

- [54] **FLAT BED ELECTROSTATIC
PHOTOCOPIER DESIGN FOR CUSTOMER
SERVICEABILITY**
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[51] Int. Cl. G03g 15/22
[58] Field of Search 355/3, 8; 219/383,
219/384, 388; 317/262; 250/495 ZC

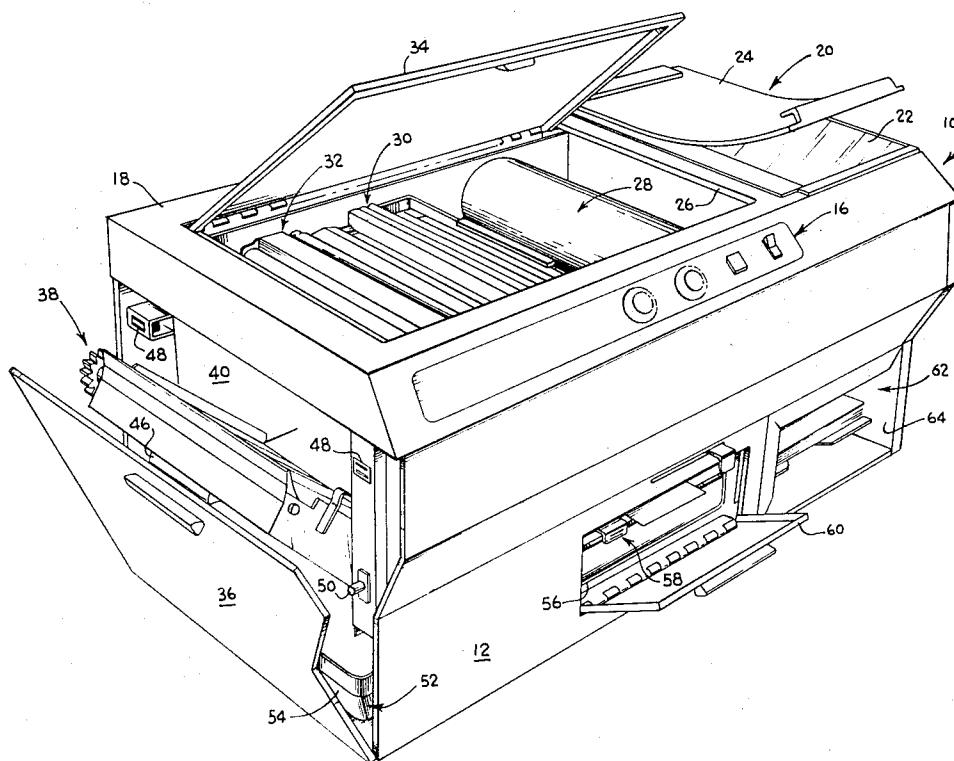
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[57] **ABSTRACT**

The disclosed flat bed electrostatic photocopier utilizes a U-shaped feedpath for feeding successive copy sheets from a supply through various processing stations to a receiving compartment. All segments of the feedpath are adjacent the perimeter of the copier and accessible through openings in the copier housing. Flash illumination of the original is utilized to achieve a full reflected image for projection onto the copy sheet while in transit through the imaging station.

10 Claims, 7 Drawing Figures



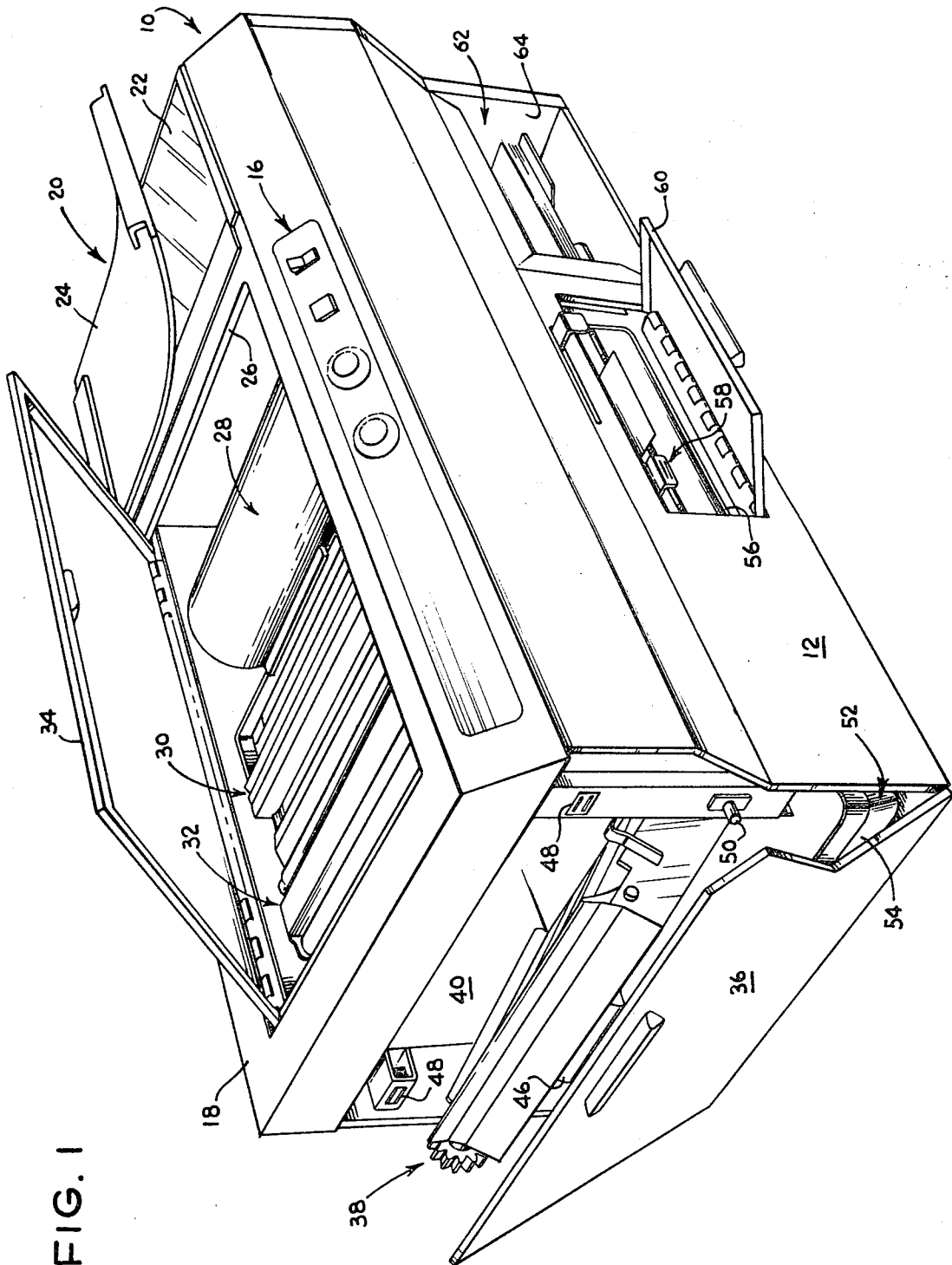


FIG. 1

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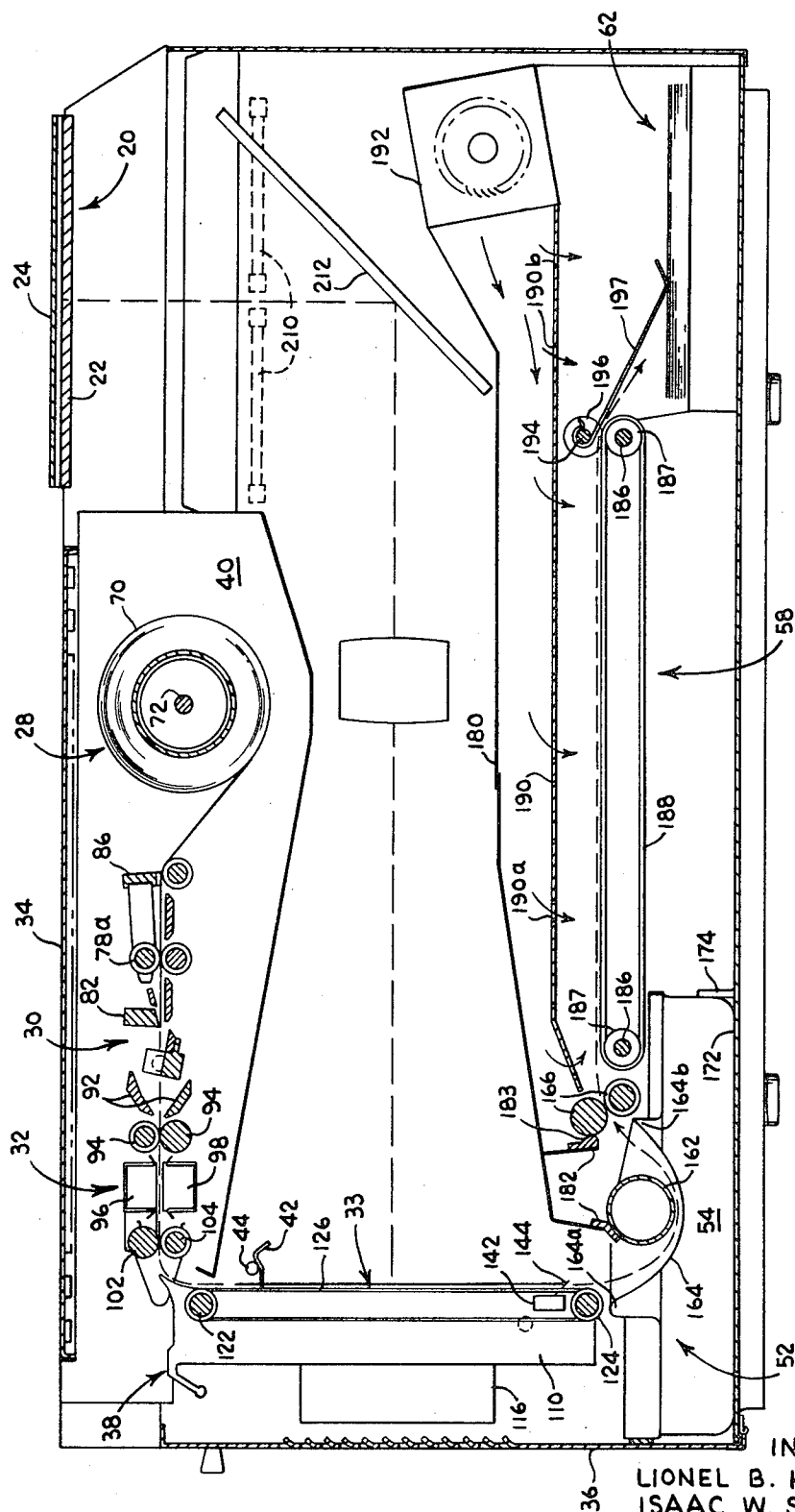


FIG. 2

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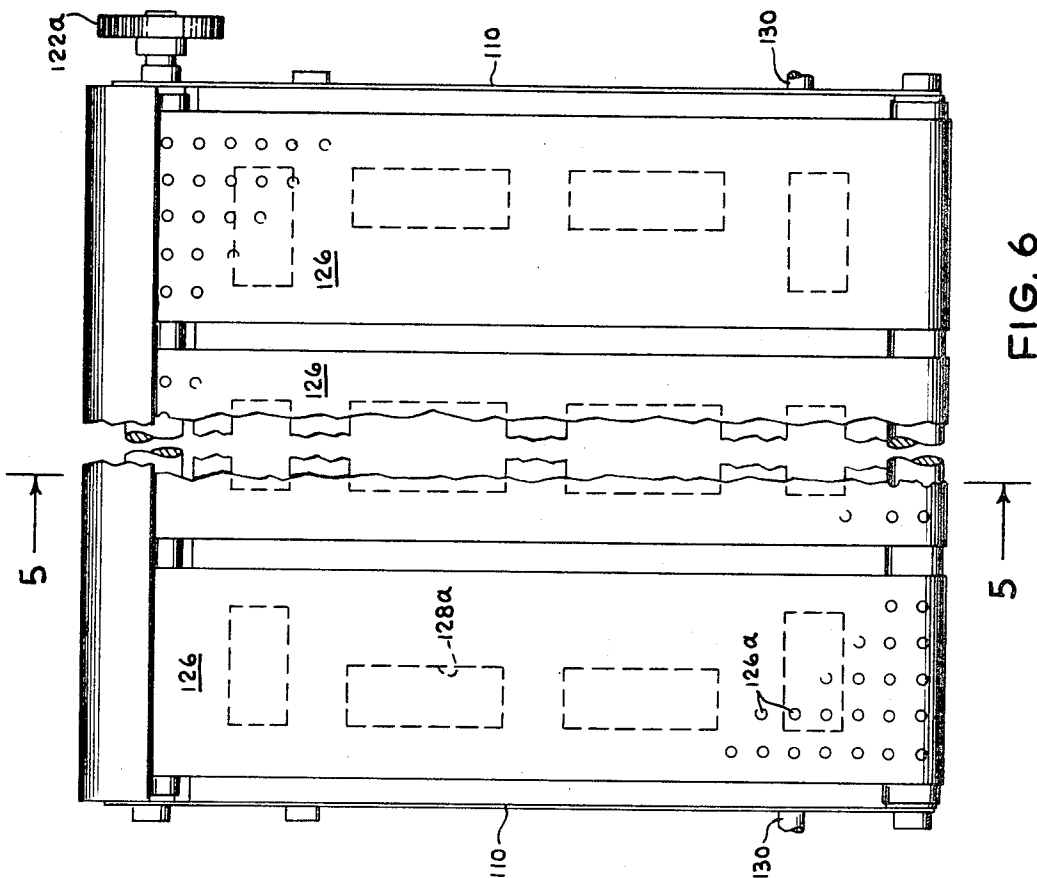


FIG. 6

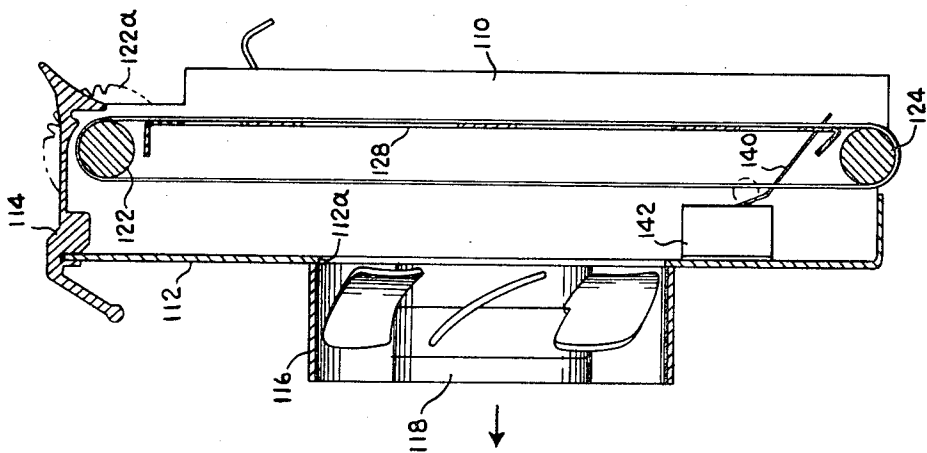


FIG. 5

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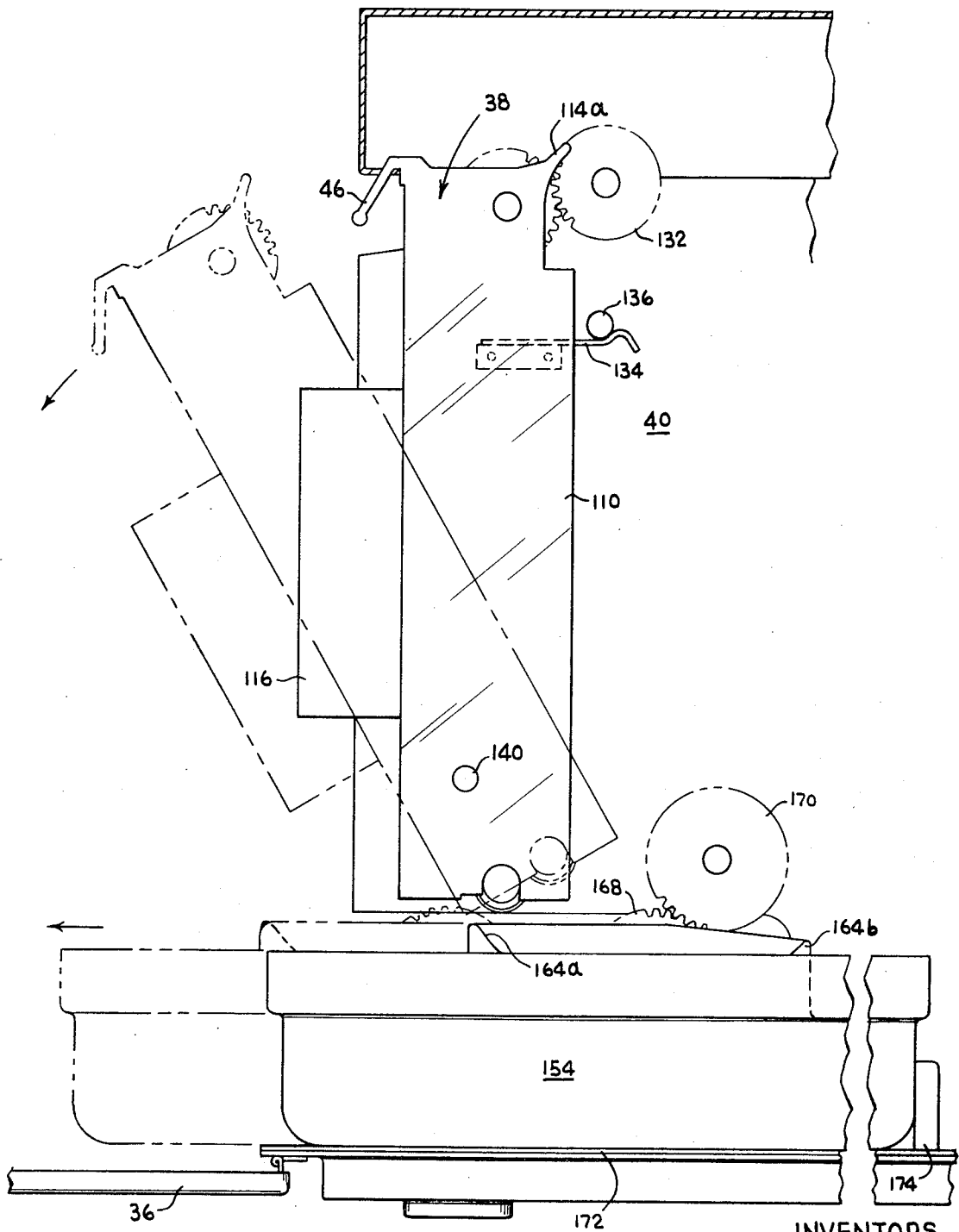


FIG. 7

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FLAT BED ELECTROSTATIC PHOTOCOPIER DESIGN FOR CUSTOMER SERVICEABILITY

BACKGROUND OF THE INVENTION

A significant consideration in the design of any office photocopier is serviceability. Large scale manufacturers of such equipment must, if they are to achieve any measure of marketing success, maintain service personnel in all those geographical areas where their photocopiers are sold or leased in quantity. If a customer is going to be satisfied with his copier, down time must be held to an absolute minimum, and therefore prompt servicing is essential.

Current office photocopiers, particularly those utilizing electrophotographic techniques, are relatively sophisticated and thus complex. Thus, most of the malfunctions plus the recommended periodic preventive maintenance must be handled by trained service personnel.

Probably the most frequent copier malfunction is a paper jam, either of the original document sheet as it passes through its feedpath or the copy paper sheet as it is conveyed through its, typically separate, feedpath. Most photocopier designs permit a serviceman to clear a paper jam in several minutes or less. However, the customer must call the service department and await the arrival of a serviceman which may take hours and even days. In the meantime the photocopier is out of service.

It would be highly advantageous both from the standpoints of the customer and the manufacturer's servicing load if the photocopiers were customer serviceable for certain malfunctions. For example, if the operators of photocopiers, typically office personnel untrained in the internal intricacies of the equipment, could readily clear paper jams, they would gladly do so rather than having to summon a serviceman and then await his arrival in order to complete a copy run. Copier down time could be reduced and the load on the service personnel relieved. In many electrostatic photocopier designs, the packaging of the various components and the deviousness of the sheet feedpaths renders it virtually impossible for the operator to clear paper jams unless equipped with special training and tools.

In many office situations, it is essential that a photocopier, in order to satisfy all of the customer's needs, have book copying capability. Thus, so-called "flat bed" photocopiers are popular. In this type of copier the original document sheet is not fed through a feedpath, but instead is placed face down on a transparent bed plate. The original is line scanned and the series of line images are successively transferred to a copy sheet transported along its feedpath in synchronism through an imaging station. Since the original sheet is not fed through the copier, as in many types of copiers, it may be bound with other sheets in book fashion. This scanning technique requires relative motion between the scanning light and the original, which is expensive to implement and service.

Moreover, this scanning technique, which incidentally is also inherent in those copiers where the original is fed along a feedpath past a fixed illuminating source, is a limiting factor on the copy rate of the equipment. In addition, means are required for accurately synchronizing the scanning of an original with the movement of a copy sheet through the imaging station.

It is accordingly a generally object of the present invention to provide electrophotographic apparatus which is extremely reliable in operation, however, it is also uniquely designed to provide complete accessibility to the entire copy sheet feedpath for convenient operator extraction of stranded copy sheets should a paper jam occur. Moreover, the electrophotographic apparatus of the invention is of simplified design for low cost and ease of service by trained service personnel and, in some important instances, by the customer as well.

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

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided electrophotographic apparatus of a novel design which is eminently conducive to customer serviceability. More particularly, the instant photocopier is provided with a U-shaped copy sheet feedpath extending from the copy sheet supply to a copy sheet receiving department. All segments of this feedpath, including the various processing stations through which the copy sheets successively pass, are located adjacent the perimeter of the photocopier and are accessible through openings in the copier housing. The practice of folding the copy sheet feedpath on itself commonly employed in current photocopier designs is avoided, and thus all segments of the feedpath are accessible to the operator for convenient removal of stranded copy sheets.

Further in accordance with the present invention, the various copy paper processing stations are constructed for convenient displacement from the copy sheet feedpath to not only further facilitate access to stranded sheets but also to release a stranded sheet for convenient removal in its entirety. Thus, instances of tearing and shredding the stranded copy sheets in attempting to remove them are avoided.

More specifically, the corona charging unit through which copy paper passes from the copy sheet supply pursuant to imposing a uniform electrostatic charge on its photoconductive surface is constructed such that its upper half pivots upwardly away from its lower half to permit extraction of a copy sheet stranded therebetween. The imaging station of the present invention consists of a sheet transport conveyor adapted to accept successive copy sheets from the charging station and convey them along an imaging plane where its charged photoconductive surface is subjected to a projection of the original image to be copied pursuant to creating a corresponding latent electrostatic image. This transport conveyor is pivotally mounted to swing outwardly away from the image plane to expose a copy sheet stranded thereat for convenient extraction.

Preferably, in accordance with the present invention, this transport conveyor is a vacuum conveyor employing air pressure to hold the copy paper against moving conveyor belts pursuant to transporting a copy paper sheet along the imaging plane. The vacuum generating source as well as the conveyor belts are carried by a frame pivotally mounted to the copier chassis, and thus nothing obstructs the accessibility to a copy sheet stranded in the imaging station when the transport conveyor is pivoted away from the imaging plane.

In analogous fashion, the development station which, in the disclosed embodiment of the invention includes

a liquid developer tank, is mounted such that it can be bodily removed from its operative position to facilitate extraction of a copy sheet stranded thereat.

Finally, the drying station, positioned between the development station and the copy sheet receiving compartment and wherein the copy sheets are dried, consists of a series of laterally spaced conveyor belts moving through a drying chamber. A copy sheet exiting from the development station rests on these belts as it is conveyed to the receiving compartment. An opening in the copier housing adjacent the side of this sheet conveyor permits convenient access to a copy sheet stranded in the drying station.

As an additional feature of the present invention, flash illumination of the original document as it rests at the illuminating station is utilized to develop a complete reflected image of the entire original sheet which is then projected onto the copy sheet while in transit through the imaging station. The high intensity and brevity of illumination of the original permits the copy sheet to be moving during image projection on its photoconductive surface and nevertheless create a sharp latent electrostatic image thereon. Thus, expensive scanning and synchronizing equipment typically found in current photocopiers is eliminated and the copy rate can be significantly increased.

Synchronism is achieved simply by detecting when the copy sheet arrives at the appropriate position in the imaging station to receive image projection, whereupon flash illumination of the original document is initiated. Thus stringent control of the movement of the copy sheet along its feedpath is unnecessary.

Furthermore, the use of flash illumination rather than incandescent illumination reduces the amount of power consumption and also obviates the accumulation of heat which is characteristic of current office photocopiers. The heat generated by incandescent lamps can accumulate to the point wherein it has a degrading effect on the photoconductive properties of the copy paper and the liquid or dry toner used in the development station.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a perspective view of electrophotographic apparatus constructed according to a preferred embodiment of the invention;

FIG. 2 is a longitudinal sectional view of the electrophotographic apparatus of FIG. 1;

FIG. 3 is a side elevational view of an operator handle which serves as an "out of copy paper" switch actuator and as an actuator for separating initial copy paper feed rollers to facilitate starting a paper supply roll.

FIG. 4 is a perspective view of a corona charging station employed in the electrophotographic apparatus of FIG. 1;

FIG. 5 is a side view of sheet transport apparatus employed in the imaging station of the electrophotographic apparatus of FIG. 1;

FIG. 6 is a front view of the sheet transport apparatus of FIG. 5; and

FIG. 7 is a side view of the sheet transport apparatus and a portion of the development station illustrating in phantom their removability from their operative positions to facilitate extraction of jammed copy sheets.

Like reference numerals refer to corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

The electrophotographic apparatus of the present invention, as seen in FIG. 1, takes the form of a table top photocopier whose working components are enclosed by a rectangular housing, generally indicated at 10. Front wall 12 of housing 10 accommodates a control and indicator panel 16. Top wall 18 of the housing mounts an illuminating station, generally indicated at 20 and consisting of a transparent bed plate 22 mounted in an opening in the housing. An opaque original document to be copied is suitably positioned faced down on bed plate 22 and is pressed flat thereagainst by a blanket 24 hinged to the housing.

To the left of the illuminating station 20, the housing top wall 18 is formed with an enlarged opening 26 to facilitate access to an electrophotographic copy paper supply 28, a knife assembly 30, and a corona charging station 32. Opening 26 is closed by a suitably electrically inter-locked door 34.

The left end of the copier housing 10, as seen in FIG. 1, is closed off by a door 36 facilitating access to the imaging and development stations of the disclosed electrophotographic copier. As will be seen more clearly from the description to follow, the imaging station is constituted by a copy sheet transport, generally indicated at 38, which is pivotally mounted adjacent its bottom to copier side chassis members 40. When the transport 38 is swung inwardly from its position shown in FIG. 1 to an essentially vertical orientation, it accepts successive electrostatically charged copy paper sheets from the charging station 32 and conveys them downwardly along an image plane. When each copy sheet is properly positioned in the imaging station by transport 38, the image of the original document at the illuminating station 20 is projected onto its charged photoconductive surface pursuant to creating a corresponding electrostatic latent image. In the event of a paper jam in the area of the imaging station, access door 36 is opened, and the transport 38 is grasped via a handle 46 and swung outwardly to expose stranded sheets. Access door 36 is held in its closed position by magnetic catches 48, and an inter-lock switch 50 automatically disconnects electrical power when access door 36 is opened.

As will also be seen from the description to follow, access door 36 facilitates access to a development station, generally indicated at 52 and situated below the imaging station. The development station includes a developer tank 54 which may be slid bodily out of the open left end of housing 10 to permit convenient access to copy sheets stranded thereat.

Still referring to FIG. 1, the lower portion of front wall 12 is formed with an access opening 56 permitting access to a drying station, generally indicated at 58. Opening 56 is normally closed by a door 60. The ultimate destination of the copy sheets is a receiving compartment 62 located below the illuminating station 20 and accessible through an opening 64 in front wall 12.

As will be seen more clearly from FIG. 2, the copy paper feedpath is essentially U-shaped starting from the copy sheet supply 28 and terminating at the receiving compartment 62. It will be noted that copy paper supply 28, knife assembly 30 and corona charging station 32 are aligned in the upper horizontal leg of the U-shaped feedpath, and are fully accessible through access door 34. The vertical leg of this U-shaped copy sheet feedpath, which is constituted entirely by transport 38, is fully accessible when access door 36 and transport 38 are swung open. The lower horizontal leg of the copy sheet feedpath, which includes development station 52, drying station 58 and receiving compartment 62, is fully accessible either through access door 36, access door 50 of opening 64 in front wall 12.

Referring now to FIG. 2, the copy paper supply 28 is constituted by a roll 70 of copy paper carried on a spindle 72 mounted at each end by copier side frames. The copy paper roll 70 is preferably reversed wrapped such that the photoconductive coating faces outwardly and thus the web 74 of copy paper is withdrawn from the under side of the supply roll. The tendency of the leading edge and the trailing edge of a copy sheet produced by knife assembly 30 is to curl outwardly from the plane of its feedpath. In the event of a paper jam, the copy paper has a greater tendency to accumulate on the outboard side of its feedpath and thus be more conveniently accessible for removal. Also the outward curl tendency of the leading edge of the copy paper web insures successful transfer to and conveyance by the transport 38.

The web 74 of copy paper is withdrawn from the supply roll 70 over an idler roller 76 and a lower guide 77 by an initial pair of feed rollers 78a and 78b. The leading edge of the web is directed by upper and lower guides 80 between an upper stationary knife blade 82 and a lower rotatable knife blade 84 of knife assembly 30. Lower knife blade 84 rotates upwardly to sever the copy paper web 74 into successive sheet lengths.

As best seen in FIG. 3, a handle 86 is pivotally mounted on the end mounting shafts 88 for initial feed roller 78a. Handle 86 includes projections 89 extending beyond its mounting shafts 88 which, upon pivoting the handle upwardly as shown in phantom, act to depress lower initial feed roller 78b against springs 90 normally maintaining the initial feed rollers in peripheral engagement. There is thus created a gap between the initial feed rollers to facilitate the insertion of the leading edge of the paper web 74 therethrough and into alignment with the cutting edge of the upper knife blade 82. The handle 86 is then pivoted downwardly to its operative position, thereby releasing the lower initial feed roller 78b and springs 90 raise it into paper feeding engagement with upper initial feed roller 78a.

It is thus seen that the forced separation of the initial feed rollers induced by handle 86 conveniently facilitates the starting of a new copy paper supply roll 70 and further permits the accurate alignment of the leading edge of the paper web 74 with the cutting edge of the upper knife blade 82, which is its proper position for the start of each copy cycle. Thus, the first copy sheet run off after the starting of a new copy paper roll is an accurately sized, usable copy sheet. This is unlike current roll paper office copiers wherein an initial copy cycle must be initiated in order to achieve a precisely aligned leading paper web edge. If the leading edge of the paper web is irregular or jagged, it may be ad-

vanced beyond the upper fixed knife blade 82 and pulled upward against its cutting edge to create a true, accurately aligned leading edge.

It will be observed that these various operations performed manually by the operator and facilitated by the positioning of the copy paper supply 28 and the knife assembly 30 in close proximity to the top wall 18 of the copier housing 10 and the expanse of access opening 26 therein.

A second function of handle 86 is that of an "out of copy paper" switch actuator. As seen in FIG. 3 the portion of handle 86 extending transversely to the feedpath is formed with one or more downwardly extending projections 86a, each aligned with an annular groove 76a in idler roller 76. So long as the paper web 74 is trained over idler roller 76, the projections bear on the back surface of the copy paper and handle 86 is held in disengaged relation to an out of copy paper switch 91. When the supply of copy paper is exhausted or there is a breakage in advance of idler roller 76, the projections 86a fall into the annular grooves 76a in idler roller 76 and the handle 86 drops into engaging relation with the out of paper switch 91. This condition is indicated to the operator by energization of a single light included at the control panel 16 and subsequent copy cycles are inhibited.

Returning to FIG. 2, copy paper web 74 is advanced by initial feed rollers 78a and 78b, and its leading edge is directed by upper and lower guides 92 to the nip of a next feed roller pair 94. Beyond this feed roller pair, the copy paper passes between an upper corona charging unit 96 and a lower charging unit 98 of the charging station 32. As best seen in FIG. 4, lower unit 98 consists of a conductive shell 98a detachably mounted by and electrically grounded to the copier chassis. The upper edges of the front and back walls of the shell are flared outwardly to provide lips 98b which serve as lower entry and exit guides for the leading edge of the copy paper web 74. Tabs 98c formed in these entry and exit guide lips facilitate the stringing of an insulating monofilament strand 98d back and forth across the open mouth of shell 98a for maintaining the copy paper web in spaced relation to a pair of corona wires 99 strung between terminal blocks 99a at each end of conductive shell 98a.

The upper unit 96 of the corona charging station 32 likewise consists of a conductive shell 96a which is electrically grounded to the copier chassis. The front and back walls of the upper shell are formed with upper entry and exit flared guide lips 96b which cooperate with the lower guide lips 98b in directing the leading edge of the copy paper web 74 into and out of the charging station 32. Upper guide lips 96b are similarly formed with tabs 96c to facilitate the stringing of an insulating monofilament strand back and forth across the mouth of shell 96a so as to maintain the upper back side of the copy paper web 74 in spaced relation to a pair of corona wires (not shown) strung between the shell end walls. These exit guides are suitably coated with insulative material in order that the imposed surface charges are not dissipated to the upper and lower conductive shells.

In accordance with an important feature of the invention, the upper corona charging unit 96 is pivotally mounted by arms 100 to the end mounting shafts 102a for an upper feed roller 102 operating in conjunction with a lower feed roller 104 beyond the exit of the

charging station 32. The free ends of the mounting arms 100 are formed with keyhole slots 100a such that the upper corona charging unit 96 may be snap-fitted on the upper feed roller shafts 102a. Thus, the upper corona charging unit 96 is pivotally mounted to swing upwardly away from the lower corona charging unit 98, and is also readily removable for servicing. Moreover, the pivotal and detachable mounting of the upper corona charging unit 96 facilitates access to the lower corona charging unit 98 for servicing. Another important advantage to the pivotal mounting of the upper corona charging unit 96 is that it will yield in the event the copy paper web becomes jammed in the charging station 32. That is, if for some reason the leading edge of the copy paper web cannot exit from the charging station and the feed rollers in advance of the charging station continue to feed copy paper, the resulting buckling of the copy paper raises the upper corona charging unit 96. Thus damage to the charging station 32 is avoided and removal of the copy paper accumulated upstream of the charging station is facilitated. It will be noted that the opening 26 in top wall 18 of the housing 10 extends beyond the charging station 32, thus facilitating convenient access thereto.

From the description thusfar, it is seen that the enlarged opening 26 in the housing permits access to the entire upper leg of the U-shaped feedpath from the copy paper supply 28 to and beyond the charging station 32. Thus, the operator has complete access to this segment of the copy paper feedpath. Any jam of the copy paper feed beyond the initial feed rollers 78a and 78b may be readily cleared by breaking the copy paper web at the supply roll 70, lifting handle 86 to separate the initial feed rollers and then pulling the stranded portion of the web from the feedpath. If the jam occurs beyond the knife assembly 30, there will be one or more cut sheets backed up in front of the charging station 32 which may be readily removed. Once the jam is cleared, the copy paper web 74 is rethreaded through the initial feed rollers and, if necessary, a true leading edge can be created by manually severing the copy paper web on the cutting edge of the fixed knife blade 82 (FIG. 2). It will be noted that there is considerable space above and below this upper segment of the U-shaped copy paper feedpath to accommodate a considerable backup of copy paper without damage to any of the working components.

Returning to FIG. 2, the copy paper web 74 is drawn from the charging station 32 by feed rollers 102 and 104 and transferred to the paper transport 38 of the imaging station, generally indicated at 33 in FIG. 2. Transport 38, as best seen in FIGS. 5 through 7, is in the form of a vacuum conveyor having a mounting frame consisting of sides 110 and an interconnecting top 114. A frame mounted rear plate 112 is formed with a central aperture 112a about which is mounted a hood 116, which in turn mounts an electric fan 118.

Sides 110 are adapted to journal the ends of an upper roller 122 and a lower roller 124 which mount and drive a series of side by side conveyor belts 126. The inner reach of each of the conveyor belts 126 passes over a plate 128 mounted between frame sides 110. The conveyor belts are perforated, as indicated at 126a in FIG. 6, and the backing plate 128 is apertured in the belt underlying areas, as inciated at 128a, such that, upon energization of the fan 118, air is drawn through

the conveyer belt perforations and the backing plate apertures and out aperture 112a in rear plate 112.

The mounting shaft for upper roller 122 is extended through and beyond one of the frame sides 110, and a gear 122a is mounted on the end thereof. As seen in FIG. 7, the transport 38 is detachably pivotally mounted by pivot posts 130 to chassis sides 40. When the transport 38 is in its vertical, operative position, gear 122a assumes a position of meshing engagement with a gear 132 included in the main copier drive train. Thus, as long as the copier is turned on, gear 132 is driven, which, in turn, rotates gear 122a and rollers 122 and 124 to move the inner reach of the perforated conveyor belts 126 downwardly across the aperture plate 128, as seen in FIG. 5.

The vertical, operative position of transport 38 is releasably maintained by the engagement of spring arms 134 carried by each frame side 110 with catch posts 136 carried by each chassis side 40. It is further seen from FIGS. 2 and 7 that, when the transport 38 is in its vertical, operative position, a guide 114a integrally formed with frame top 114 is in position to divert the leading edge of the copy paper web 74 exiting from feed rollers 102 and 104 downwardly onto the moving conveyor belts 126. Due to the partial vacuum created by fan 118, the copy paper is held against the conveyor belts 126 and pulled downwardly thereby through the imaging station. The outward curl tendency of the paper web leading edge insures that it is immediately picked up and conveyed by transport 38.

As will become apparent from the description of the optical system to follow, the conveyor belts moving over apertured backing plate 128 define the image plane of the imaging station 33 along which the copy paper is conveyed. At a predetermined point during the progression of the leading edge of the copy paper web 74 through the imaging station, the knife apparatus 30 is triggered to sever the copy paper web into a discrete sheet. As will be described subsequently, when the leading edge of the now segmented copy paper web reaches the point in the imaging station when the trailing edge has moved onto the conveyor belts 126, and the entire copy paper sheet becomes properly aligned in the image plane, the leading sheed edge engages an actuating arm 140 of a microswitch 142. The resulting actuation of microswitch 142 initiates the illumination of the original document image at the illuminating station 20 and the projection of the reflected document image onto the electrostatically charged surface of the photoconductive coating on the copy paper sheet creates a corresponding electrostatic latent image.

It is apparent that should a paper jam occur in the imaging station 33, the operator merely opens access door 36 and grasps handle 46 to swing the upper end of transport 38 outwardly away from the image plane to expose the one or more copy paper sheets stranded thereat. It will also be appreciated that the swinging of the transport 38 away from the imaging plane also exposes the leading edge portion of copy paper extending downstream of feed rollers 102 and 104 beyond the exit of the charging station 32 and the trailing edges of copy sheets extending upstream from development station 52. In other words, the entire vertical segment of the U-shaped copy sheet feedpath is rendered accessible through the open end of the copier housing once the transport 38 is swung outwardly away from the image plane of the imaging station 33.

Also accessible through this open end of the copier housing 10, once access door 36 is opened, is development station 52. The development station is of modular design which includes a developer tank 54, as best seen in FIGS. 2 and 7. The developer tank contains liquid toner for visibly developing the latent electrostatic image created on the copy paper sheet and is preferably adapted to mount the various components typically associated with liquid development stations. Thus, the development tank 54 may be adapted to mount an agitator for maintaining toner particles properly dispersed in the liquid vehicle, a toner density control which monitors the liquid toner pursuant to initiating and controlling the addition of toner concentrate or replenisher, etc. As specifically shown in FIGS. 2 and 7, developer tank 160 is preferably adapted to mount an intensifier electrode 162 which is in the form of an electrically conductive, rotatably mounted roller. The intensifier electrode 162 is accommodated in a laterally extending trough 164 having an arcuate bottom surface which serves as a guide for the copy paper sheets as they pass through the development station 52. The sides of the trough are extended upwardly to serve as an entry guide 164a for guiding the leading edge of each copy paper sheet exiting the transport 38 along the trough bottom and under the intensifier electrode 162 and an exit guide 164b adapted to direct the leading edge of the copy sheet exiting from the developing station into the nip of feed roller pair 166. Again the outward curl tendency of the sheet leading edge insures that it passes under the intensifier electrode. Preferably, the development station also includes pumping means mounted by the developer tank for circulating developer fluid from the developer tank proper, which serves as a sump, into the trough, from which it draws slowly back into the tank. Thus the copy paper is submerged in liquid toner as it passes under intensifier electrode 162.

In order to insure proper development of the latent electrostatic image on the copy sheet, it is preferable to rotate the intensifier electrode 162. To this end, a stub shaft extending from one end of the intensifier electrode carries a gear 168, as seen in FIG. 7, which engages a gear 170, included in the copier drive train, when the developer tank 54 is in its operative position.

In accordance with the present invention, the developer tank 54 merely rests on the floor 172 of the copier chassis. Thus, the developer tank may be readily slid outwardly through the open end of the copier housing to facilitate servicing and the extraction of copy sheet stranded thereat. The only linkages between the development station 52 and the copier proper are the meshing engagement between gears 168 and 170 and the requisite electrical linkage through flexible conductors to the various electrical components of the development station. Thus, the development station can be partially removed from the copier or completely, bodily removed upon disconnection of the electrical link between it and the copier proper. The return of the development station to its operative position is guided by the chassis sides 40 and an abutment 174 which, when engaged by the back wall of the development tank 54 assures that gears 168 and 170 are in engagement and that entry and exit guides 164a and 164b are properly positioned relative to the transport 38 and the feed roller pair 166, respectively. Rotation of intensifier electrode 162 facilitates the cleaning of its periph-

ery by a wiper 182 mounted to partition 180. Also, the rotation of the intensifier electrode helps to prevent paper jams in the development station. In fact, a short copy sheet lodged in the development station is typically picked up and carried out by the next full length sheet. An additional wiper 183 cleans the upper feed roller of the pair 166.

From the development station, the copy paper sheets are deposited by feed roller pair 166 onto a conveyor consisting of a pair of longitudinally spaced, laterally extending driven shafts 186, each mounting a series of laterally spaced pulleys 187. The pulleys mount O-ring belt loops 188 which serve as a belt conveyor for transporting the copy paper sheets through drying station 58. Immediately above and coextensive with the length and width of this belt conveyor is a plenum chamber defined by partition 180 and a perforated discharge plate 190. A blower 192 supplies air into this plenum chamber which is then discharged through the perforations 190a in plate 190 to subject the copy sheets to drying air as they travel through the drying station.

At the exit end of this conveyor, is a shaft 194 mounted immediately above shaft 187. This shaft 194 carries a series of discs 196 which are positioned between belt pulleys 187 and are dimensioned as such that their peripheries project below the plane of travel of the copy sheets on belts 188. Thus, as the copy sheets exit from the belt conveyor into the receiving compartment 62, the individual sheets are deformed into a corrugated configuration thereby imparting a measure of longitudinal rigidity to the copy sheets as they pass into the receiving department. This serves to prevent copy sheets from buckling over and thus not properly stack in the receiving compartment. To further insure that the copy sheets are stacked properly in the receiving compartment 62, a series of elongated fingers 197 are loosely, pivotally mounted on shaft 194. The copy sheets as they leave the drying station conveyor pass under these fingers 197 to further insure that they will not buckle despite the natural curl imparted to them during storage on supply roll 70. Alternatively, the discharge plate 190 may be perforated as indicated at 190b in the area overlying receiving compartment 62 to allow the air discharging therefrom to perform the function of fingers 197 in insuring proper stacking of the copy sheets.

It will be appreciated that in the event of a paper jam in the drying station, full access thereto is afforded through door 60 and housing opening 56. Thus, the entire lower horizontal segment of the U-shaped copy paper feedpath is accessible either through door 36 and upon removal, if necessary, of the development tank and access door 60.

Yet to be described is the optical system for, in effect, transferring the original document image to the copy sheet. Preferably, this is accomplished while the copy sheets are in transit through the imaging station. To this end, the original document while situated at the illuminating station is illuminated by a plurality of flash tubes 210, preferably xenon filled, which are strategically positioned below and to the sides of the illuminating station to uniformly illuminate the entire original document image to be copied through the transparent bed plate 22. The full original document image is reflected as a unit from the illuminating station downwardly to a mirror 212 which redirects it horizontally to projection optics, generally indicated at 214. The

image is then projected onto the copy sheet lying centered in the image plane at the imaging station 33. As previously noted, the arrival of each copy sheet at the appropriate imaging position is signaled by the actuation of microswitch 142 by the leading edge of a copy sheet which initiates firing of the flash tubes 210. The intensity and short duration of the illumination generated by these flash tubes is such that the movement of a copy sheet through the imaging station is frozen, and thus the latent electrostatic image created on its photoconductive surface is sharp and clear upon development at the development station.

From the foregoing description, it is seen that the disclosed electrophotographic apparatus is an improved design eminently suited for customer serviceability. Moreover, the use of flash illumination to transfer the original image to a copy sheet while the latter is in transit through the image station permits extremely high copy rates. Synchronism of the scanning of an original with the movement of a copy sheet is achieved quite simply, reliably and inexpensively by the tripping of microswitch 142. Thus no stringent controls of the movement of the copy paper along its feedpath are required; imaging being initiated merely upon arrival of a copy sheet at the appropriate imaging position in the imaging station.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. Electrophotographic apparatus comprising, in combination:

- A. a generally rectangular housing;
- B. an illuminating station accommodated in the top of said housing, said illuminating station including a transparent bed plate on which an opaque original is placed face down;
- C. a copy sheet supply positioned adjacent the top of said housing laterally of said illuminating station;
- D. a charging station for imposing a uniform electrostatic charge on copy paper fed from said copy sheet supply;
- E. an imaging station including
 1. a vertically oriented image plane, disposed in adjacent relation to a side of said housing
 2. a vacuum conveyor for transporting successive copy sheets from said charging station downwardly in said image plane, and
 3. means pivotally mounting said conveyor adjacent its lower end,
 4. a door providing access through an opening in said housing side to permit manually induced outward swinging movement of the upper end portion of said conveyor about said pivotal mounting means through said opening to expose said imaging plane,
 1. whereby to facilitate access to copy sheets stranded in said imaging station without dismounting said conveyor;
- G. a development station positioned below said imaging station adjacent the bottom of said housing to

accept copy sheets from said conveyor, said development station including a developer tank slidably mounted on the floor of said housing for convenient partial withdrawal through said opening to facilitate access to copy sheets stranded therein;

H. a receiving compartment positioned generally below said illuminating station adjacent the bottom of said housing for accumulating successive copy sheets;

I. a drying station extending along the bottom of said housing and including a transport for conveying copy sheets from said development station to said receiving compartment;

J. means forming an opening in another side of said housing for convenient access to copy sheets stranded in said drying station; and

K. an optical system including

1. at least one lamp positioned below said illuminating station for illuminating an original thereat, and

2. projection optics for projecting the image reflected downwardly from the illuminated original generally horizontally between said copy sheet supply and charging station adjacent the top of said housing and said drying and development stations adjacent the bottom of said housing onto a copy sheet at said imaging station;

L. wherein the copy paper feed path from said supply to said receiving compartment is essentially U-shaped and consists of an upper horizontal segment including said copy sheet supply and charging stations, a vertical segment including said imaging station, and a lower horizontal segment including said developing means, said drying station, and said receiving compartment.

2. The apparatus defined in claim 1, wherein said charging station includes upper and lower corona charging units between which the copy sheets pass, said upper unit being pivotally mounted to swing upwardly away from said lower unit.

3. The apparatus defined in claim 1, wherein said copy sheet supply includes a supply roll of copy paper and a knife assembly for severing the copy paper into separate sheets, and the copy paper is withdrawn from the underside of said supply roll.

4. The electrophotographic apparatus defined in claim 1, wherein said development station further includes an intensifier electrode rotatably mounted by said tank and a driven gear mounted to said intensifier electrode, said driven gear engaging a drive gear in the apparatus main train when said tank is slid inwardly to its operative position.

5. The electrophotographic apparatus defined in claim 1, which further includes a plenum chamber overlying said drying station and said receiving compartment, said plenum chamber having a perforated discharge face for directing air on copy sheets as they are conveyed through said drying station and as they exit into said receiving compartment to insure proper stacking thereat.

6. The apparatus defined in claim 1, wherein said lamp is a flash tube, said apparatus further including switching means mounted by said vacuum conveyor in a position to be actuated by the leading edge of a copy sheet upon its assumption of an appropriately aligned position in said image plane, said switching means operating upon actuation to initiate firing of said flash

lamp, whereby to image a copy paper sheet while in transit through said imaging station.

7. Electrophotographic apparatus comprising, in combination:

- A. a generally rectangular housing; 5
- B. an illuminating station accommodated in the top wall of said housing, said illuminating station including a transparent bed plate on which an opaque original is placed face down;
- C. a copy sheet supply positioned laterally of said illuminating station adjacent said top wall, said supply including 10
 - 1. a supply roll of copy paper,
 - 2. a knife assembly for severing the copy paper into separate sheets, 15
 - 3. a pair of initial feed rollers located between said supply roll and said knife assembly for withdrawing copy paper,
 - 4. a handle member pivotally mounted to one roller of said pair and being operable, when manually pivoted upwardly, to produce forced separation of said feed roller pair and thereby facilitate insertion therebetween of a web of copy paper withdrawn from said supply roll, 20
 - 5. an out-of-paper switch, 25
 - 6. an idler roller over which the web of copy paper is drawn from said supply by said initial feed roller pair, said idler roller having an annular groove formed therein, and
 - 7. a projection carried by said handle and bearing against the back of the paper web in overlying relation with said annular groove such that, in the absence of the copy paper web, said projection falls into said groove and said handle drops into actuating engagement with said switch; 30
- D. means forming an opening in said top wall of said housing facilitating access to said copy sheet supply; 35
- E. an imaging station positioned adjacent a first side of said housing; 40
- F. means forming an opening in said first side of said housing facilitating access to said imaging station;
- G. a charging station intermediate said copy sheet supply and said imaging station; 45
- H. paper transport means for transporting successive copy sheets from said copy sheet supply received via said charging station downwardly through said imaging station, and means pivotally mounting said transport means to swing outwardly through said first side opening and expose a copy sheet stranded in the vicinity of said imaging station; 50
- I. developing means positioned below said imaging station to accept copy sheets from said transport means, and means mounting said developing means for outward movement through said first side opening to expose copy sheets stranded thereat; 55
- J. a receiving compartment positioned generally below said illuminating station adjacent the bottom of said housing for accumulating successive copy sheets for ultimate removal by the operator; 60
- K. a drying station extending along the bottom of said housing and including a conveyor for conveying copy sheets from said developing means to said receiving compartment
- L. means forming an opening in a second side of said housing facilitating access to copy sheets stranded in said drying station; and 65

M. an optical system including

- 1. at least one lamp positioned below said illuminating station for illuminating an original thereat, and
 - 2. projection optics for projecting the image reflected from the illuminated original downwardly and then generally horizontally between said copy sheet supply and said drying station and said developing means onto a copy sheet at said imaging station.
8. Electrophotographic apparatus comprising, in combination:
- A. a generally rectangular housing;
 - B. an illuminating station accommodated in the top of said housing, said illuminating station including a transparent bed plate on which an opaque original is placed face down;
 - C. a copy sheet supply positioned adjacent the top of said housing laterally of said illuminating station;
 - D. a charging station for imposing a uniform electrostatic charge on copy paper fed from said copy sheet supply;
 - E. an imaging station including
 - 1. a vertically oriented image plane;
 - 2. a vacuum conveyor for transporting successive copy sheets from said charging station downwardly in said image plane,
 - 3. means pivotally mounting said conveyor for swinging movement away from said image plane and out of a side of said housing, and
 - 4. a driven gear mounted by said conveyor for meshing engagement with a drive gear in the apparatus main drive train while said conveyor is aligned with said image plane, said driven gear disengaging from said drive gear incident to swinging said conveyor away from said image plane to facilitate access to copy sheets stranded at said imaging station;
 - F. a development station positioned below said imaging station adjacent the bottom of said housing to accept copy sheets from said conveyor, said development station removably mounted in said housing to facilitate access to copy sheets stranded thereat;
 - G. a receiving compartment positioned generally below said illuminating station adjacent the bottom of said housing for accumulating successive copy sheets;
 - H. a drying station extending along the bottom of said housing and including a conveyor for conveying copy sheets from said development station to said receiving compartment; and
 - I. an optical system including
 - 1. at least one lamp positioned below said illuminating station for illuminating an original thereat, and
 - 2. projection optics for projecting the image reflected downwardly from the illuminated original generally horizontally between said copy sheet supply and charging station adjacent the top of said housing and said drying and development stations adjacent the bottom of said housing onto a copy sheet at said imaging station.
9. The electrophotographic apparatus defined in claim 8, wherein said conveyor mounts a guide positioned, when said conveyor is aligned with said image plane, to direct the leading edge of the copy paper exit-

ing in a horizontal plane from said charging station downwardly onto said conveyor.

10. Electrophotographic apparatus comprising, in combination:

- A. a generally rectangular housing; 5
- B. an illuminating station accommodated in the top of said housing, said illuminating station including a transparent bed plate on which an opaque original is placed face down; 10
- C. a copy sheet supply positioned adjacent the top of said housing laterally of said illuminating station, said copy sheet supply including a supply roll of copy paper, a knife assembly for severing the copy paper into separate sheets, a pair of initial feed rollers located intermediate said supply roll and said knife assembly, a handle pivotally mounted to one roller of said feed roller pair, said handle including a projection extending beyond its pivotal mounting for engaging the other roller of said feed roller pair to produce a forced separation of said feed roller pair when said handle is manually pivoted upwardly to facilitate the insertion of a web of copy paper withdrawn from said roll, an out-of-paper switch, an idler roller over which the web of copy paper is drawn from said supply roll by said initial feed roller pair, said handle having at least one projection for bearing against the back of the copy paper web in overlying relation with an annular groove formed in said idler roller, whereby, in the absence of the copy paper web, said projection falls into said groove and said handle drops into actuating engagement with said switch; 20 25 30
- D. a charging station for imposing a uniform electrostatic charge on copy paper fed from said copy sheet supply; 35

- E. an imaging station including
 - 1. a vertically oriented image plane;
 - 2. a vacuum conveyor for transporting successive copy sheets from said charging station downwardly in said image plane, and
 - 3. means pivotally mounting said conveyor for swinging movement away from said image plane and out of a side of said housing,
 - 4. whereby to facilitate access to copy sheets stranded at said imaging station;
- F. a development station positioned below said imaging station adjacent the bottom of said housing to accept copy sheets from said conveyor, said development station removably mounted in said housing to facilitate access to copy sheets stranded thereat;
- G. a receiving compartment positioned generally below said illuminating station adjacent the bottom of said housing for accumulating successive copy sheets;
- H. a drying station extending along the bottom of said housing and including a conveyor for conveying copy sheets from said development station to said receiving compartment; and
- I. an optical system including
 - 1. at least one lamp positioned below said illuminating station for illuminating an original thereat, and
 - 2. projection optics for projecting the image reflected downwardly from the illuminated original generally horizontally between said copy sheet supply and charging station adjacent the top of said housing and said drying and development stations adjacent the bottom of said housing onto a copy sheet at said imaging station.

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