw 119. The hub carries gear 111 previously described which is spaced from a second gear 121 by a spacer element 122, both of the gears and the spacer element being fixed to the hub by screws 123. Mounted on a stud 124 extending through the frame 60 is a bearing 125 which is freely rotatable on the stud. Mounted on the bearing are two gears 112 and 127 separated by a spacer element 128, gear 127 being spaced from the frame by a shoulder 129 formed as part of the bearing 125. The two gears and spacer are clamped against the shoulder of the bearing by a threaded nut 131, with the composite assembly of gears, bearing and nut being retained on the stud by a collar 132. Mounted on gear 112 is the trigger cam 115 which turns therewith in response to rotation of either of the gears mounted on the bearing 125.

In the relationship shown in FIG. 5, the ratio of gears 111 and 112 is approximately 1 to 1 so that for each revolution of drive roll 45*a* the switch will be activated once by the trigger cam. For larger images, or increased spacing between successive images, the locking screw 119 is released and the hub 118 is moved towards the frame 60 until gear 121 engages gear 127 and gears 111 and 112 separate. The locking screw is then tightened to fix the position of the collar on the shaft of roller 45*a*.

The ratio of the gears 121 and 127 may be selected to provide any desired spacing as may be required by the size of the images or the desired spacing between successive images.

To release the core of rolls 11 and 56 from the reels 10 and 55 respectively, an expandable shaft for each roll is released by loosening screws 130 and 131. The platforms are elevated by manual operation of the lift motor

to support the weight of the roll. The shaft is then removed and the rolls can be manually lowered for removal from the machine. Handles **133** and **134** are provided for transverse adjustment of the position of the paper rolls when a roll has been installed. For convenience, the developer station includes an operating wheel **135** mounted on a shaft **136** which turns a worm **137**. The worm drives a worm wheel **138** on pinion shaft **139** extending across the machine. The shaft carries at each end thereof pinions (not shown) which engage the racks **140**, the latter being affixed to the developer tank **28**. Rotation of the shaft **136** effects raising and lowering of the tank through the mechanical connections above described. Also mounted on the frame **60** are motor driven fans **141** which circulate air through the dryer station **35** for drying the developed image on the web. For further details as to the charging station, exposing station, and developing station, reference is made to Serial No. 240,253, filed November 27, 1962 (docket 3948).

FIGS. 6 and 7 show the details of the sheeter assembly **50**, accelerating rolls **46** and delivery rolls **52**. Mounted on cross member **175** which is affixed rigidly to blocks **176**, which in turn are bolted to the side frames is a stationary lower shear blade **177** carried by the cross member and which cooperates with upper shear blade **178** secured to a vertically movable support member **180** to sever the web of paper into individual sheets. The support member **180** is guided in its vertical movement by rollers **181** and **182** at each end thereof rotatably mounted on studs secured in the frames **59** and **60**. As shown in FIG. 7, the shear blades overlap at points **183** and **184** which are spaced apart a sufficient distance to allow unobstructed movement of the web therebetween. The upper shear blade **178** is braced against the lower shear blade **177** by a plurality of spaced springs **186** which are carried by guide rods **187** secured to a cross member **188**, the latter being secured at its ends to the side frames with each of the springs being received in a recess **189** provided in support member **180**. Shear blade **178** is urged vertically upward by springs **190** which bear against the lower edge of support member **180** at its ends and which are supported by rods **192** mounted on shoulders **193** which form a part of blocks **176**.

Reciprocating movement of the upper shear blade **178** is accomplished by spaced cams **195** carried on a common shaft **196** journaled in the side frames, each of the cams engaging a roller **197** rotatably mounted in the movable support member **180**. Each cam **195** includes a lobe **195***a* which upon engagement with its corresponding roller **197** urges the support member **180** and the shear blade **178** in a downward direction to effect cutting of the web. Clutch **70** is an indexing clutch which is connected by a drive chain to rotate shaft **196** for one revolution per actuation of the clutch. Accordingly, the cutting action of the shear blades is rapid with respect to web travel and accurate with respect to actuation of the clutch **70**. This clutch will engage at any angular relationship of its input shaft.

Since the web is advanced during the short period of cutting, the leading edge of the web is momentarily stopped and a slight buckle develops in the web between the drive rolls **45** and the shear blades. To remove this buckle and to assist in feeding the leading end of the web through the shear blades, the accelerating roll **46** is provided and is driven by sprocket **198** which is affixed to one end thereof. Sprocket **198** is driven by chain **199** such that the surface speed of the roll **46** is sufficiently greater than the speed of the web to remove the buckle above mentioned, and to advance the leading end of the web onto a table **200** extending between the side frames.

Bearing against accelerating roll **46** are a plurality of wheels **202** rotatably mounted on arms **203** which are supported on a shaft **204** carried in the side frames **59** and **60**. A stripper and guide member **205** secured to the frame is utilized to free the leading end of the web from the upper shear blade. This member **205** is provided with a plurality of openings **206** through which the rolls extend. These rolls **202** rest in contact with the web thereby forming a low pressure nip with accelerating roll **46** which is surrounded by a paper guide **207** having an elongated slot **208** therein through which the upper surface of the roll extends. Guide member **205** and guide **207** cooperate to form a passageway confining the leading end of the web and to cause the buckling to form between the drive rolls **45** and the guides **205** and **207**.

Following the cutting action of the shear blades, each sheet is rapidly advanced away from the shear blades by delivery roll **52** which cooperates with a plurality of pressure wheels **209** each mounted on an arm **210**, the arms being carried on a common shaft **212** which is supported by the side frames. The delivery roll, like the accelerating roll, is driven by chain **199** which engages a sprocket **213** affixed to the delivery roll shaft such that the surface speed of this roll is somewhat greater than the speed of the web, and the speed of the accelerating roll **46**. From the delivery roll **52**, the sheets are advanced into a delivery tray **215** removably mounted at each side to the frames **59** and **60**.

One aspect of the present invention relates to the configuration of the shear blades and the cooperation between the shear blades, the accelerating roll **46** and the guides. As shown in FIG. 7, the lower or stationary blade **177** is ground so that the center portion **217** is slightly lower than the ends **218** thereof, for example ⅛ inch for a 30 inch web, while the upper or movable blade is straight. When the two blades are brought together the shearing action on the web starts simultaneously at both edges and progresses towards the center. During the cut, the action of the blades in stopping the web is symmetrical on opposite sides of the center of the web and this assists in forming a symmetrical buckle and preventing lateral displacement of the leading end of the web. This action plus the action of the accelerating rolls and the guiding action of the guides operates to effect substantial elimination of skew cut sheets, and further prevents side-wise wandering of the web between the drive rolls and the sheeter **50**.

Since the two blades overlap each other at the ends, and the movable blade is spring biased along its length against the fixed blade, no accurate adjustment of one relative to the other is necessary, and thus the sheeter is relatively simple to operate and maintain.

Referring to FIG. 8, the electrical circuit is shown for the tension control system and includes a variable transformer **225** connected across a 110 volt A.C. supply source. The electrical output of the transformer **225** is directly proportional to an adjustment which is manually made to the transformer by a dial thereon which is shown schematically at **227**. The electrical output of transformer **225** is used as the input to a second transformer **229** the position of whose movable element **229***a* is determined by the position of platform **80** which is memechanically connected thereto by connection **230**. The electrical output of **229** which is now a function of the tension requirement as selected by the operator and the diameter of the supply roll **11** is rectified by a full wave bridge rectifier **233** and fed into the electromagnetic brake **65** shown schematically as including spaced magnetically permeable members **65***a* and **65***b* between which are interposed magnetic particles. Element **65***b* of the brake is unmovable and is fixed to the frame of the machine while movable element **65***a* is connected to the supply roll at all times.

Also connected across the 110 volt A.C. supply is the first auto transformer **235** of a second pair of auto transformers which are used in connection with the take-up reel. The second transformer **237** of this pair receives as its electrical input the electrical output of transformer **235** which is determined by a manual setting of movable element **235***a* which is set by the operator. The movable

element 237*a* of the transformer 237 is moved according to the position of the platform 80*a* associated with the take-up reel 55 so that the output of the second transformer 237 is a function of the tension requirement manually set by the operator and the diameter of the delivery roll 56. As described in connection with transformers 225 and 229, the electrical output of the second transformer is rectified by a full wave bridge rectifier 239 and impressed on the electromagnetic clutch 75 which is shown schematically as including two magnetically permeable and rotatable members 75*a* and 75*b* with magnetic particles in the space between the two rotatable members. Rotatable plate 75*a* may be driven or fixed depending on whether the machine is in its normal operation or during a rewind condition, while rotatable member 75*b* is always connected to take-up reel 55 by chain 77.

By the appartaus above described, essentially constant tension is maintained in the web, as previously described, regardless of changes in roll diameter even though the torque is applied at varying distances from the center of the roll.

Shown schematically in FIG. 8 is the control system for the lift assembly associated with the unwind reel, and it is to be understood that a corresponding assembly is associated with the take-up reel. This control assembly includes two switches 240 and 241, switch 240 enabling automatic or manual action while switch 241 controls the up and down movement of the platform only when switch 240 is in the manual position. Each of the switches is connected to a conventional motor control unit 243 whose electrical output is fed to a gear motor 245 mechanically connected by chain assembly 246 to cause movement of chain drives 81 and 81*a* which effect raising and lowering of the platform 80. As previously described, a switch is carried by the platform 80 and is operated by a roller assembly contacting the outer periphery of the roller to supply feed back information to the motor control unit thereby altering the position of platform 80 in response to changes in diameter of the roll.

Referring to FIG. 9, the electrical components are shown for triggering the flashing light source. A supply voltage from a 117 volt A.C. source is applied across the input terminals of transformer 250 whose output provides the necessary voltages for operation of the flash tube trigger thyratron 252. In one mode of operation, switch 253 is moved to position 253*a* which brings into the circuit switch 117 which is operated by the trigger cam 115 as previously described. Each time switch 117 is actuated, a positive pulse is fed to grid 252*a* of thyratron 252 which discharges a capacitor 255 through the primary of pulse transformer 256. The output of transformer 256 appears as a trigger pulse for the flash tube 260 shown in FIG. 10.

In another mode of operation, switch 253 is moved to contacts 253*b* at which time prototube 261 will respond to a mark on the web formed at the time the first image is formed for applying a positive pulse to the grid 252*a* of thyraton 252, again energizing the flash tube as previously described. A source of light 262 for registration mark pick-off is shown along with its associated power supply 263.

Plate supply voltage for thyraton 252 is supplied through resistor 264 and the three half wave rectifiers 265 connected to the 400 volt output of transformer 250. Proper filament supply voltage is also supplied from the filament winding of transformer 250, while biasing voltage to control the set back of thyratron control grid 252*a* is obtained utilizing a portion of the filament winding plus an auxiliary winding 250*a* on transformer 250. Potentiometer 267 is utilized to adjust the setback voltage on the grid 252*a* of thyratron 252 in order that various sensitivity to marks and background level on the web may be accommodated. Connected across the auxiliary winding and one half of the filament winding of transformer 250 is a half-wave rectifying diode 268, a surge limiting resistor 269, a filter capacitor 270, a dropping resistor 271 and a regualting Zener diode 275.

For further details with respect to energizing the flash tube in response to a registration mark, reference is made to the said copending application.

Referring to FIG. 10, the circuit is shown for controlling operation of the sheeter solenoid in response to operation of the flashing light source 260. The trigger input for the light source has been described in connection with FIG. 9. Connected across tube 260 is a capacitor 280 whose voltage drops to a very low value once tube 260 fires. This voltage drop occurs in the order of 200 micro-seconds which is negligible for mechanical purposes and for virtually instant operation of the sheeter assembly. Upon firing of flash tube 260, the capacitor 280 appears as a low impedance load to a bridge rectifier 281 and a transformer 282, and the load is reflected into the primary of the transformer resulting in a current surge. The current surge moves through limiting resistor 283 and the voltage drop thereacross is sufficient to cause immediate actuation of a sheeter solenoid 285 which in turn causes operation of the indexing clutch 70.

The variation in actuation time of solenoid 285 due to A.C. line phase and flash trigger relationships is negligible. The resistor 283 performs three functions in the circuit as shown in FIG. 10. First it protects rectifier 281 while it itself is in a low voltage circuit. Secondly, it allows flash tube 260 to extinguish by slowing the recharge time of the capacitor 280. Third, the resistor 283 enables the sheeter solenoid 285 to operate by providing a voltage supply for the sheeter solenoid. Resistor 286 functions to bleed the charge off the capacitor 280 when the machine is shut down and operates as a safety device.

From the above description, it is apparent that the apparatus is capable of operating in several modes. In one mode, sheeter switch 290 is opened to disable the solenoid 285 and the web is not sheeted but is guided over the delivery roll 52 to the take-up reel 55. In this mode of operation, the firing of the flash tube may be actuated by the trigger cam 115 and microswitch 117 operating through the circuit previously described.

In another mode of operation, the web with one image thereon is rewound from the take-up reel to the unwind reel and passed a second time through the machine for formation and development of a second series of images in registry with the first series of images. In this mode of operation, the flash tube may be energized by the photocell recognition system described in connection with FIG. 9. If no additional images are to be formed and developed on the web, switch 290 is positioned to place the sheeter solenoid 285 in the circuit. The operation of the sheeter will then be controlled by the flash tube circuit described in connection with FIG. 10 although the trigger input for the tube may be controlled by the photo pick-up device described in connection with FIG. 9.

In still another mode of operation, and used primarily with images in one color, the sheeter switch 290 is closed while the flashing of flash tube 260 is controlled by the microswitch 117 and trigger cam 115 as was previously described.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In an electrophotographic apparatus for producing copies of an original wherein a web of electrophotographic paper is fed sequentially through a charging station, an exposing station and a developing station to form on said web a series of developed images, and wherein the

exposing station includes a flashing light source for exposing said moving web to a light image to be reproduced, the improvement comprising,

means to advance said web continuously through said stations,

means to energize said flashing light source for exposure of said web to an image to be reproduced,

and said flash energizing means including flash control means cooperatively associated with said web advancing means for forming a series of images and for varying the number of flash exposures for a given length of web whereby successive images of one series may be spaced a uniform predetermined distance apart and the successive images of another series may be spaced apart a uniform distance different from the spacing of said one series.

2. In an electrophotographic apparatus for producing copies of an original wherein a web of electrophotographic paper is fed sequentially through a charging station, an exposing station and a developing station to form on said web a series of developed images, and wherein the exposing station includes a flashing light source for exposing said moving web to a light image to be reproduced, the improvement comprising,

means to advance said web continuously through said stations,

said advancing means including means contacting each side of said web and rotating at a speed proportional to the speed of said web,

and flash control means operated by said contacting means for forming a series of images and for varying the number of flash exposures for a given length of web whereby successive images of one series may be spaced a uniform predetermined distance apart and the successive images of another series may be spaced apart a uniform distance different from the spacing of said one series.

3. In an electrophotographic apparatus for producing copies of an original wherein a web of electrophotographic paper is fed sequentially through a charging station, an exposing station and a developing station to form on said web a series of developed images, and wherein the exposing station includes a flashing light source for exposing said moving web to a light image to be reproduced, the improvement comprising,

means to cause flashing of said light source in predetermined relation to movement of said web for forming spaced images thereon;

a sheeter mechanism receiving said web from said developing station,

said sheeter mechanism including sheeter blade means, and

sheeter mechanism operating means operative in predetermined relation to said flash means for severing said web into sheets.

4. In an electrophotographic apparatus for producing copies of an original wherein a web of electrophotographic paper is fed sequentially through a charging station, an exposing station and a developing station to form on said web a series of developed images, and wherein the exposing station includes a flashing light source for exposing said moving web to a light image to be reproduced, the improvement comprising,

means to advance said web continuously through said stations,

means to energize said flashing light source for exposure of said web to an image to be reproduced,

sheeting means receiving said web from the developing station and including a sheeter blade for severing said developed web into sheets,

sheeting control means operative in response to each flash of said flashing lighting source for actuating said sheeting means,

flash control means to vary the number of flash exposures for a given length of web independently of the speed of the web thereby to vary the spacing of leading edges of successive images on said web, and

compensating means to change the length of web extending between said exposure station and said sheeting means such that said sheeting means severs said web only between successive developed images on said web.

5. In an electrophotographic apparatus for producing copies of an original wherein a web of electrophotographic paper is fed sequentially through a charging station, an exposing station and a developing station to form on said web a series of developed images, and wherein the exposed station includes a flashing light source for exposing said moving web to a light image to be reproduced, the improvement comprising,

means for driving said web through said stations,

sheeter means for severing said sheets from the web subsequent to development of the image thereon,

indexing clutch means for operating said sheeter means, and

means to actuate said clutch means to connect said clutch means to said drive means at any position of said drive means whereby said sheeter means is actuated in any desired relation to said web.

6. In an electrophotographic apparatus for producing copies of an original wherein a web of electrophotographic paper in roll form is fed sequentially through a charging station, an exposing station and a developing station to form on said web a series of developed images, and wherein the exposing station includes means to expose said moving web to a light image to be reproduced, the improvement comprising,

means for unwinding said roll of paper,

means for taking up said roll of paper,

means to advance said web continuously through said stations, said last named means including web driving means between said unwind and take-up means and engaging each side of said web,

means for maintaining an initial value of tension on said web, said means including brake means operatively associated with said unwind means and clutch means operatively associated with said take-up means,

means for sensing the change in diameter of the roll at each of said unwind and take-up means, means for controlling the braking effect of said brake means in response to changes in the diameter of said roll in said unwind for maintaining the tension between said unwind means and said drive means substantially constant, and

means for controlling the driving effect of said clutch means in response to changes in the diameter of said roll in said take-up means for maintaining the tension between said take-up means and said drive means substantially constant.

7. In an electrophotographic apparatus for producing copies of an original wherein a web of electrophotographic paper is fed sequentially through a charging station, an exposing station and a developing station to form on said web a series of developed images, and wherein the exposing station includes means for exposing said moving web to a light image to be reproduced, the improvement comprising,

means for advancing said web through said stations including drive roll means engaging each surface of said web,

sheeting means spaced from said drive roll means for receiving the web therefrom,

accelerating roll means between said drive roll means and said sheeting means forming a low pressure frictional contact with said web,

means for driving said accelerating roll means at a surface speed faster than the speed of said web,

said sheeting means including blade means recipro-

cable transversely of the direction of web travel to sever said web,

said blade means being arranged to engage each edge of said web simultaneously during a cutting stroke and to cause the shearing action to progress from the edge of the web to the center, said blades momentarily halting that portion of the web being cut thereby causing a buckle to form between the drive roll means and said sheeter means,

guide means on each side of the web and associated with said accelerating roll means and said blade means to confine and prevent buckling of the web between said blade means and said accelerating roll means, and

means to energize said sheeting means to cause reciprocating movement of said blade means.

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