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Reick et al.

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[54] **HAND-FED ELECTROPHOTOGRAPHIC COPIER**

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[52] **U.S. Cl.** **355/8**, 355/51

[51] **Int. Cl.** **G03g 15/12**

[58] **Field of Search** 355/67, 8, 51, 3, 355/10, 18, 27, 66, 50

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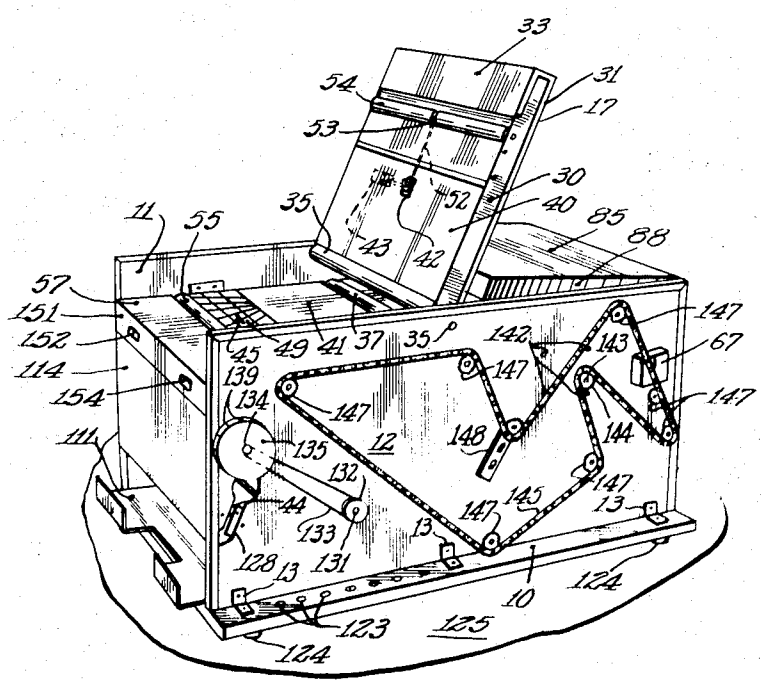
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[57] **ABSTRACT**

A hand-fed electrophotographic copier cabinet has vertically aligned front entrances into copy sheet and document original guide passageways with respective conveyor rollers located to receive the respective edges of the copy and document at the same distance into the respective passages, with the document tripping a switch to illuminate a scanning aperture as the document approaches such aperture and the copy sheet approaches an exposure aperture while passing through an electrostatic charging device. The document maintains the switch closed until both the document and the copy sheet have left their respective apertures. An upper front cover serves as a document feed table and also as part of the document guide means carrying the control switch, idler rollers and a hold-down plate over the exposure aperture, and is mounted to be opened for immediate access to the document passage for any reason such as jamming difficulty. The exposed copy sheet travels through a developer tray, subsequent squeeze rollers and down a chute to a receiving point at the lower front of the cabinet while passing through a circulation of drying air and a set of copy sheet pacing rollers. At the upper rear and at the back of the cabinet respective covers enable ready access to the copy sheet transport and treatment area of the cabinet.

17 Claims, 6 Drawing Figures



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SHEET 1 OF 3

Fig. 1

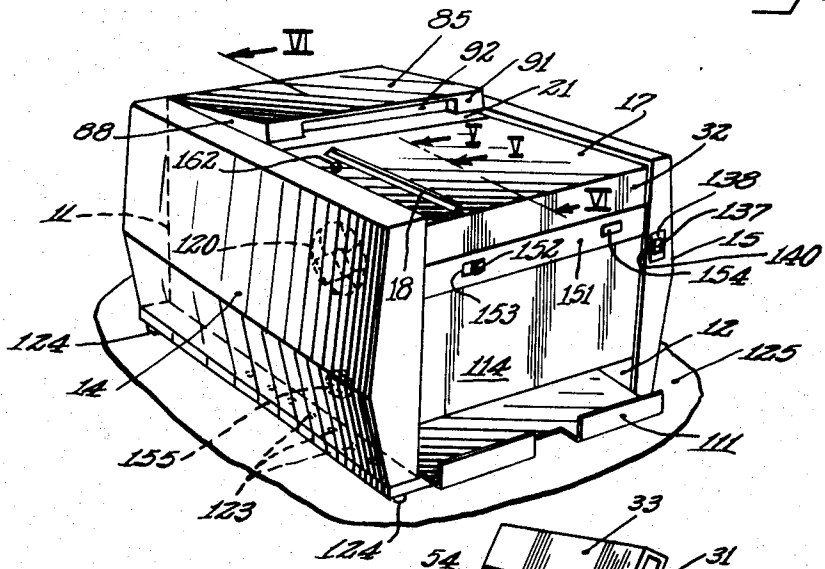
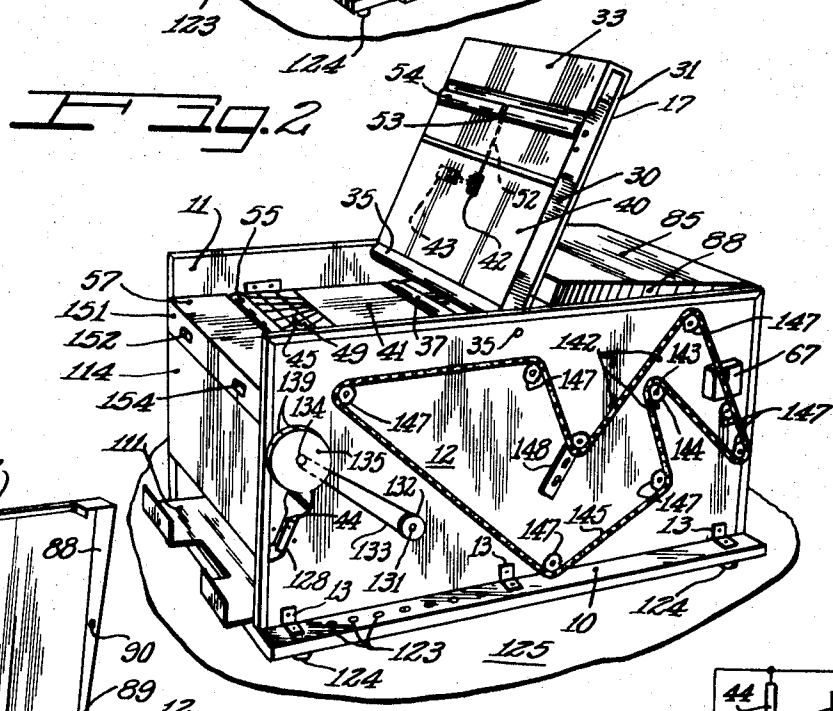


Fig. 2



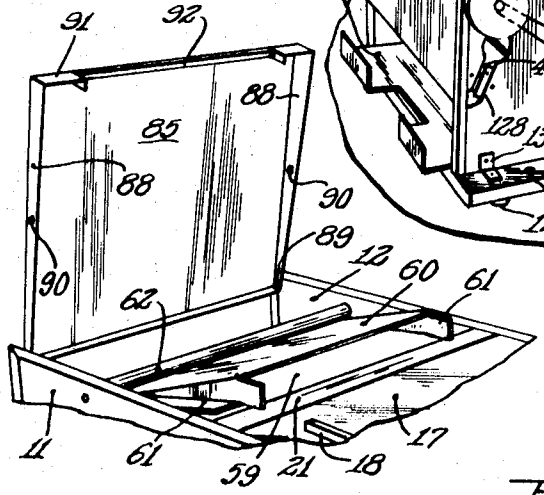


Fig. 3

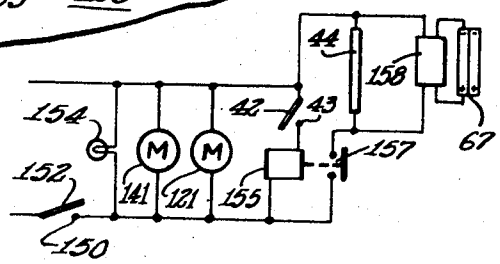


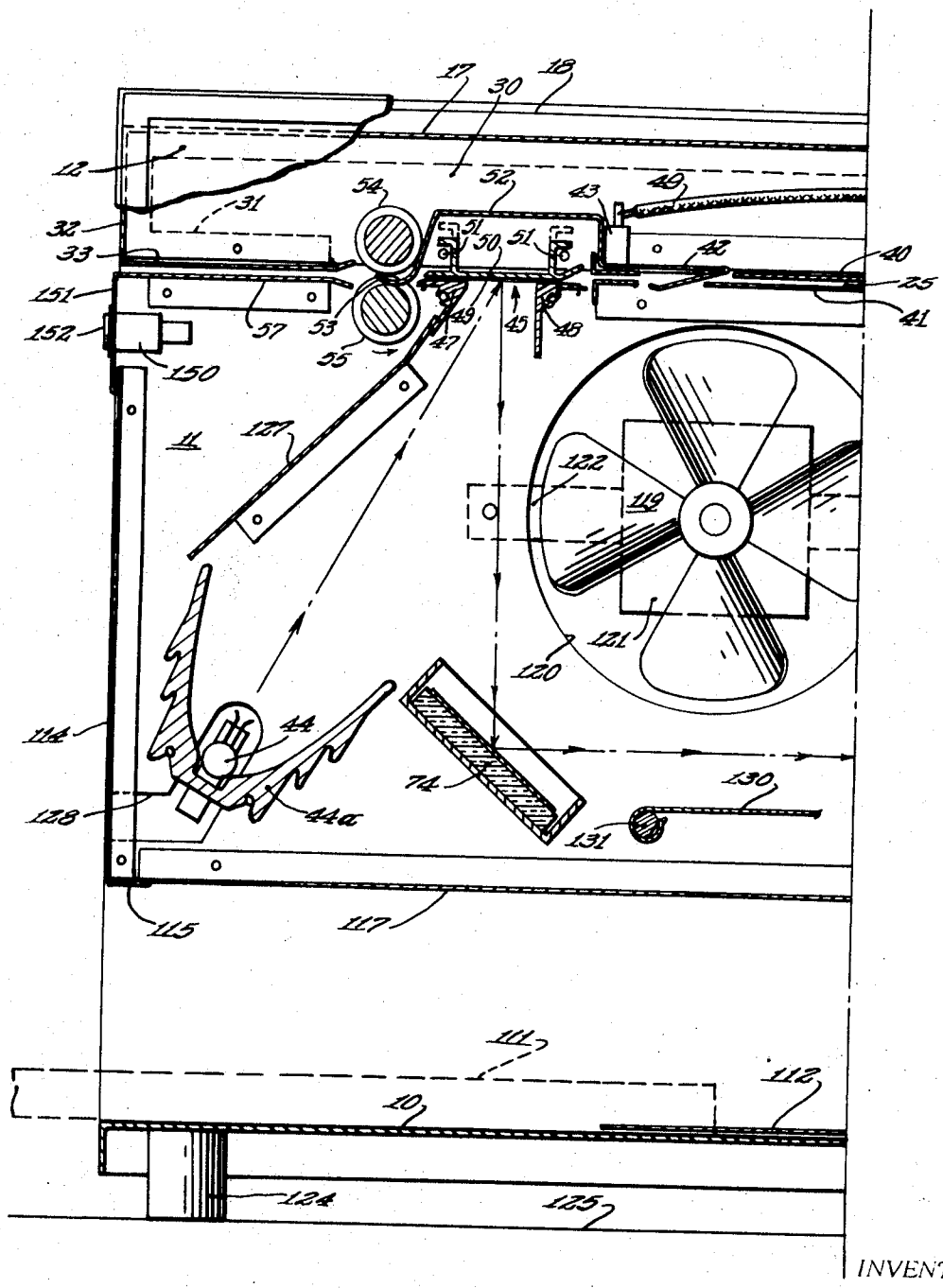
Fig. 4

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Fig. 5



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SHEET 3 OF 3

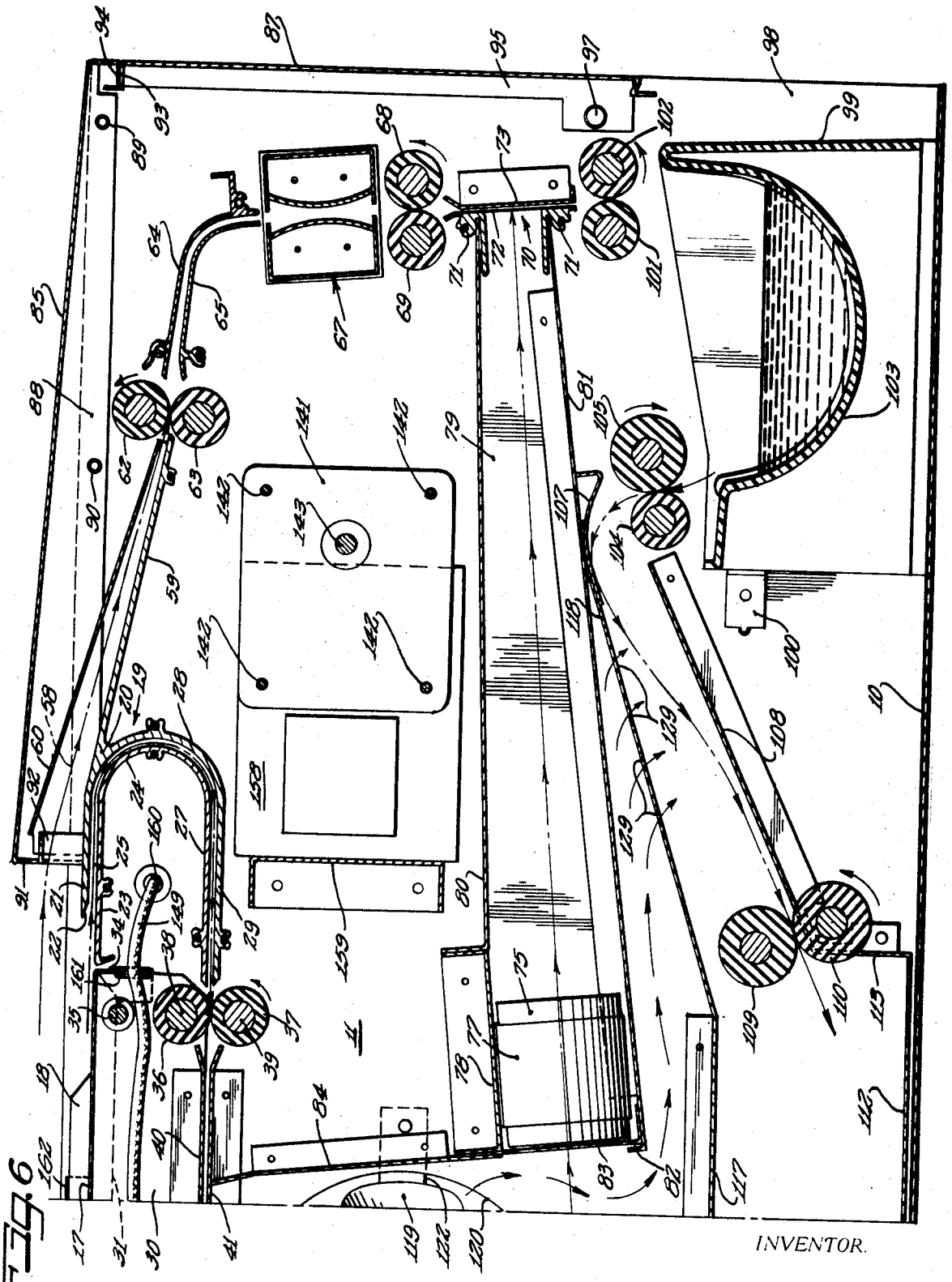


FIG. 6

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HAND-FED ELECTROPHOTOGRAPHIC COPIER

This invention relates to a novel hand-fed copying machine and is more particularly concerned with the provision of a small, compact desk model electrophotographic coper.

Efficient, high-speed and relatively large capacity copying machines have heretofore been provided, including so-called desk model types, of which U.S. Pat. No. 3,345,926 issued Oct. 10, 1967 and assigned to the same assignee as the present application is a prime example and it will be recognized that in general organization, the machine of the present application follows certain desirable features of the patented disclosure.

In those machines which embody a magazine for a substantial supply of copy sheets either in a stack of separate sheets or a roll from which the sheets are cut as used, some sort of feeding device and means for controlling the feeding device for synchronization of movement of the copy sheets with the documents must be provided and accounts for a considerable portion of the original cost of such a machine.

Another substantial cost factor in prior machines of the electrostatic type has been in the copy sheet developing feature, being more costly where fusion heat setting of the developer power has been employed, but also where liquid developer has been employed using pumping means for supplying a so-called toner tray from a liquid developer tank.

Where large production of copies is required such prior machines have supplied a definite need within the range of economics for such capacity as evidenced by the rather large number of machines of this type which have been absorbed by the market. On the other hand, a large market for machines of this general type exists in which the more expensive machines are not warranted because of the relatively low volume of copies required, but where the convenience of such a copier for the occassional or relatively low volume copy demand is desirable. For this market an electrostatic copier stripped down to its bare essentials will suffice and hand feeding of copy sheets is readily tolerated. A frequently bothersome problem in prior machines has been the relative difficulty or at least inconvenience in gaining access to especially the passageway and guidance system for the document original in the event of jamming for any reason.

Among important objects of the present invention is the provision of a new and improved copying machine of simplified, compact, rugged and efficient construction having desirable features of easy hand feeding of documents and copy sheets, speedy operation, ready and convenient access-ibility, and low original cost as well as low operating cost.

Another object of the invention is to provide new and improved means for synchronizing movement of documents to be copied and copy sheets in a hand-fed electrophotographic copier.

A further object of the invention is to provide a new and improved simplified means for operating an electrophotographic copier.

Still another object of the invention is to provide a novel combination cover, table and document guide structure for copying machines.

Yet another object of the invention is to provide new and improved means for hand feeding of copy sheets in a copying machine.

A still further object of the invention is to provide new and improved means for handling and drying of copy sheets after leaving a liquid toner developer.

A further object of the invention is to provide new and improved air circulation means in an electrophotographic copying machine.

Other objects, features and advantages of the invention will be readily apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure, and in which:

FIG. 1 is a perspective view of a copying machine embodying features of the invention;

FIG. 2 is a side perspective view of the machine showing the combination cover, table and document guide in open position and showing one side cover of the machine removed;

FIG. 3 is a fragmentary perspective view of the rear top portion of the machine;

FIG. 4 is a schematic electrical diagram;

FIG. 5 is an enlarged illustrative fragmentary vertical sectional detail view taken substantially along line V—V of FIG. 1; and

FIG. 6 is an enlarged fragmentary vertical illustrative sectional detail view taken substantially along line VI—VI of FIG. 1.

A copying machine embodying features of the invention is housed within a cabinet comprising base **10** desirably in the form of a horizontal panel. Inset from longitudinal edges of the base panel and extending vertically therefrom and desirably coextensive in length therewith are respective left-hand and right-hand rectangular supporting panels **11** and **12** attached to the base panel as by means of angle brackets **13**. Supported on the laterally outwardly extending longitudinal portions of the base panel **10** and enclosing and suitably attached to the respective supporting panels **11** and **12** are removable side closure panels or covers **14** and **15** respectively which enclose respective mechanism and air circulation chambers at the outer sides of the supporting panels. On and between the supporting panels **11** and **12** are various stationary and movable parts useful in the operation of the machine. Between the upper marginal portions of the panels **11** and **12**, means are provided for hand feeding of each respective document to be copied together with an aligned copy sheet into the machine wherein they respectively travel through a scanning path and an exposure path. To this end, there is provided on the front top portion of the cabinet a feed table **17** having along one side an upstanding longitudinally extending paper edge guide **18**, desirably in the form of a bar located along the left side portion of the table. Thereby, a matching or aligned set of a document to be copied face up and a copy sheet with its sensitizable face down on the document may be manually moved rearwardly along the table **17** with their left side longitudinal edges squared up against the guide **18** and either their front or rear edges substantially aligned. At the rear end of the table **17**, the advancing rear ends of the document and copy sheet are separated and thrust by the manual advance into their separate paths, the entrances to which are defined by a combination separating and guiding structure **19** (FIGS. **1** and **6**). This comprises a member **20**, which may be an aluminum extrusion secured to and between

the side panels 11 and 12. Projecting forwardly on the member 20 is a horizontal divider blade portion 21 lying suitably above the plane of the table 17 and having a rearwardly and downwardly chamferred lead-in surface 22 on its forward lip end cooperating with an underlying portion 23 extending rearwardly as an extension of the feed-in table surface on a document guide member 24 which may also be an aluminum extrusion secured to and between the side panels 11 and 12. Through this arrangement, the guide portions 21 and 23 provide an entrance into and the first portion of a scanning guide passageway or path 25 for the document to be copied, the guide portion 23 desirably projecting forwardly a limited distance from the mouth of the passageway and with its end in closely adjacent relation to the inner end of the table 17 so that there will be minimum possibility of the leading end of the document slipping into the joint between such ends during manual feed-in movement. From the inner end of the guide portion 23, the member 24 extends on a semi-circular radius downwardly and forwardly and has a forwardly extending guide portion in spaced parallel relation below the guide portion 23 and cooperates with complementary coextensive semi-circular and forwardly extending guide portions 28 and 29 on the member 20 to provide a turnaround passage continuation of the guide passageway 25.

Advantageously, the table 17 provides also an upper front access cover and provides document guide means in continuation of the passageway 25 provided by the guide assembly structure 19. To this end, the table comprises a top panel having opposite side coextensive longitudinal panels 30 secured thereto through angular attachment flanges 31 along the side edges of the top panel and along the sides of an integral downward front panel extension 32 on the front end of the top panel having a rearwardly extending document guide panel extension 33 and providing under the top panel and between the side panels 30 and the front panel 32 a box-like hollow space. Within a rear upper corner defined between the panel 17 and a downwardly extending rear panel extension 34 is a transverse shaft 35 by which the table, cover, panel structure is hingedly mounted between the cabinet body side panels 11 and 12 for swinging between closed position as shown in FIGS. 1, 5 and 6 and an open position as shown in FIG. 2.

From the inner exit end of the portion of the document scanning guide passageway 25 in the guide assembly 19, the document follows the directional arrow path into the nip of cooperating upper and lower rollers 36 and 37, respectively. While the roller 36 idles on a shaft 38 extending between and journalled on the lower inner end portions of the side panels 30, the roller 37 is carried on a shaft 39 which extends between and is journalled on the cabinet panels 11 and 12 and is driven to advance the document when engaged between the rollers. From the rollers 36 and 37, the advancing document enters and is projected through a continuation of the guide passageway 25 provided between a pair of spaced parallel and substantially coextensive guide plates 40 and 41 of which the plate 40 is mounted on and between the cover side panels 30 and the plate 41 is mounted on and between the cabinet side panels 11 and 12.

At a suitable point in its advance between the guide plates 40 and 41, the leading end of the document engages and lifts a trip arm 42 (FIGS. 2 and 5) which closes a normally open switch 43 and thus an electrical circuit to energize and activate a scanning illumination lamp 44 mounted in a reflector 44a secured to and between the cabinet panels 11 and 12 below and forwardly from a scanning aperture 45 toward which the reflector is beamed and which is located a limited distance forwardly from the point at which the switch arm 42 is tripped.

Desirably, the scanning aperture 45 is defined between a pair of spaced parallel transverse front and rear aperture frame bars 47 and 48, respectively, which may be aluminum extrusions and are mounted on and between the cabinet support plates 11 and 12, with the aperture gap between the bars bridged by suitable anti-deflection guide strands in a known manner. Opposing the aperture bars 47 and 48, and more particularly the guide strands 49 to assure flat planar movement of the document across the aperture is a downwardly, and in this instance gravitationally, biased hold-down guide plate 50 vertically movably supported by and between the cover side plates 30 as by means of pins 51 carried thereby and enabling a substantial range of vertical movement as indicated between full line and dash line positions in FIG. 5. Such a hold-down plate arrangement may be in accordance with U.S. Pat. No. 3,424,529, issued Jan. 28, 1969. In order to maintain the switch 43 closed until the trailing end of the document has left the scanning aperture 45, the switch actuating arm 43 has an extension 52 which arches over the floating holddown plate 50 and has a trip arm portion 53 extending downwardly forwardly adjacent to the scanning aperture in the path of forward movement of the document.

As the document leaves the scanning aperture 45, it is engaged between and advanced by cooperating upper and lower rollers 54 and 55 respectively of which the upper is an idler carried by and between the cover side plates 30 and the lower is power driven in synchronism with the roller 37. From the rollers 54 and 55 the document is advanced forwardly through the final portion of the document guide passageway provided between the rearward extension flange plate 33 and a confronting spaced parallel guide plate 57 thereunder mounted on and between the cabinet plates 11 and 12. Thence, the document exits from the front of the machine cabinet and is retrieved by the user.

Travel of the matching copy sheet along a path in a guide passageway 58 is synchronized with its document along its passageway 25. To this end, the guide member 19 has a rearwardly and downwardly extending copy guide ramp extension 59 on which is mounted a guide plate 60 which converges from a front end spaced above the divider blade portion 21 to the rear end portion of the ramp 59 providing, in effect, a throat in which the leading end portion of the copy sheet is received. At its sides the guide plate 60 has angular paper guide and mounting flanges 61 which are secured to the top of the ramp extension 59 with the left-hand flange aligned with the edge guide bar 18.

From the rear end of the passageway throat, the copy sheet enters the nip of upper and lower advancing rollers 62 and 63, respectively, the shafts of which extend between and are journalled on the cabinet side plates 11 and 12, with the upper roller 62 driven in synchronism with the rollers 37 and 55 and the lower roller 63 an idler. The distance from the edge of the divider blade portion 21 to the rollers 62 and 63 is substantially

the same as the distance from such edge to the document advancing rollers **36** and **37** so that as the copy sheet and document are manually thrust into their respective passageways their leading ends will reach the respective sets of advancing rollers as nearly as practicable at the same time.

From the rollers **62** and **63** the copy sheet is advanced through a continuation of the guide passageway **58** between a pair of substantially coextensive confronting spaced upper and lower guide plates **64** and **65**, respectively, which may be in the form of aluminum extrusions and are mounted on and between the cabinet panels **11** and **12**. These guide plates are turned downwardly at their rear end portions to guide the copy sheet into and through a corona discharge or charging device **67** shown more or less schematically in FIG. **6** and which may embody structure and function in the manner described and covered in U.S. Pat. Nos. 3,276,773 and 3,277,298, both issued Oct. 4, 1966. The corona charging device **67** is desirably energized by closing of the switch **43** by the advancing document while the leading end portion of the copy sheet is still in the charging zone of the device **67**, and energization of the device continues at least until the trailing end of the copy sheet has passed through the charging zone.

From the corona device **67**, the electrostatically charged copy paper enters the nip of conveyor rollers **68** and **69** mounted rotatably on and between the cabinet panels **11** and **12** and one of which such as the roller **68** is driven synchronously with the rollers **62** and **63**. The rollers **68** and **69** guidingly direct the copy sheet to travel across an exposure aperture **70** defined between a pair of spaced parallel frame bars **71** having suitable anti-deflection strands **72** thereacross and with a backing guide plate **73** confronting the aperture bars and the aperture, and mounted on and between the panels **11** and **12**.

As the copy sheet traverses the exposure aperture **70**, the image to be impressed on the electrostatically charged surface of the copy sheet from the document original is optically transferred by means of a tilted reflecting mirror **74** carried on and between the cabinet panels **11** and **12** rearwardly adjacent to the reflector **44** and under the scanning aperture **45** to receive the image therefrom and reflect the same rearwardly through a lens assembly **75** which projects the image into the exposure aperture. Mounting of the housing of the lens assembly **75** is desirably effected by means of a strap member **77** secured to a supporting and frame bar **78** extending between and attached to the cabinet panels **11** and **12**. Thorough light shielding of the sensitized forwardly facing surface of the copy sheet is assured by transmission of the optical image through a light-tight tunnel **79** defined in part by the supporting and reinforcing bar **78** and an upper tunnel panel **80** secured at its front end to the bar and at its rear end to the upper aperture bar **71** and extending in closely fitting relation between the cabinet panels **11** and **12**. At its lower side the tunnel **79** is defined by a panel **81** extending between and secured to the side panels **11** and **12**, with its rear end engaged with the lower aperture bar **71** and its front end engaged with a front tunnel shield panel **82** having an opening **83** therein registering with the front of the lens assembly **75** and its upper end portion attached to the front side of the bar **78** and in engagement with a shielding panel **84** which extends between and in attached relation to the cabinet panels **11** and **12** and between the bar **78** and the lower face of the guide panel **41**.

At the top and rear of the cabinet within which the copy sheet passageway is housed, removable closure means are provided comprising a top rear cover **85** and a rear wall closure panel **87**. Desirably the cover **85** is of a width to extend freely between the upper margins of the cabinet panels **11** and **12** and of a length to extend from overlying relation to the front end of the guide plate **60** to the rear wall of the cabinet and has respective side flanges **88** which are pivotally attached at **89** adjacent to their rear ends to the cabinet side panels and at their front ends rest on the guide member **20**. Friction devices **90** mounted on the flanges **88** at respective points intermediately therealong may engage with the cabinet side panels to hold the cover **85** down against unintended opening from the closed position shown in FIGS. **1, 2** and **6**, but enabling ready opening of the cover to the position shown in FIG. **3** about the pivots **89** by manual effort when desired. At its front end, the cover **85** is provided with a depending flange **91** having an entry opening **92** by a turned in reinforcing portion thereof aligned with the mouth of the copy sheet passageway throat.

Mounting of the rear wall closure panel **87** is conveniently effected by engaging a rabbet flange **93** on its upper end with a complementary downwardly and inwardly turned angular rear terminal flange **94** on the cover **85**. At its sides the rear wall panel **87** has respective flanges **95** which on their lower end portions have means such as respective ball catches **97** for snap-on and snap-off retaining engagement with the side panels **11** and **12**.

Desirably the lower end of the rear wall panel **87** is located at a substantial elevation above the rear end of the base panel **10** to afford a rear entrance **98** through which a developer tray **99** is adapted to be readily inserted into position under the exposure aperture to receive copy sheets therefrom for development of the image thereon as by means of liquid toner carried in the tray and poured thereinto before the tray is inserted into the cabinet. Respective stop members **100** mounted on the inner faces of the side panels **11** and **12** are engaged by the front side of the tray **99** to determine its proper location in the rear bottom portion of the cabinet. As the copy sheet leaves the exposure aperture **70** it is engaged in the nip of conveyor rollers **101** and **102** mounted rotatably on and between the cabinet side panels **11** and **12** and of which the roller **102** may be driven. These rollers **101** and **102** direct the exposed copy sheet into and through developer or toner in the tray **99** which has a curvate guide bottom **103** which leads the copy sheet out of the developer bath into the nip of squeeze and conveyor rollers **104** and **105** mounted rotatably on and between the cabeint panels **11** and **12** and at least one of which such as the roller **105** is driven in timed relation with the rollers **101** and **102**.

From the rollers **104** and **105**, the developed copy sheet with all free toner liquid squeezed therefrom is advanced upwardly and forwardly and is deflected by means of a curved deflector plate **107**, mounted on the under side of the tunnel panel **81**, in a generally forwardly and downward direction, as indicated in dash flow line, toward a downwardly and forwardly extending delivery ramp panel **108** mounted on and between the lower portions of the side panels **11** and **12**. From

adjacent to the roller **104**, the ramp **108** extends to a final set of rollers **109** and **110** mounted rotatably on and between the side plates **11** and **12** and with at least one of the rollers, herein the roller **110** driven in timed relation with the rollers **104** and **105**. At the front end of the ramp **108** the leading end of the copy sheet is directed into the nip of the rollers **109** and **110** which drive the copy sheet in a generally downward and forward direction into a collection area in the front bottom portion of the cabinet where, on leaving the rollers, the copy sheet is received in a tray **111** slidably movably related at its inner end portion between the base panel **10** and a forwardly extending downwardly offset extension **112** from the ramp **108** and joined thereto by a downwardly extending offsetting flange portion **113** serving as a stop against rearward escape of the copy sheet after it leaves the lower roller **110**. A function of the rollers **109** and **110** is to restrain and pace the fed-out copy sheet from unduly accelerated advance into the receiving area, whereby to assure drying of any residual developer or toner liquid by the time the sheet is released from the rollers **109** and **110**.

Free access to the tray **111** is had through an opening in the lower front portion of the cabinet under the lower end of a front wall panel **114** which is mounted on and between the side panels **11** and **12** and has a lower rearwardly turned flange **115** engaged by the front end of a lower closure panel **117** mounted on and between the side panels **11** and **12** and extending rearwardly as the bottom closure for the scanning illumination chamber and as the roof of the copy sheet receiving area. A rear end portion **118** of the panel **117** cooperates with the ramp **108** to provide, in effect, a chute between the upper rear set of delivery rollers **104** and **105** and the lower forward set of delivery rollers **109** and **110**. For this purpose, the panel portion **118** extends obliquely upwardly and rearwardly and terminates in engagement with and between the bottom tunnel panel **81** and the deflector plate **107**.

Means are provided for cooling the scanning illumination chamber and more particularly the lamp **44** and the optical system, and effecting circulation of the developed copy sheets after they leave the liquid developer. To this end, a fan **119** is mounted in an opening **120** in the illumination chamber area of the side panel **11** to blow cooling air into the chamber. Conveniently the blower fan **119** is carried on a drive motor **121** supported by bracket **122** mounted on the outer side of the panel **11** across the opening **120**. To promote air circulation, the laterally extending portions of the base panel **10** outwardly from the side panels **11** and **12** are provided with air circulation holes **123**, and the base panel is supported by legs **124** in upwardly spaced relation to a surface **125** such as a desk top on which the legs rest. Within the illumination chamber a light and air baffle plate **127** extends between the front scanning aperture frame bar **47** and the front side of the parabolic reflector **44a** and is mounted on and between the side panels **11** and **12**. Air blown into the illumination chamber besides escaping through openings such as lamp access openings **128** in the side panels **11** and **12**, escapes through a relatively large aggregate flow area provided by sets of drying air escape apertures **129** in the overhead panel portion **118** of the copy sheet delivery chute. Thus, the fan motivated and illumination lamp heated air for the most part vents through the apertures **129** and in substantial volume whereby efficiently to dry the developed copy sheets as they travel down the delivery chute between the rollers **104** and **105** and **109** and **110**. Since the lower part of the cabinet is open front and back the expended air readily escapes without causing undesirable draft or air current.

For intensity modulation of the exposed image, a manually operated light valve or shutter **130** is mounted on a rotary shaft **131** extending between and carried by the side panels **11** and **12** in a position rearwardly adjacent to the lower side of the reflecting mirror **74** so that the shutter can be swung in the light path between the mirror and the projection lens. For convenient operation of the shutter **130**, means are provided operatively connected to the shaft **131** and accessible from the exterior of the machine cabinet. To this end, a pulley **132** (FIG. 2) is mounted corotatively on an end portion of the shaft **131** which extends from the outer side of the cabinet panel **12** within the chamber normally enclosed by the side cover **15**. For driving the pulley **132** a continuous flexible element **133** serving as a driving belt or strand is trained over the pulley and over a rotary shaft **134** carried by the panel **12** on its front margin above the lamp access opening **128** and on which is mounted corotatively a thumb wheel **135** with its perimeter digitally operably exposed through an opening **137** (FIG. 1) in the front wall of the cover **15** and about which is desirably mounted an escutcheon **138**. For guidance of a user, the perimeter of the operating thumb wheel **135** is desirably provided with suitable indicia **139** such as light intensity numerals, or the like, and the escutcheon **138** may carry cooperating indicia **140** and a preferred legend instruction such as the term "Lighter" above the opening **137** and the term "Darker" below the opening, indicating the direction in which the wheel **135** should be rotated to attain the quality of document exposure through positioning of the shutter **130**.

Driving of the several sets of rollers in the document and copy sheet guide passageway conveyor systems is by means of a single electrical motor **141** (FIG. 6) which is desirably mounted as by means of fasteners **142** (FIG. 2) on the inner side of the cabinet panel **12** within the chamber located above the light tunnel **79** forwardly from the charging means **67** and rearwardly from the illumination and scanning chamber. A motor drive shaft **143** extends through the cabinet panel and has thereon means such as a drive sprocket **144** which drives an endless flexible transmission element such as a sprocket chain **145** trained over respective driven sprockets **147** on the ends of the shafts of the driven rollers extending through the panel **12**. Thereby all of the rollers are driven in unison. An adjustable chain slack take-up device **148** may be mounted on the panel **12**.

In operation, a simple electrical circuit **149** (FIG. 4) of the machine, suitably connected to an electrical power source such as the customary house current by means of an electrical plug (not shown) inserted into an outlet, is energized by closing a switch **150** (FIG. 5) desirably mounted in a convenient position on the front of the cabinet as, for example, on a depending front wall panel extension **151** on the document guide plate **57** cooperating with the upper end of the front wall panel **114**. Operation of the switch **150** to close and open the same manually is adapted to be effected through a button or lever **152** conveniently exposed for manipulation through a suitable opening **153** in the

panel flange **151.** Energizing of the circuit **149** through closing of the power switch **150** causes a pilot light **154** to illuminate. This light is desirably mounted where it can be readily viewed by the user to show visually that the machine is operative. A convenient such location is on the panel flange **151.** At the same time, energizing of the circuit **149** causes the drive motor **141** and the lower fan motor **121** to be energized, thus preparing the machine to receive and process a document original and a copy sheet hand-fed thereinto.

Upon closing of the switch **43** by action of the document actuating the trip arm **42,** a relay **155** is energized to close normally open contacts **157** to complete the electrical circuit through and energize the lamp **44** and transformer **158** to activate the corona device **67** while the leading end of the copy sheet is still in the charging device. Desirably, the transformer **158** is mounted in the chamber above the light tunnel **79** on a transverse reinforcement and supporting bar **159** secured to and between the side panels **11** and **12.** The relay **155** may be conveniently mounted on the outer side of the side panel **11** within the chamber enclosed by the side cover **14** (FIG. **1**) and within which chamber various connecting electrical wires may also be housed. To accommodate connection with the document operated switch **43** within the top cover **17,** the relevant wires of the electrical circuit **149** may extend through a grommet **160** (FIG. **6**) mounted in the panel **11** in the area at the inside of the document guide **23.** To clear the roller **36,** a grommet **161** mounted in the cover flange **34** received the wires therethrough. This also facilitates opening and closing movements of the cover **17** without damaging the electrical wires.

If for any reason the cover **17** must be opened, it will be held in upwardly extending and generally rearwardly slanting relation as shown in FIG. **2,** by engagement of a preferably resilient bumper **162** against the upper front edge of the rear cover **85.**

I claim as my invention:

1. A compact hand-fed electrophotographic copier comprising, in combination:

a cabinet having a base panel on which are supported upright front to rear spaced apart side panels, front wall panel means supported by and between said side wall panels with an opening forwardly thereunder above said base panel, and rear wall panel means spaced above said base panel;

a top structure supported on and between said side panels and including means at an intermediate area in front to back direction for receiving hand-fed matching document original and copy sheets;

means providing a document original path leading from said receiving means downwardly and forwardly above said front panel means and including a scanning aperture;

closure panel means extending rearwardly from the lower edge of said front panel means above said base panel providing an illumination and scanning chamber under said scanning aperture and having therein illumination means and optical means to provide an image of a document original crossing said scanning aperture and for directing the image rearwardly;

a light tunnel comprising panels supported by and between said side panels and extending rearwardly spaced above said base panel;

means providing a copy sheet path from said receiving means rearwardly and downwardly and including an exposure aperture aligned with the rear end of said tunnel;

a liquid developer tray removably receivable on said base plate through the opening under said rear wall panel means in position to receive exposed copy sheets below said ex-posure aperture;

respective roller means for driving document originals and copy sheets through their respective paths and other roller means receiving developed copy sheets from said developer tray and moving the same forwardly into position in the space over the forward portion of said base plate for removal through the opening under said front panel means;

electrostatic charging means ahead of said exposure aperture in said copy sheet path;

a rear chamber defined above said light tunnel forwardly from said charging means and rearwardly from said illumination and scanning chamber;

a driving motor mounted within said rear chamber and having means connected therewith for driving all of said roller means in unison; and

a transformer for said charging means mounted within said rear chamber.

2. A copier according to claim **1,** including a partition separating said chambers at the front end of said light tunnel, an opening in one of said side panels aligned with said illumination and scanning chamber, a blower fan mounted in said opening to blow cooling air into said illumination and scanning chamber, and means for exhausting air from said illumination and scanning chamber in drying relation to developed copy sheets after they leave said tray.

3. A copier according to claim **2,** wherein said means for exhausting air includes a guide plate overlying the path of the copy sheets as handled by said other roller means and providing an opening through which exhausting air is directed toward the developed copy sheets.

4. A copier according to claim **1,** including a fan to effect cooling air circulation in said illumination and scanning chamber, said base panel having air holes therein, means maintaining the base panel raised above a supporting surface for circulation of air through said air holes by action of said fan, and means providing a passageway effecting communication between said air holes and said fan.

5. A copier according to claim **4,** including means for exhausting air from said illumination and scanning chamber in drying relation to develop copy sheets after they leave said tray and are handled by said other roller means.

6. In a copier having a cabinet provided therein with means defining a scanning aperture and means defining an exposure aperture, with means for scanning a document passing across said scanning aperture and including an optical system for transmitting an image from the scanning aperture into the exposure aperture:

a cabinet top having a front portion providing a feed table for receiving a document sheet and a copy sheet superimposed thereon;

means providing a document sheet guide passageway across said scanning aperture;

means providing a guide passageway for copy sheets across said exposure aperture;

means located along a rear edge of said table providing an entrance into the document sheet passageway aligned with the top of the table and an entrance into said copy sheet passageway for copy sheets located above said document sheet passageway entrance, with a sheet divider between said entrances;

said table comprising a front cover hinged at a rear end portion thereof to enable opening thereof for access to said scanning aperture;

a rear cover having a front portion raised above said copy sheet passageway entrance; and

said front portion serving as a stop for holding said front cover in open position in upwardly and rearwardly directed relation.

7. A copier having means providing an aperture across which a sheet is adapted to be moved:

a sheet feeding table having means facing said aperture to guide a sheet thereacross;

means cooperating with said table for directing a sheet in movement from the table in a path to travel between said aperture and said guide means;

means enabling opening of said table as a cover for access to said aperture;

said means for directing a sheet comprising a structure providing a passageway having a sheet-receiving entrance adjacent to an edge of said table and extending therefrom about a radius and in reverse direction toward said guide means;

said structure including a knife portion at said entrance for separating a document original sheet to travel said path and a copy sheet matched therewith to travel a copy sheet path;

a ramp on said structure beyond and aligned with said knife portion to receive the copy sheet; and

driving rollers located to receive the document original sheet at the exit from the path provided by said structure to advance the original sheet;

driving rollers operative to receive the copy sheet as it leaves said ramp to advance the copy sheet;

both of said original sheet and copy sheet advancing rollers being located substantially the same distance from said entrance;

electrostatic charging means through which said copy sheet rollers advance the copy sheet;

means providing an exposure aperture through which the copy sheet is advanced from said charging means;

an electrical lamp and reflector for illuminating said scanning aperture;

means including an electrical circuit including a switch having an actuator beyond said original sheet advancing rollers in the direction of advancement of the original sheet to be actuated by the original sheet to close the switch for energizing of said lamp and said electrostatic charging means;

liquid developing means receptive of the exposed copy sheet after it leaves said exposure aperture;

means for transporting the developed copy sheet to a delivery point;

a fan operative to blow cooling air past said lamp; and

a guide plate providing part of said exposed copy sheet transport means and overlying the exposed copy sheet and having openings therein through which said cooling air is exhausted in drying relation toward the developed copy sheet.

8. A copier having means providing an upwardly direct aperture across which a sheet is adapted to be moved:

a sheet feeding table having means facing said aperture to guide a sheet thereacross;

means cooperating with a rear portion of said table for receiving and directing a sheet in movement from the table in a path to travel between said aperture and said guide means;

means hinging said rear portion of the table enabling opening of said table as a cover forwardly from, relative to, and without requiring any opening of said receiving and directing means for access to said aperture;

guide means aligned with said aperture and cooperating with the guide means of the table;

sheet advancing rollers in part carried by said table and in part remaining with said cooperating guide means when the table is opened;

hold-down plate means carried by the table and facing said aperture;

a light source for illuminating said aperture;

an electrical circuit for energizing said light source;

a normally open switch in said circuit and mounted on said table; and

a switch actuator mounted in the path of travel of the sheet toward the aperture for closing the switch response to actuation by a sheet;

said actuator having an extension engaged by the sheet after it leaves said aperture to maintain the switch closed until the trailing end of the sheet leaves the aperture.

9. A copier according to claim 8, including means defining a path for a copy sheet, and an electrostatic charging device in said path, said circuit including said charging device whereby the charging device is energized upon closing of said switch, concurrently with energizing of the light source.

10. In an electrophotographic copier including a cabinet having front, side, back and top walls with a chamber in the front portion of the cabinet under means defining a scanning aperture, and means defining an exposure aperture in the back portion of the cabinet, the improvement comprising:

an illumination lamp and reflector in the lower forward portion of said cabinet for directing scanning light into the scanning aperture;

a mirror rearwardly adjacent to the reflector to receive reflected image from said scanning aperture and tilted to direct the image rearwardly toward said exposure aperture;

an image intensity modulating shutter mounted on a rotary shaft operatively rearwardly adjacent to said mirror; and

means at the front of the cabinet for operating said shutter comprising a pulley on the shaft, a digitally operable adjustment wheel exposed for manipulation at the front of the cabinet, and a flexible drive connection between said wheel and said pulley.

11. A copier including a supporting structure carrying means providing an upwardly directed aperture across which a sheet is adapted to be moved in generally horizontal rear-to-front direction:

a generally horizontal sheet feeding table panel structure providing a separable cover over said aperture and having a top surface over which a sheet is movable toward a rear edge of the table panel struc-

ture, and a bottom surface including sheet guide means separably facing said aperture to guide a sheet thereacross;

guide structure fixedly carried by said supporting structure and comprising complementary guide members providing a turnaround passage having an entry end aligned with said rear edge of said table panel structure for receiving a sheet in movement from said top surface and extending rearwardly and then curving downwardly and then extending forwardly to direct a sheet through said passage, and having an exit end aligned with and directing the sheet to and between said bottom surface and guide means and said aperture; and

means hinging a rear end portion of the table panel structure on said supporting structure separated from said guide structure and enabling swinging open of said table panel structure on a horizontal pivot axis transverse to said passage and relative to and without opening of said guide structure in order to gain access to said aperture.

12. A copier according to claim **11**, in which said top surface and said passage are free and unobstructed for manual rearward thrusting of a sheet along said top surface and reception of its leading end in said entry to be guided through said passage and out of said exit end, and a pair of cooperating sheet driving rollers located immediately beyond said exit and to receive the leading end of the sheet and drive the sheet forwardly between said sheet guide means and aperture, one of said rollers being mounted in driven rotary relation on said supporting structure and the other of said rollers being rotatably mounted on said table panel movable into separated relation to said driven roller when the table panel is swung open.

13. A copier according to claim **11**, wherein said table panel structure comprises a flat top panel providing said top surface, narrow side panels depending from said top panel, a bottom panel spaced from said top panel carried by said side panels and providing said bottom surface, said bottom panel having a transverse gap therein aligned with said aperture in the closed condition of the table panel structure, said guide means comprising a guide plate relatively movably connected to said side panels within said gap and normally biased toward said aperture in the closed condition of the table panel structure, said guide plate being carried separably away from said aperture when the table panel structure is moved into the open position.

14. A copier according to claim **13**, including an electrical control means having a switch mounted in a space provided between said top and bottom panels and having a control arm actuator freely straddling said guide plate within said space and having an end portion operatively located adjacent to the rear side of said gap for actuation by the advancing sheet, and a second end portion located adjacent to the front side of said gap for engagement by the advancing sheet after it has traversed said aperture.

15. A copier including a supporting structure carrying means providing an upwardly directed aperture across which a sheet is adapted to be moved in a generally horizontal rear-to-front direction:

a generally horizontal sheet feeding table panel structure providing a separable cover over said aperture and having a top surface over which a sheet is movable toward a rear edge of the table panel structure, and a bottom surface including sheet guide means separably facing said aperture to guide a sheet thereacross;

guide structure fixedly carried by said supporting structure and comprising complementary guide members providing a turnaround passage having an entry end aligned with said rear edge of said table panel structure for receiving a sheet in movement from said top surface and extending rearwardly and then curving downwardly and then extending forwardly to direct a sheet through said passage, and having an exit end aligned with and directing the sheet to and between said bottom surface and guide means and said aperture;

means hinging a rear end portion of the table panel structure on said supporting structure separated from said guide structure and enabling swinging open of said table panel structure on a horizontal pivot axis transverse to said passage and relative to and without opening of said guide structure in order to gain access to said aperture; and

stop means carried by said supporting structure for holding said table panel structure in an upwardly and rearwardly directed relation when swung open.

16. In a copier having a cabinet provided therein with means defining a scanning aperture and means defining an exposure aperture, with means for scanning a document passing across said scanning aperture and including an optical system for transmitting an image from the scanning aperture into the exposure aperture:

a cabinet top having a front portion providing a feed table for receiving a document sheet and a copy sheet superimposed thereon;

means providing a document sheet guide passageway across said scanning aperture;

means providing a guide passageway for copy sheets across said exposure aperture;

means located along a rear edge of said table providing an entrance into the document sheet passageway aligned with the top of the table and an entrance into said copy sheet passageway for copy sheets located above said document sheet passageway entrance, with a sheet divider between said entrances;

said table comprising a front cover hinged at a rear end portion thereof to enable opening thereof for access to said scanning aperture;

a rear cover having a front portion raised above said copy sheet passageway entrance;

said front portion serving as a stop for holding said front cover in open position in an upwardly and rearwardly directed relation;

said front cover providing part of said document sheet guide passageway; and

a guide plate relatively movably connected to said front cover and normally biased toward said scanning aperture;

said guide plate being carried by said front cover separably away from said scanning aperture when said front cover is moved into said open position.

17. A copier according to claim **16**, including electrical control means having a switch mounted on said front cover and having a control arm extending into said document sheet guide passageway for actuation by a document sheet moving through said document sheet passageway, said switch and control arm being separably movable away from said scanning aperture with said front cover when the front cover is moved into the open position.

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