

- [54] **XEROGRAPHIC COPIER WITH ASYNCHRONOUS COPY FEED**
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[73] Assignee: **Sperry Rand Corporation,** New York, N.Y.
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[52] U.S. Cl. **355/8, 355/49, 355/51, 355/14, 271/DIG. 9**
[51] Int. Cl. **G03b 15/00**
[58] Field of Search **355/8, 14, 3, 48, 49, 50, 355/51; 271/DIG. 9**

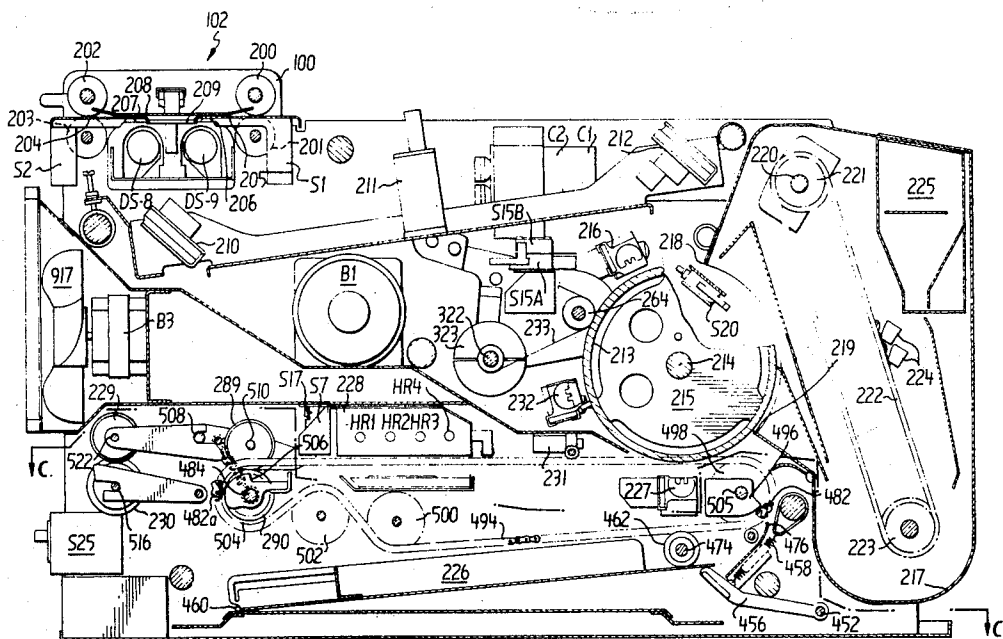
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[57] **ABSTRACT**
A xerographic copier is provided with a continuously rotating photoconductive drum surface, continuously operative document feed means capable of moving a document through a scanning station in either a forward or reverse direction so that multiple scans of the document may take place when multiple copies are to be made, and copy paper transport means which is normally at rest but is brought into motion during each copy cycle. The copy paper transport moves as the same linear speed as the drum surface so that a toner image on the drum may be transferred to the copy paper. However, since all document images are not placed on the drum at the same area, the time at which the copy paper transport begins moving is not synchronized with any particular point in the drum cycle but is instead synchronized with the document image formed on the drum surface. The original document actuates switches which in turn control the time at which the copy paper transport begins its movement. Since document movement is synchronized with drum surface movement, this provides synchronization between the copy paper feed and the image on the drum.

9 Claims, 12 Drawing Figures



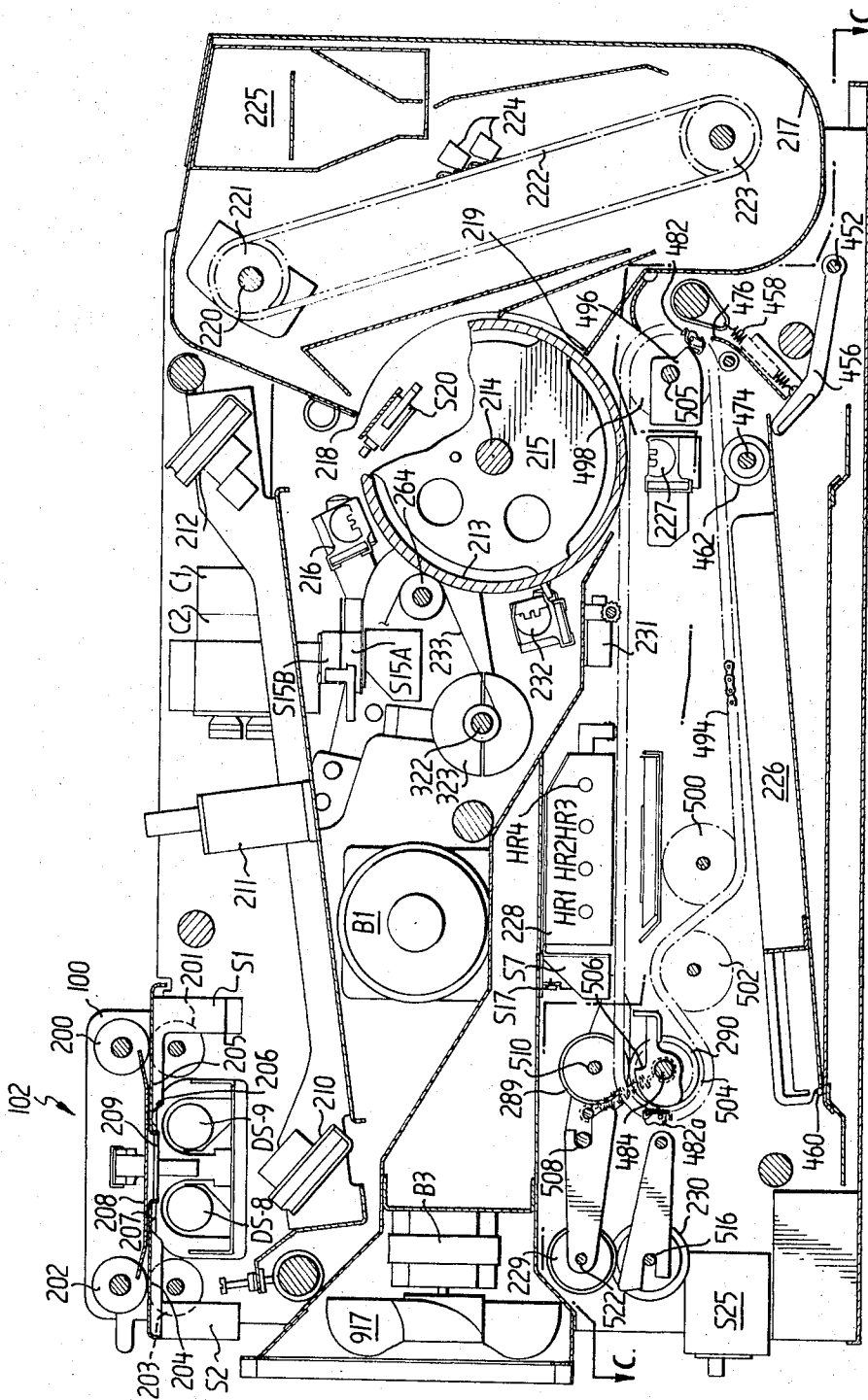


FIG. 2

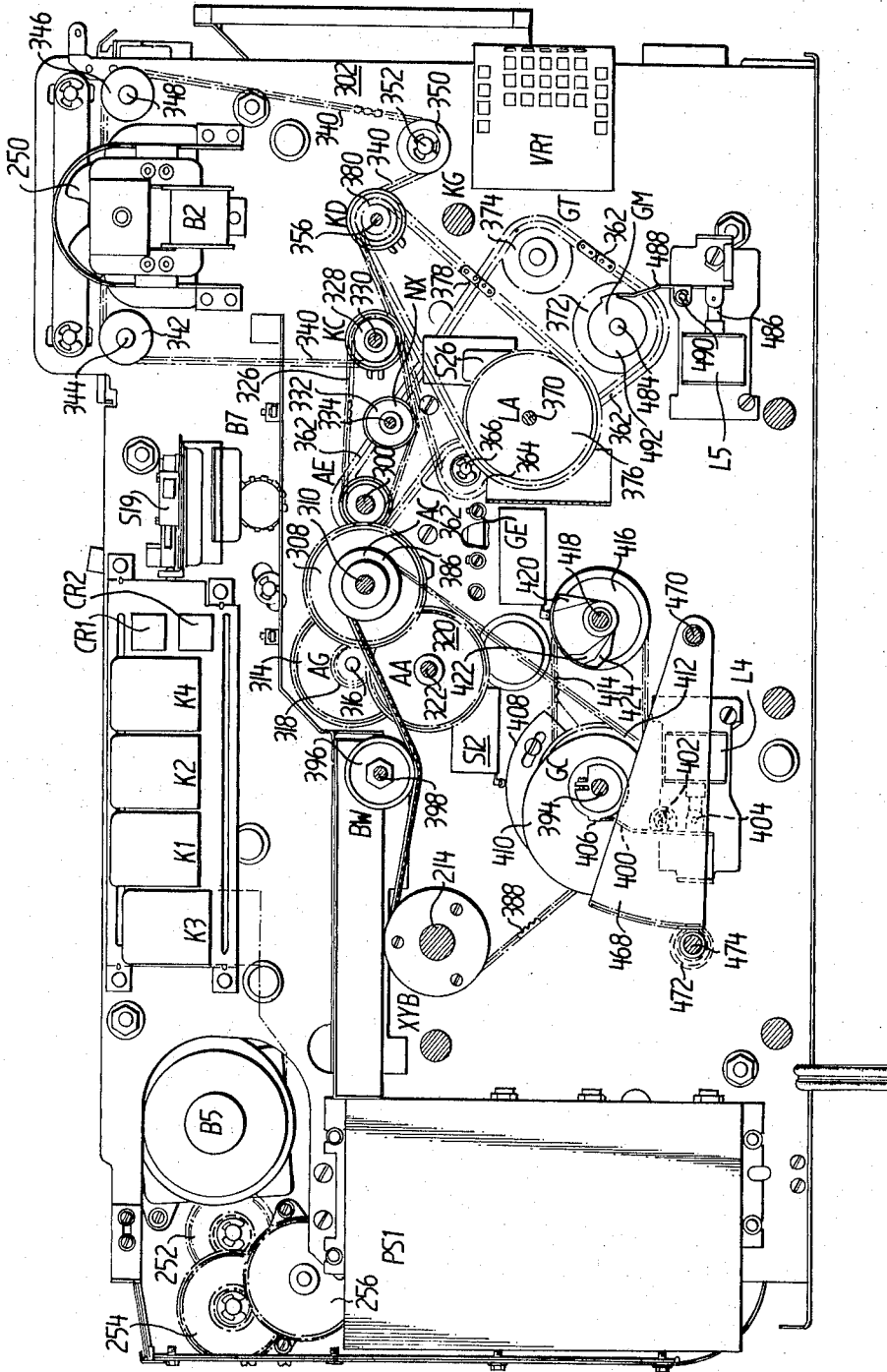


FIG. 3

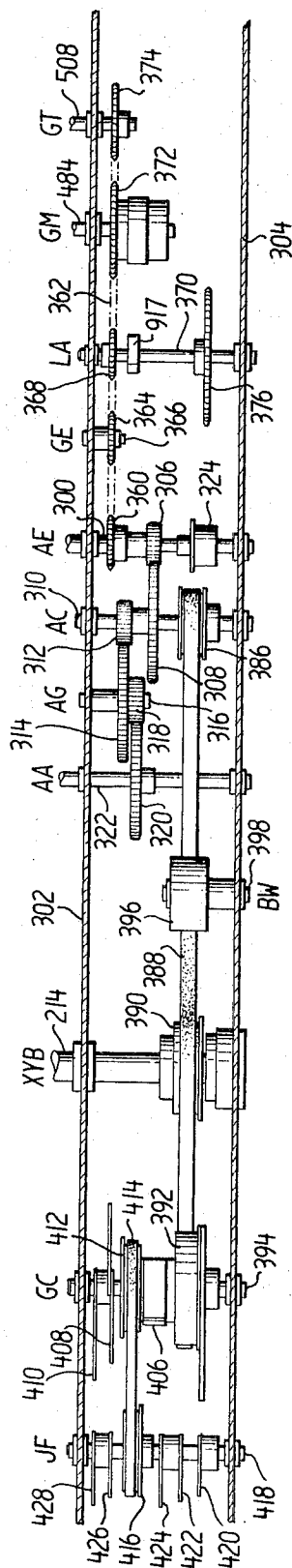


FIG. 4A

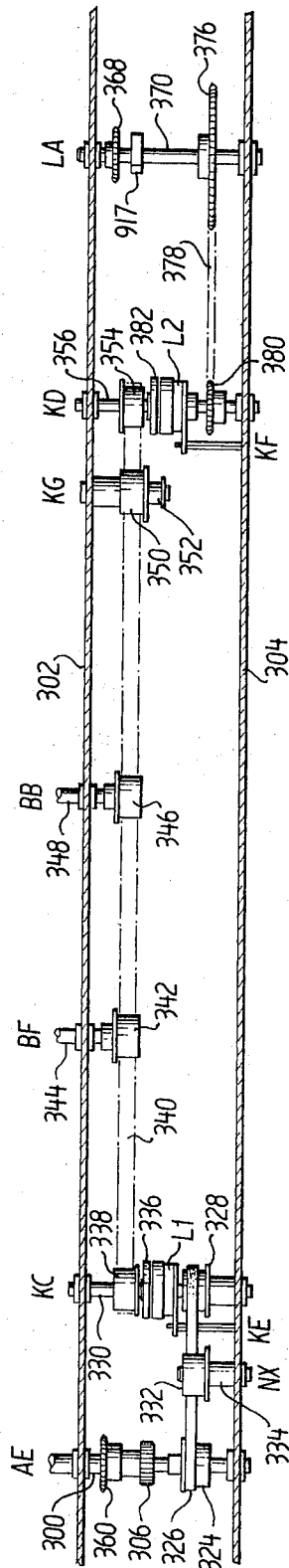


FIG. 4B

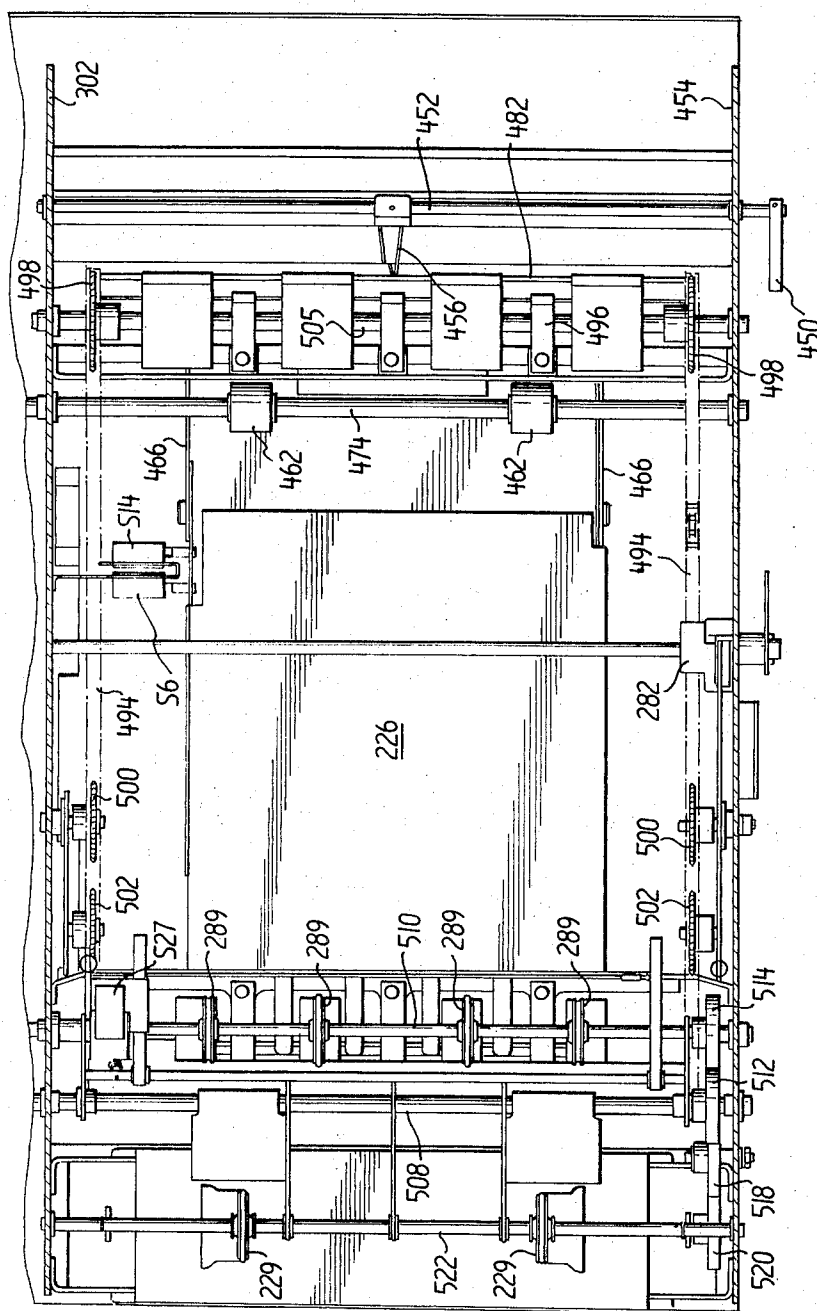


FIG. 5

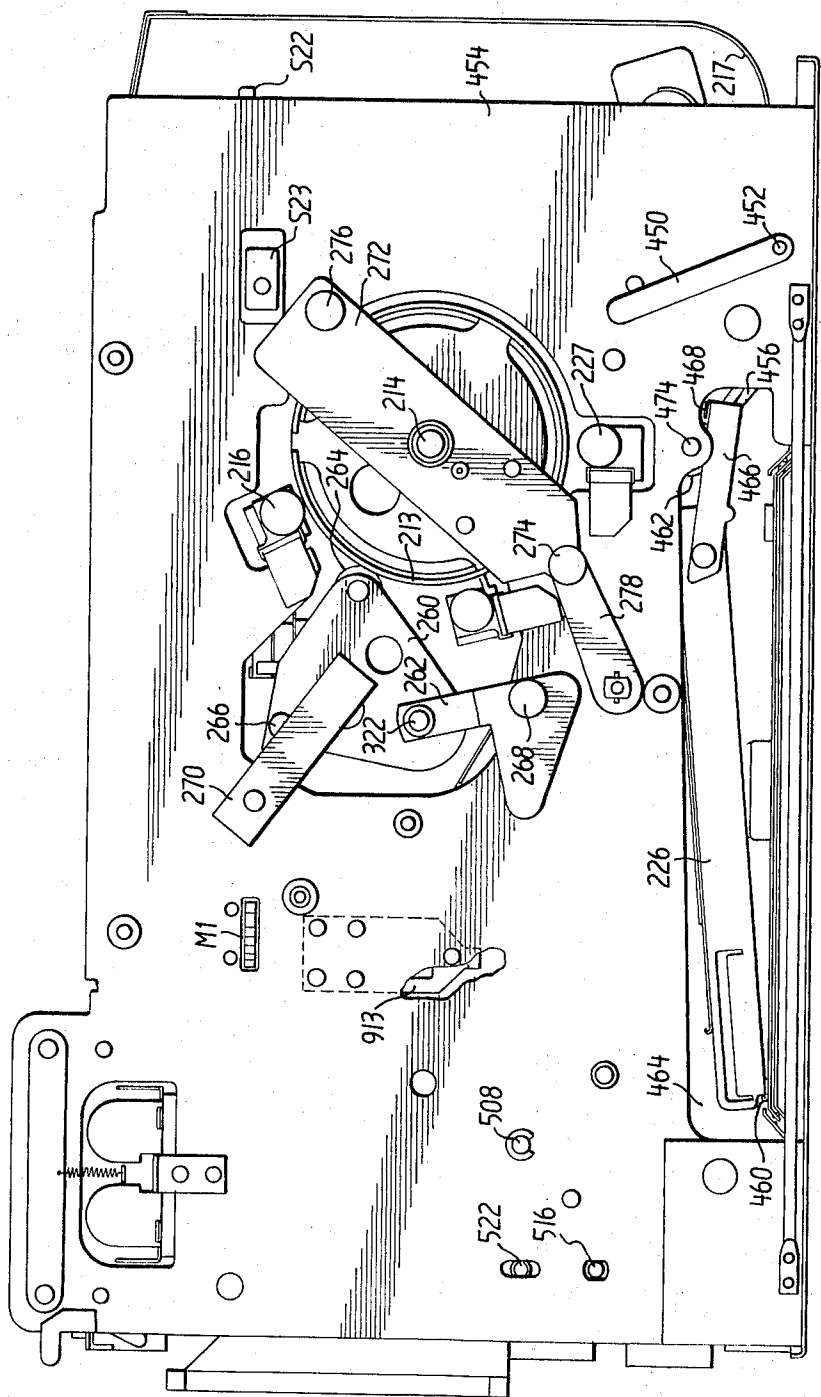


FIG. 6

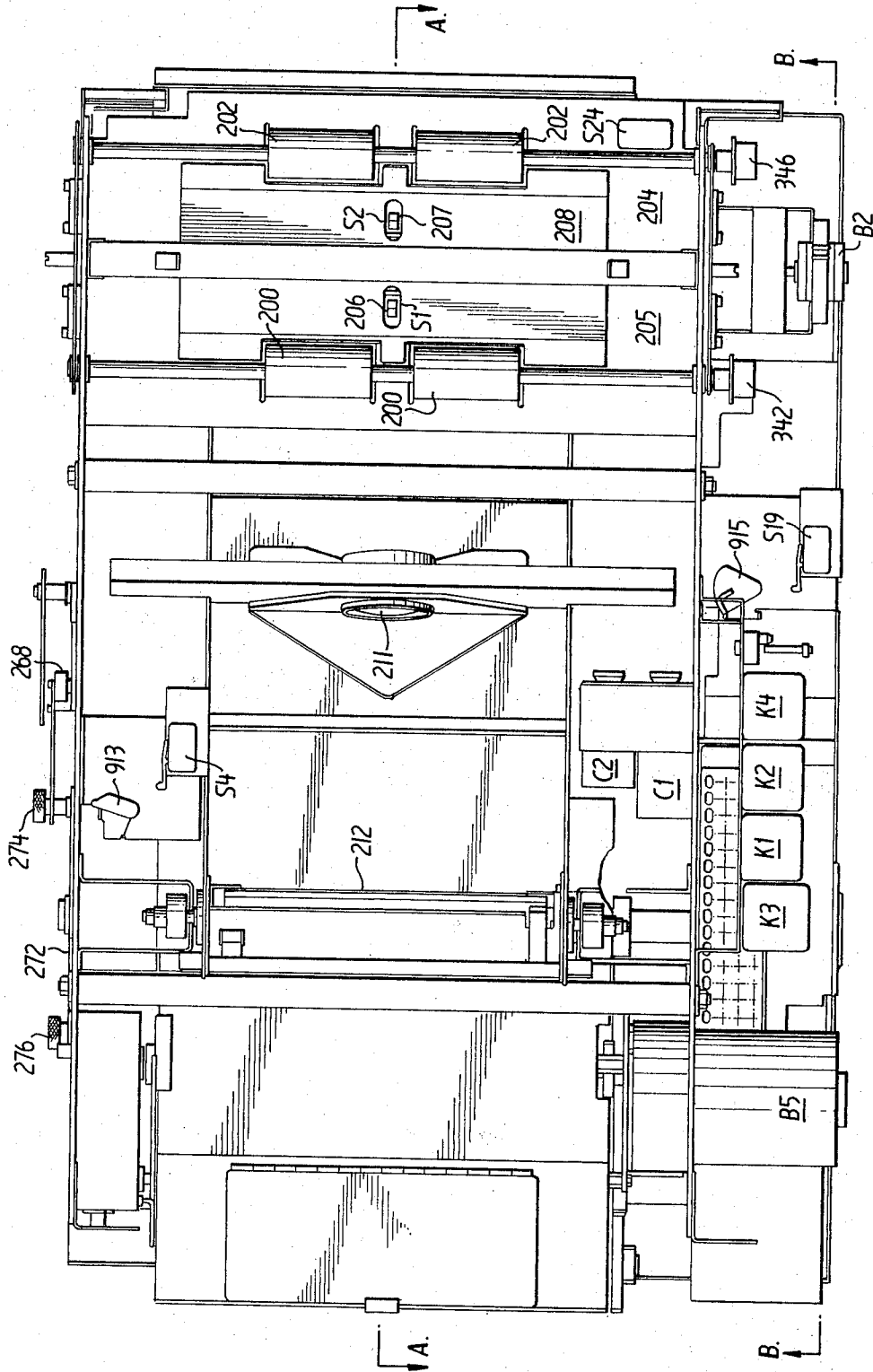


FIG. 7

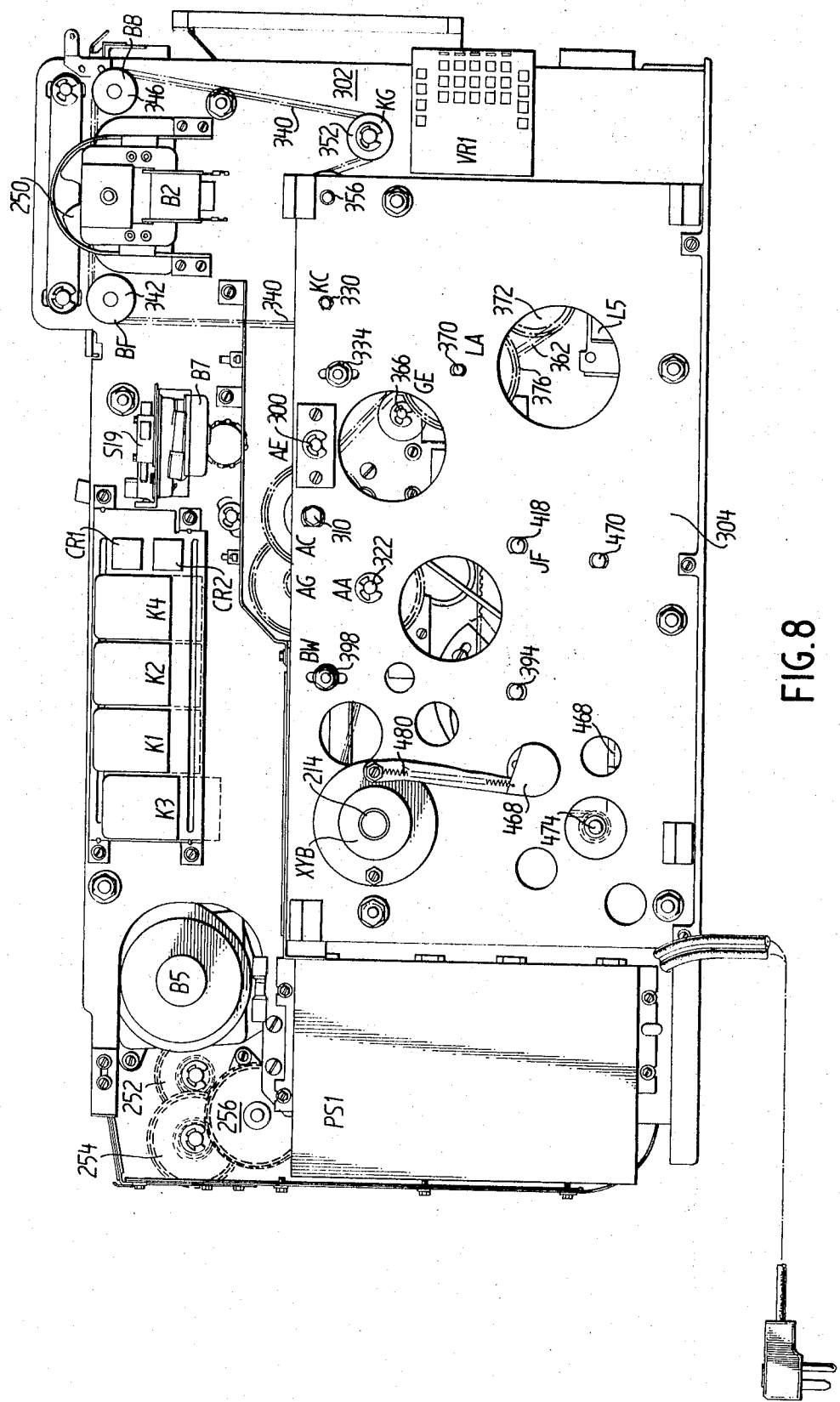


FIG. 8

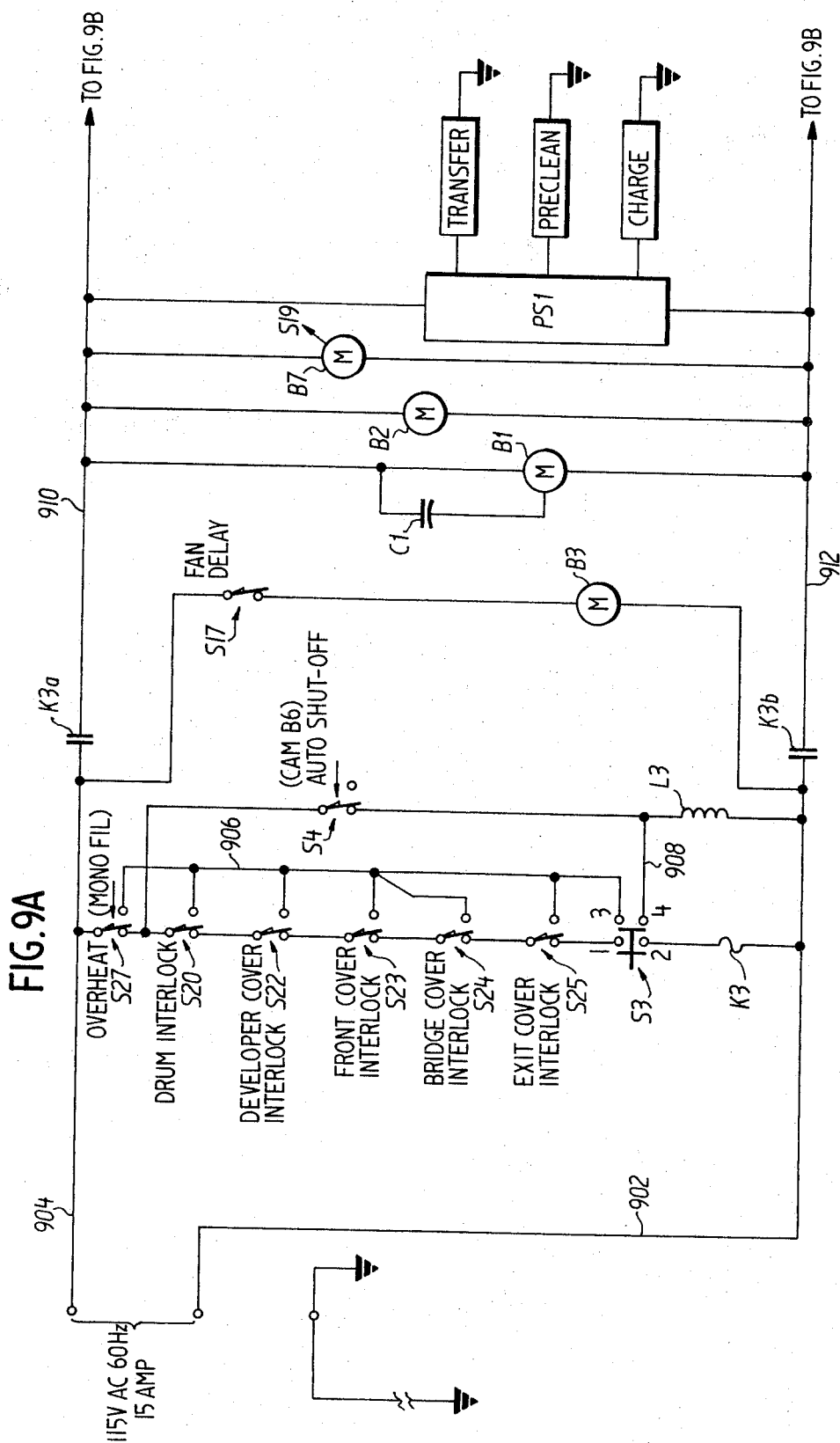
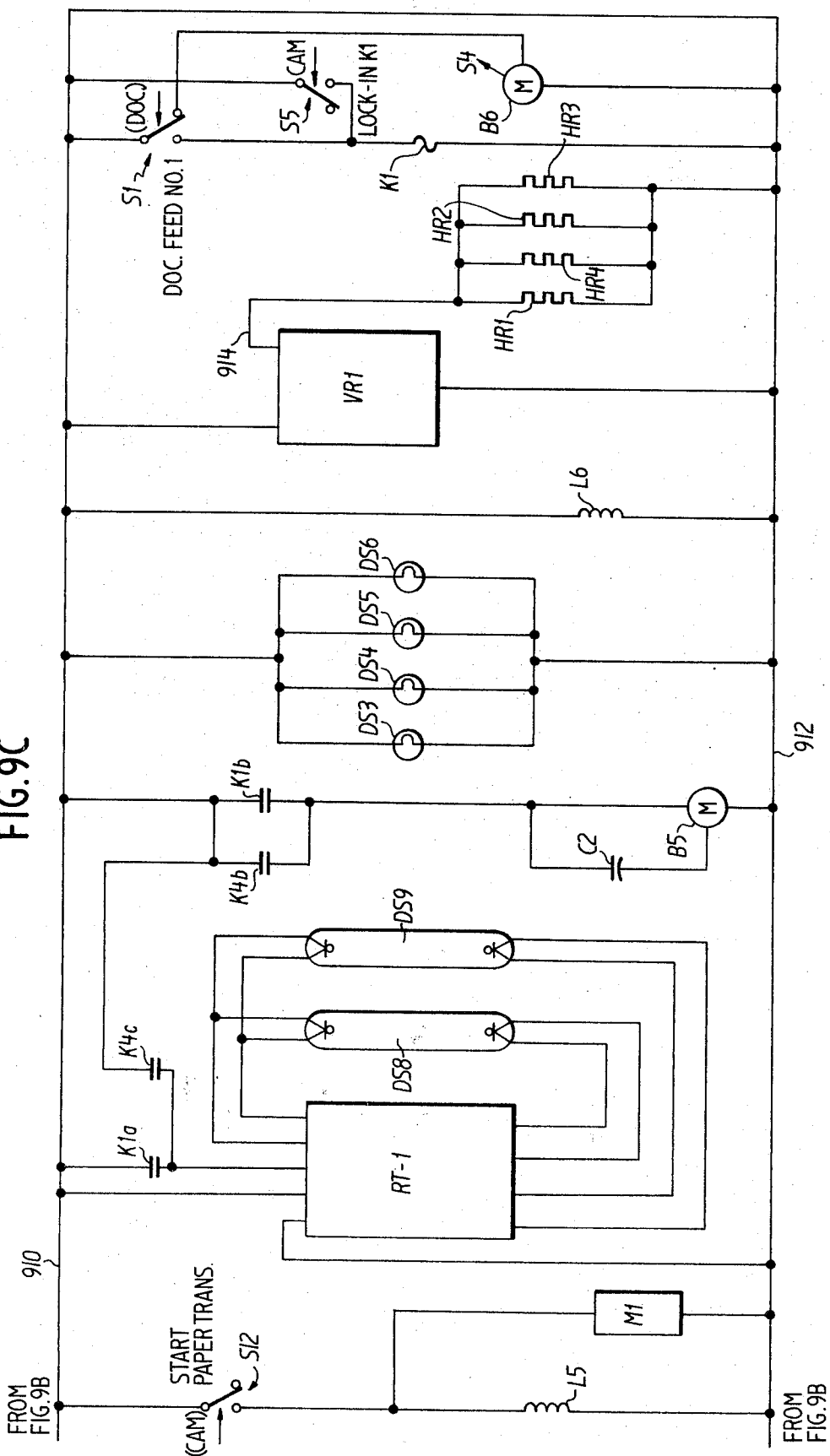


FIG. 9C



XEROGRAPHIC COPIER WITH ASYNCHRONOUS COPY FEED

BACKGROUND OF THE INVENTION

This invention relates to xerographic copier or reproduction apparatus capable of producing one or more copies of an original document on one or more copy sheets.

As is well known in the art, these devices usually include a rotating drum having a photoconductive surface. A uniform electrostatic charge is placed over the drum surface and the drum surface is then exposed to a light image obtained by scanning the document to be reproduced. The drum surface retains the charge on those areas which correspond to dark areas of the document, thus forming an electrostatic image of the document. The electrostatic image is developed by cascading toner particles over the drum surface, the particles adhering to the charged areas thereby producing a visible image. The drum surface is then rotated past an image transfer station where the toner particles forming the visible image are transferred to copy paper which is moved through the transfer station at the same speed as the drum surface.

In most prior art devices, the feeding of the document through the scanning station has been synchronized with the rotation of the drum so that the electrostatic image of each document has been laid down over the same area of the drum surface. As a consequence, the copy paper transport mechanism has been cycled in synchronism with the drum cycle so that the copy paper always contacts the same area of the drum at the image transfer station, thereby insuring that the toner image is properly transferred to the copy sheet. However, this arrangement requires that the copy paper transport mechanism be in operation any time the drum is moving.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a xerographic copier wherein an electrostatic image may be laid down on any portion of an electrostatically charged drum surface.

An object of this invention is to provide a xerographic copier wherein a scanning station document feed mechanism and photoconductive drum surface move continuously as long as the copier is on, and wherein the area of the drum upon which an electrostatic image is formed is determined by the time at which an operator inserts a document into the feed mechanism at the scanning station.

A further object of the invention is to provide a xerographic copier wherein a xerographic drum surface is continuously rotated past a transfer station, and wherein an intermittently driven copy sheet transport mechanism is provided for transporting copy sheets through the transfer station at the same linear speed as the drum surface.

Still another object of the invention is to provide a xerographic copier wherein documents of various lengths may be copied by feeding the documents past a scanning station, and wherein progress of a document through the scanning station is automatically sensed to control forward and reverse operations of the document feed mechanism, thereby permitting a document

to be automatically scanned a plurality of times to produce a plurality of copies.

The above-stated and other objects of the invention are obtained by providing a xerographic copier having a continuously rotating photoconductive drum surface, a scanning station having continuously operative reversible document feed means, means for projecting an image of a scanned document onto said drum surface, sensing means for sensing progress of a document through the scanning station, copy paper transport means, and means responsive to the sensing means for initiating movement of said transport means when a document reaches a predetermined position in said scanning station. A manually adjustable multiple copy control is provided for setting two cams, the cams being indexed toward a home position by an electric motor. Means responsive to the sensing means are provided for driving the index motor and for driving the document feed means in the reverse and then the forward direction until the cams have been indexed to their home position, whereby a document may be scanned a number of times equal to the initial setting of the multiple copy control.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the invention showing the operator controls and visual indicators;

FIG. 2 is a sectional view taken along the line A—A of FIG. 7;

FIG. 3 is a sectional view taken along the line B—B of FIG. 7;

FIGS. 4a and 4b are expanded top views of the mechanical drive;

FIG. 5 is a sectional view taken along the line C—C of FIG. 2;

FIG. 6 is a front view with the covers removed;

FIG. 7 is a top view with the covers removed;

FIG. 8 is a rear view with the covers removed; and,

FIGS. 9a, 9b, and 9c, when taken together, show the circuits for controlling the xerographic copier.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 illustrates a xerographic copy machine constructed in accordance with the principles of the present invention. The photocopier is quite small and compact and is adapted to be placed on a desk or table. Each document to be photocopied is manually inserted into a slot 100 and is optically scanned at a document scanning station generally indicated at 102. After a document has been scanned it exits through an exit slot 104 and is caught in a document receiving tray 106. Copy sheets exit from the machine and are received in a receiving tray 108. The front cover 110 is easily removable so that sheets of copy paper or other suitable image support material may be inserted into a tray in the lower front portion of the machine.

A control panel cover 112 extends upwardly from a generally flat work surface 114, the control panel being located toward the rear of the machine so as to provide an ample work surface in front of the control panel.

The photocopier is quite simple to operate and has only two controls. One control is an on-off push button 116. If the machine is off this push button may be depressed to turn the machine on. If the machine is on the pushbutton 116 may be depressed to turn it off.

The second control is a multiple copy control knob 118. This knob is used to select the number of copies to be made from each original document inserted into the slot 100. The copier is designed to make up to 15 copies hence the numerals 1 through 15 are imprinted around the periphery of the knob 118. As multiple copies are being made the knob 118 is automatically indexed or rotated hence it must be set each time a new document is inserted into the slot 100, if more than one copy is desired.

The control panel carries three visual indicators. A Not Ready indicator 120 is illuminated during a warmup interval immediately after the machine is turned on. The Not Ready indicator is also illuminated while the copier is in the process of scanning a document and thus is unable to receive a new document through the slot 100. The indicator is also illuminated any time an over-temperature condition is sensed in the machine, or when there are no more copy sheets in the machine.

As subsequently explained in detail, the photocopier employs a continuously moving web to clean a photosensitive drum surface. When the copier has used up a web a web out indicator 122 is illuminated.

Copies are made on individual sheets of paper and from time to time it is necessary to replenish the supply of paper sheets contained in the machine. When the supply of paper gets low (about 20 sheets) a contact is closed so that on each copy cycle an Add Paper indicator 124 flashes on and off.

DOCUMENT SCANNING AND REPRODUCTION

The document scanning station 102 is illustrated in FIGS. 2 and 3 and includes upper and lower entrance feed rolls 200 and 201, upper and lower exit feed rolls 202 and 203, and first and second elongated exposure lamps DS8 and DS9. Two plates 204 and 205 define the path of the document through the scanning station and these plates are provided with openings so that the lower rollers may grip the document and advance it through the scanning station. In addition, the lower plates are provided with apertures through which extend the operating arms 206 and 207 of a pair of document feed switches S1 and S2. A top plate 208 is provided to confine the movement of the document through the scanning station. The lower plates 204 and 205 are separated by a glass window or scanning slit 209. A motor B2 (FIG. 8) drives a fan 250 to blow air over the exposure lamps and remove heat produced by the lamps.

When a document is inserted into the entrance feed rollers 200 and 201, these feed rolls move the document toward the window 209. Before reaching the window, the leading edge of the document depresses the operating arm 206 to close the switch S1. As subsequently explained in connection with FIG. 9A, the contacts of switch S1 turn on the exposure lamps DS8 and DS9. As the document is moved past the window 209, light from the exposure lamps is reflected off of successive increments of the document onto a fixed mirror 210. From mirror 210 the light is reflected toward a lens 211 and passes through this lens to a second mirror 212. The mirror 212 reflects the light downwardly onto the surface of a continuously rotating drum 213. The drum is a hollow drum supported on a continuously rotating shaft 214 by two spiders 215.

The outer surface of drum 213 may be coated with any conventional photoconductive insulating material such as vitreous selenium. As viewed in FIG. 2, the drum rotates in a clockwise direction and as it rotates a corotron or corona charging unit 216 places a uniform electrical charge on the photoconductive surface. As the charged surface is exposed to light reflected from the mirror 212, selected areas of the photoconductive surface are discharged thus leaving charged areas on the drum surface corresponding to the darker areas of the document being scanned.

A conventional cascade developing system is employed for changing the electrostatic image on the drum to a visible image. The developer includes an enclosure or housing 217 which is enclosed except for the region where the housing is in proximity to the drum 213. Seals may be provided at each end of the drum, these seals extending around the periphery of the drum from a point 218 to a point generally indicated at 219, to prevent the escape of developer material from the system at points where the developer housing is in close proximity to the rotating drum surface. A supply of developer material is maintained in the lower portion of the housing 217, this developer material comprising toner particles mixed with beads or particles exhibiting the triboelectric effect as is well known in the art.

The developer is driven by its own drive motor B5 (FIGS. 7 and 8) and this motor is actuated by the switch S1 at the document scanning station. The developer motor, through intermediate gearing (not shown) drives the shaft 220 which carries a sprocket 221. A chain 222 is carried by the sprocket 221 and an idler sprocket 223. The chain carries a plurality of buckets 224 so that the buckets pick up developer material from the lower portion of the housing 217 and discharge it above the drum 213. The developer material cascades over the drum surface generally in the region between the point 218 and a point approximately 20° above the horizontal, and as this takes place the toner particles are attracted to the charged areas of the photoconductive surface thus rendering these areas visible. The triboelectric beads fall back into the lower portion of the housing 217 where they attract more toner material.

Associated with the developer is a toner dispenser 225 which serves to supply metered amounts of toner to the developer housing to replace the toner that is used up during the reproduction process. The toner dispenser is driven through intermediate gears 252, 254 and 256 (FIG. 3) by the same motor B5 that drives the developer. The toner dispenser is fully described in co-pending application Ser. No. 393,477 filed Nov. 3, 1972.

After the toner particles have adhered to the photoconductive drum surface to form a visible image, this image must be transferred to a sheet of copy paper. The sheets of copy paper are stored in a tray 226 and one sheet is dispensed from the tray each time a copy is to be made. As will become evident when the copy transport mechanism is described, the transport mechanism is not continuously driven but is started up and synchronized with drum movement each time a copy is to be made. It is sufficient at this time to note that a sheet of copy paper is brought into contact with the photoconductive surface of the drum and is moved at approximately the same speed as the drum. In a typical embodiment the drum surface may rotate at 3.76

inches per second while the copy paper is moved at 3.75 inches per second.

The copy sheet and the photoconductive surface carrying the toner particles are moved past a transfer station having a transfer corotron 227. The transfer corotron applies to the copy sheet a charge greater than that on the drum. This charge attracts the toner particles away from the drum surface and onto the surface of the copy sheet. The visible image of the original document is thus transferred from the drum surface to the sheet of copy paper. The copy paper is then fed under a fuser unit 228 which heats the toner particles to their melting point and fuses them to the copy paper. The copy is then fed out of the copier through two sets of exit feed rolls 289 and 290, and 229 and 230.

As the photoconductive surface of the drum leaves the transfer station, it is exposed to four discharge lamps mounted on a support 231. Exposure of the photoconductive surface to the light from these discharge lamps reduces or removes any charge remaining on the drum surface thus reducing the attraction of any particles which may still be adhered to the drum. The drum surface then rotates past a preclean corotron unit 232 which supplies a charge opposite to that supplied by the charging unit 216. This removes further residual toner particles from the drum surface. Finally, the drum surface is contacted by a slowly but continuously moving web 233. This web wipes the drum surface and removes from the drum any toner particles still adhering to the drum surface. The drum surface is now cleaned and is ready to again be charged by the corona charging unit 216 in preparation for receiving a new image.

DRUM CLEANING WEB DRIVE

The motor B1 (FIG. 2) serves as a source of mechanical power for driving most of the units in the machine. The shaft 300 of the motor B1 is shown in FIG. 3, FIG. 4a, and FIG. 4b. At this point it should be noted that FIGS. 4a and 4b are, for the purpose of clearly illustrating the drive, drawn on an expanded scale.

The motor shaft 300 extends through an intermediate vertical support plate 302 and is journaled at its outer end in a vertical rear support plate 304. The shaft 300 carries a gear 306 which meshes with a further gear 308 carried on a shaft 310. The shaft 310 is journaled in support plates 302 and 304 and drives a gear 312. The gear 312 meshes with a gear 314 which idles on a stub shaft 316. The stub shaft is mounted on the support plate 302 and carries a gear 318 which is integrally formed with gear 314. Gear 318 meshes with and drives a gear 320 so as to rotate a shaft 322 on which the gear 320 is mounted. The shaft 322 is the shaft on which the takeup spool 323 (FIG. 2) of the drum cleaning web is mounted.

As shown in FIG. 6, the shaft extends through a web support bracket 260 and a plate 262. The support bracket supports the shaft of an elongated roller 264 which presses the cleaning web 233 (FIG. 2) against the surface of drum 213. Therefore, as long as the motor B1 is energized the shaft 322 is rotated so that successive increments of the cleaning web 233 are brought into contact with the photoconductive surface of the drum 213. The supply roll carrying the clean web is supported on the shaft 266 (FIG. 6). A new supply of cleaning web may be inserted into the copier, and the used roll removed, by removing a thumb screw 268,

turning a locking handle 270 clockwise, and then removing the web support bracket.

DOCUMENT FEED DRIVE

The power for driving the document feed rolls 200 through 203 in either the forward or reverse direction is derived from the shaft 300. Referring to FIG. 4b, the shaft 300 drives a toothed pulley 324 around which is looped a toothed or timing belt 326. The belt 326 is also looped around a pulley 328 which is affixed to a shaft 330. An idler pulley 332 is freely mounted on a stub shaft 334 and the stub shaft is adjustably mounted on the vertical plate 304 to obtain proper tension in the belt 326.

The shaft 330 extends through, and rotates freely in, the coil L1 of a magnetic clutch. This clutch includes a clutch plate 336 which is firmly affixed to the shaft 330. A pulley 338 is mounted for free rotation about the shaft 330. When the coil L1 of the clutch is energized the pulley 338 is attracted toward the plate 336 and the friction between these two drives the pulley 338. The pulley 338 drives a timing belt 340 and this belt drives a pulley 342 affixed to the lower entrance document feed roll shaft 344 and a pulley 346 attached to the lower exit feed roll shaft 348. Thus, any time the coil L1 of the forward clutch is energized the feed rolls attached to the shafts 344 and 348 rotate in a direction so as to drive a document through the scanning station in the forward direction.

The timing belt 340 also loops around a tension idler pulley 350 which idles on an adjustable stub shaft 352. Furthermore, the timing belt 340 also loops around a toothed pulley 354 which is mounted for free rotation about a reverse clutch shaft 356.

The motor shaft 300 also serves as the source of power for driving the document feed rolls in the reverse direction. A sprocket 360 (FIG. 4a) is attached to the shaft 300 and as the shaft rotates the sprocket drives a chain 362. The chain 362 drives a chain tension idler sprocket 364 mounted on a stub shaft 366, a sprocket 368 mounted on a shaft 370, and two further sprockets 372 and 374.

Referring now to FIG. 4b where the shaft 370 is again shown, a further sprocket 376 is attached to the shaft and drives a chain 378. The chain drives a sprocket 380 attached to the reverse clutch shaft 356. A stationary reverse feed clutch coil L2 surrounds the shaft 356 and a plate 382 associated with the clutch is attached to rotate with the shaft. A toothed pulley 354 is mounted for free rotation about the shaft 356 but upon energization of the coil L2 of the reverse feed clutch the pulley 354 is attracted toward the plate 382 and the friction between the two drives the pulley. The pulley in turn drives the timing belt 340 and the timing belt rotates the toothed pulleys 342 and 346 in a direction so as to feed a document in the scanning station in the reverse direction.

In summary, drive power is continuously supplied to the forward feed clutch shaft 330 and the reverse feed clutch shaft 356. If the forward feed clutch coil L1 is energized the belt 340 is moved in one direction to feed documents through the scanning station in the forward direction, and if the reverse feed clutch coil L2 is energized the belt 340 is driven in the reverse direction so as to feed documents in the scanning station in the reverse direction.

DRUM DRIVE

As previously stated, the photoconductive drum 213 is rotated as long as the copier is on. In FIG. 4a, the drive motor B1 continuously rotates the shaft 300 and through gears 306 and 308 rotates the shaft 310. This shaft has a toothed pulley 386 attached thereto which drives a timing belt 388. The belt 388 drives a toothed pulley 390 affixed to the drum shaft 214, and a toothed pulley 392 attached to a timing cam shaft 394. A tension idler pulley 396 is mounted on an adjustable stub shaft 398 for the purpose of adjusting the tension of the timing belt.

In FIG. 6, one end of the drum shaft 214 is journaled in a plate 272, the plate being attached to support plate 454 by a pair of thumb screws 274 and 276. The drum may be removed by removing plate 272 and rotating the handle 278 clockwise. The handle operates a plate 282 (FIG. 5) which depresses a paper transport chain 494, thus providing a clear path for sliding the drum off of its shaft toward the front of the copier.

TIMING CAM DRIVE

In addition to driving the drum shaft 214, the belt 388 (FIG. 4a) drives the pulley 392 to provide input power to the timing cam shaft 394. However, the pulley 392 is not directly connected to the shaft 394 but supplies driving power to the shaft through a conventional spring clutch. As shown in FIG. 3 the timing cam clutch includes a latch arm 400 pivoted about a point 402 and connected at a point 404 to the plunger of a solenoid L4. The latch arm 400 engages the surface of a cam 406 when the clutch is latched up. When the solenoid L4 is energized the latch arm 400 pivots out of the way of the cam 406 and the cam rotates thereby permitting a spring (not shown) driven by the pulley 392 to drive the shaft 394. The solenoid L4 is energized only for a short interval of time after which a spring (not shown) returns the solenoid plunger and the latch arm 400 to their original position. At the end of one revolution of the shaft 394 the cam 406 again engages the latch arm 400 and this in turn disengages the spring from the shaft.

In FIG. 4a, two timing cams 408 and 410 are attached to the shaft 394 and turn therewith. These cams actuate contacts S11 and S12 of the control circuit shown in FIGS. 9b and 9c.

A toothed pulley 412 is attached to the shaft 394 and drives a timing belt 414. The timing belt is looped around a toothed pulley 416 which is attached to a shaft 418. Also affixed to this shaft are five timing cams 420, 422, 424, 426 and 428. These cams drive cam contacts S5, S9, S13, S16 and S21 shown in FIGS. 9b and 9c. Thus, each time the timing cam control clutch solenoid L4 is energized seven timing cams are rotated through one complete cycle after which the clutch latches up. These timing cams control various operations as subsequently described in connection with FIGS. 9a - 9c.

COPY SHEET TRANSPORT

Referring now to FIGS. 2, 5 and 6, up to 200 copy sheets may be loaded into the storage tray 226 by rotating a handle 450 counterclockwise. The handle is attached to shaft 452 which is journaled in the front frame plate 454 and the intermediate frame plate 302. An operating arm 456 is attached to the shaft 452 at a

point approximately midway between frame plate 302 and 454. A spring 458 (FIG. 2) normally biases the arm 456 in a clockwise direction and the tip of the arm acts against the bottom of the tray 226. The tray 226 is pivoted at 460 so that upward pressure exerted by the arm 456 raises the tray 226 until the paper in the tray rests against a pair of rubber paper feed rollers 462.

When the handle 450 is turned counterclockwise, the arm 456 is moved counterclockwise against the force of the bias spring 458 and this permits the tray 226 to drop to a horizontal position. The front frame plate 454 is provided with an aperture 464 and the operator may slide the paper receiving tray 226 outwardly through this opening to facilitate loading of a new supply of copy sheets. The paper tray carries a pair of arms 466 each having paper separator fingers 468 thereon. After the paper has been inserted in the tray 226, the separators are placed on top of the paper and, while the arm 450 is held rotated in the counterclockwise position, the tray is reinserted in the machine. The handle 450 is then released and the spring 458 pulls the arm 456 in a clockwise direction, the action of this arm against the bottom of the tray 226 pressing the top copy sheet against the feed rollers 462.

On each copy cycle, the top sheet of copy paper is fed from the supply in the tray 226. As previously explained, the timing cam clutch solenoid L4 (FIG. 3) is energized and the timing cams are driven through one revolution during each copy cycle. As the timing cam 410 begins to turn, it contacts a stud (not shown) attached to the side of a sector gear 468 (FIG. 3). The sector gear is pivoted on a shaft 470 and has teeth engaging the teeth of a one-way ratchet gear 472 which is attached to the paper feed shaft 474. As the cam 410 rotates, the sector gear is driven downwardly as viewed in FIG. 3 and this rotates the shaft 474. The shaft 474 carries the rubber paper feed rollers 462 so that when the shaft is rotated the top sheet of paper from the supply tray is fed underneath the rollers 462 and along a paper guide 476 (FIG. 2) to a set of gripper bars 482.

Subsequently the sector gear 468 is returned to its initial position by return spring 480 as best shown in the cut-out portion of FIG. 8.

Once a copy sheet has been delivered to the gripper bars 482, a second mechanism transports the copy sheet past the image transfer station 227 and the fuser station 228. In FIG. 4a, the motor B1 continuously drives the shaft 300 and the sprocket 360 attached to this shaft drives the chain 362. The chain drives the sprocket 372 which is mounted for normally free rotation on a shaft 484. The gear 372 provides the input power to drive the shaft 484 through a spring clutch. In FIG. 3, the clutch includes a spring (not shown), a clutch solenoid L5, a solenoid plunger 486 attached to a latch arm 488 that is pivoted about a point 490, and a latch cam 492 which is affixed to the shaft 484.

As long as the solenoid L5 is not energized, the latch arm 488 engages the cam 492 and this prevents transmission of power from the continuously rotating sprocket 372 through the spring to the shaft 484. Immediately after a copy sheet is delivered to the gripper bars 482, one of the timing cams closes its associated contacts to energize the solenoid L5. The plunger 486 is drawn into the solenoid and pivots the latch arm 488 away from the cam 492 thereby permitting power to be transmitted from the sprocket 372 through the spring to the shaft 484. The solenoid L5 is energized long

enough to permit the cam 492 to make three revolutions after which it latches up. During these three revolutions of the shaft 484, the gripper bars 482 grip the leading edge of the copy sheet and transport it to the position 482a shown in FIG. 2. At the same time, a second set of gripper bars are moved from the position 482a to the position 482 so as to be in position to receive the next copy sheet.

In FIG. 2, the jaws of the gripper bars are open at the time a copy sheet is delivered to the gripper bars from the paper supply. These gripper bars are more fully described in copending application Ser. No. 327,865 filed concurrently herewith. The gripper bars are attached to two transport chains 494. One of the gripper bars is firmly affixed to the chain and the other one is mounted for pivoting movement. As the gripper bars are moved into the position 482, a series of cams 496 cam the pivoted bar open so as to receive a copy sheet transported thereto from the supply tray 226. Each of the chains is driven by a sprocket 504, as best seen in FIG. 2. The sprockets 504 are mounted on shaft 484 so when the transport clutch solenoid L5 (FIG. 3) is energized and the shaft 484 begins to turn, the chains 494 are driven through sprockets 504. Almost immediately, the pivoted gripper bar drops off of the cams 496 and since this gripper bar is spring loaded it clamps the leading edge of the paper between the pivoted and fixed gripper bar. The shaft 484 continues its rotation and the chains 494 move the gripper bars at a constant rate past the transfer station 227 and the fuser station 228.

The chains 494 each form a closed loop extending around a pair of tension idler sprockets 500 and 502 and a further sprocket 498 which idles on a shaft 505 as best shown in FIG. 2. As the gripper bars pass a position over the sprocket 504, a set of cams 506 open the gripper bars thereby releasing the leading edge of the paper. The chain continues its movement for a slight distance until the transport clutch latches up at which time the gripper bars are in the position 482a.

Once the copy sheet has been released by the gripper bars it is transported by two sets of continuously rotating feed rollers. In FIG. 4a, the chain 362 continuously drives the sprocket 374 which is attached to a shaft 508. In FIG. 5, the shaft 508 drives an upper feed roll shaft 510 through gears 512 and 514. The shaft 510 carries a plurality of upper feed rolls 289 and through friction these feed rolls drive a set of lower feed rolls 290 (FIG. 2) which are freely mounted on the shaft 484.

The continuously rotating shaft 508 also drives a lower feed roll shaft 516 which carries a plurality of feed rolls 230. The gear 512 on the shaft 508 meshes with an idler gear 518 and the idler meshes with a gear 520 attached to the shaft 516. As the shaft 516 rotates, friction between feed rolls 230 and upper feed rolls 229 rotates the upper feed rolls on a shaft 522.

Thus, when the leading edge of a copy sheet is released by the gripper bars, the feed rolls 289 and 290 continue the forward movement of the copy sheet and it enters the feed rolls 229 and 230. These feed rolls carry the copy sheet out of the exit opening and it drops into the receiving tray 108 (FIG. 1).

CONTROL CIRCUIT ON-OFF

The control circuits for the photocopier are shown in FIGS. 9A-9C and are designed to operate from a 115 volt, 60 cycle, 15 amp power source. Power from this

source is applied to the copier over the input leads 902 and 904.

The ON-OFF pushbutton switch S3 is operated by the ON-OFF pushbutton 116 and has a first set of normally open contacts connected in a series circuit extending between lines 902 and 904. This series circuit includes the normally closed contacts of an over temperature interlock switch S27, a drum interlock switch S20, a developer cover interlock switch S22, a front cover interlock switch S23, a scan station cover interlock switch S24, an exit cover interlock switch S25, the contacts of ON-OFF switch S3, and the coil of a relay K3. Each of the interlock switches has a normally open contact connected to a lead 906. The ON-OFF switch S3 has a second set of normally open contacts connected between the lead 906 and a lead 908. The lead 908 is connected through a solenoid coil L3 to the line 902.

The switch S27 is located adjacent the path of copy sheets, at a point (FIG. 5) near the exit rolls. The contacts S27 are actuated to disable the copy machine when the temperature reaches a predetermined maximum at a point adjacent the copy sheet feed path. The drum interlock switch S20 is positioned as shown in FIG. 2 and disables the copy machine when the drum 213 is not properly installed. The cover interlock switches S22 and S23 (FIG. 6), S24 (FIG. 7), and S25 (FIG. 2) disable the copy machine when any of the outer covers are removed.

The ON-OFF switch S3 is a push button switch of the type disclosed in copending application Ser. No. 274,748 filed July 24, 1972. One depression of the push button closes both sets of normally open contacts on the switch and the contacts are latched in the closed position. The next depression of the push button releases both sets of contacts and they return to the open position. The push button switch shaft may be depressed manually or it may be operated automatically by energizing a solenoid L3.

The photocopy machine is ON when the relay K3 is energized and is OFF when the relay K3 is not energized. The relay has a first set of normally open contacts K3a connected between lead 904 and a lead 910, and a second set of normally open contacts K3b connected between the lead 902 and a lead 912. The leads 910 and 912 are the main leads for distributing electrical power to the various elements of the control system.

The machine may be turned on by manually depressing the ON-OFF push button to actuate switch S3 and close both sets of its contacts. This energizes relay K3 and closes the normally open contacts K3a and K3b to distribute power to the various elements of the system. The machine may be turned off by again depressing the ON-OFF push button to open the contacts of switch S3. The machine may also be turned off by energizing the solenoid L3 and this can be done in either one of two ways. First, the machine automatically shuts off if, for an interval of 20 seconds, no document is present in the scanning station. A timer motor B6 (FIG. 9C) tolls the 20 second interval in a manner subsequently described, and at the end of the 20 second interval a cam 913 (FIG. 7) actuates a switch S4 so that a circuit is formed (FIG. 9a) from lead 904, through contacts S27 and S4, to the solenoid L3. The machine may also be turned off if any of the interlock switches S27, S20, S22, S23, S24, or S25 is operated. In this case a circuit is formed from

the lead 904 through the actuated interlock switch, lead 906, the contacts of S3 (now closed), and lead 908 to the solenoid L3. When the solenoid L3 is energized it actuates S3 and opens both sets of its contacts thereby releasing relay K3 and removing power from the various circuits of the control system.

ON-OFF CONTROL CIRCUIT-WARM UP MODE

When the push button switch S3 is depressed it energizes relay K3 and closes the contacts K3a and K3b to initiate a twelve second warm-up interval.

The fuser door solenoid L6 (FIG. 9C) is connected directly across the leads 910 and 912 so this solenoid is energized to close the door on the fuser housing. This door is normally spring biased open but when solenoid L6 is energized, the link 913 (FIG. 6) closes the door so that the fuser will reach its operating temperature sooner.

The voltage regulator VR1 is also connected directly across the leads 910 and 912 and the voltage regulator is energized to provide output power on a lead 914. Four resistance heating elements HR1 through HR4 are connected in parallel between the lead 914 and the lead 912 so these elements begin heating up to produce the heat necessary to fuse the tone particles to the copy sheet.

The main drive motor B1, the exposure lamp fan motor B2, and the Not Ready timer motor B7 (FIG. 9a) are all connected in parallel across the lines 910 and 912 so each of these motors is energized at the time relay K3 is energized. The motor B7, through a slip clutch, drives a cam 915 (FIG. 7) to time a 12 second warm up interval. The motor B2 drives the fan 250 (FIG. 8) which supplies cooling ventilation to the exposure lamps at the document scanning station. The main drive motor B1 begins driving the gear train which supplies driving power to the photosensitive drum, and to the forward and reverse clutches which control the feed rolls at the document feeding station. The forward clutch solenoid L1 (FIG. 9b) is energized to drive the feed rolls in the forward direction. The circuit extends from lead 910 through normally closed contacts S10, over lead 918, through full wave rectifier CR1 and the solenoid L1, to lead 912.

The corona power supply PS1 (FIG. 9a) is also connected directly across leads 910 and 912 and thus is energized when relay K3 is energized. The power supply provides power to the pre-clean corotron 232, the charge corotron 216, and the transfer corotron 227 shown in FIG. 2. In addition, since the discharge lamps DS3 through DS6 (indicated at 231 in FIG. 2) are also connected directly across the leads 910 and 912 (FIG. 9a), these lamps are energized at the time the relay K3 is energized.

When the relay K3 is energized a visual indicator DS2 is energized on the control panel to indicate that the copy machine is not yet ready for operation. The circuit for energizing DS2 extends from lead 910 (FIG. 9b) through switch S19 and DS2 to lead 912.

At some time after the relay K3 is energized, the machine fan motor B3 is energized to remove excess heat from the photocopy machine. The motor B3 is connected in series with a thermostatically controlled switch S17 (FIG. 9a) in a series circuit extending between input leads 904 and 902. At some time after relay K3 is energized the fuser heaters will produce sufficient heat to raise the temperature within the photo-

copy machine and the switch S17 will close thereby energizing the machine fan motor B3 to drive the fan 917 (FIG. 2).

A Web Out indicator DS1 (FIG. 9b) and/or a Paper Low indicator DS7 may be turned on during the warm-up interval or at any other time after the relay K3 is energized. A switch S15 (FIG. 2) has contacts S15b connected in series with the Web Out indicator. This switch senses the presence of cleaning web 233 and closes the contacts S15b when there is no more unused web to wipe the photoconductive drum. When contacts S15b close, indicator DS1 is turned on to provide the operator with a warning that a new cleaning web should be installed.

A switch S14 has its contacts connected in series with a set of switch contacts S26 and the paper low indicator DS7. The switch S14 is located as shown in FIG. 5 and is actuated to close its contacts if there are fewer than about 20 sheets of copy paper in the paper tray 226. Switch S26 (FIG. 3) is cyclically operated by a cam 917 (FIG. 4a) as long as the drive motor B1 is energized. If there are fewer than about 20 sheets of paper in the paper tray, the Paper Low indicator DS7 continuously flashes on and off to signal the operator to load more paper into the paper tray.

If the paper tray is completely empty, this condition is sensed by a switch S6 (FIG. 5) and the switch contacts S6 (FIG. 9b) transfer. This provides a circuit to energize the Not Ready indicator DS2.

During the 12 second warm up interval the Not Ready timer motor B7 continuously drives the cam 915 (FIG. 7) through a slip clutch. After approximately 12 seconds, the cam 915 actuates switch S19 thus opening the circuit to the Not Ready indicator light DS2. If there is paper in the paper tray, the Not Ready light on the control panel goes out thus indicating to the operator that the machine has completed its warm-up cycle and is ready to copy documents. The slip clutch slips and cam 915 holds switch S19 open until the copier is turned off at which time a spring (not shown) returns the cam to its initial position.

SINGLE COPY MODE

A photocopy cycle is initiated to make a single copy of a document by inserting the document to be copied into the entrance feed rolls 200 and 201 at the document scanning station with the multiple copy knob 118 (FIG. 1) set for one copy. This setting of the knob 118 causes contacts S10 (FIG. 9B) to be set as shown. The document is fed into the scanning station at a constant rate and before it reaches the scanning window 209 it actuates the document feed switch S1 by depressing the operating arm 206. The contacts S1 (FIG. 9c) transfer thus de-energizing the auto-off motor B6 and energizing the relay K1. The motor B6 normally drives cam 913 (FIG. 7) to shut the copy machine off at an interval of 20 seconds elapses without a document being inserted into the scanning station. When the motor is de-energized, a spring returns cam 913 to its initial position so that it is ready to begin timing a new 20 second interval.

When relay K1 is energized its normally open contacts K1a close so that power is applied to the exposure lamp ballast RT1. Thus, the exposure lamps DS8 and DS9 are turned on prior to the time that the leading edge of the document reaches the scanning window 209.

Energization of relay K1 also closes the normally open contacts K1b so that power is applied to the motor B5. This motor drives the developer and the toner dispenser mechanism so that the developer mechanism begins cascading developer over the photosensitive drum.

The leading edge of the document continues its forward movement and passes the scanning window 209 so that the process is begun to lay down an electrostatic image of the document on the photosensitive drum. As the leading edge of the document continues its forward movement, and after it passes the scanning window, it depresses the arm 207 and closes the document feed switch contacts S2 thereby energizing the relay K2.

The relay K2 (FIG. 9b) has a set of normally open contacts K2a connected in series with the normally closed contacts of an over-temperature switch S7, a paper out switch S6, a web out switch S15, and the timing cam control clutch solenoid L4. The over-temperature switch S7 is located adjacent the fuser 228 (FIG. 2) and opens to prevent operation of the copier if the temperature at the fuser rises to too high a level. The paper out switch S6 (FIG. 5) is operated by the absence of paper in the paper tray 226. The web out switch S15 (FIG. 2) senses the absence of unused cleaning web in the machine. Assuming that there is paper in the copy paper tray, the fuser is not over its designed operating temperature, and that there is unused cleaning web in the machine, the solenoid L4 is energized when the relay contacts K2a are closed. When the solenoid L4 is energized the cam control clutch clutches in and begins driving the shaft 410 carrying the timing cams which actuate the seven timing cam contacts S5, S9, S11, S12, S13, S16, and S21.

Cam contacts S5 (FIG. 9c) close to provide a holding circuit for relay K1 after the trailing edge of the document releases document feed switch contacts S1. This insures that the exposure lamps and developer drive motor remain energized until after the trailing edge of the document has passed the scanning window.

In FIG. 3, the cam 410 drives the sector gear 468 downwardly thus rotating paper feed shaft 474 and feeding a copy sheet into the gripper bars 482 (FIG. 2). The gripper bars are not moving at the time the sheet feeding begins and the copy sheet is buckle fed into the open gripper bars.

Just before the feeding of a copy sheet into the gripper bar is completed, a timing cam closes cam contacts S12 (FIG. 9c) thereby energizing the paper transport clutch solenoid L5. As explained with reference to FIGS. 2 and 3, this causes drive power to be applied to the chains 494 upon which the gripper bars are carried, and the bars, now gripping the leading edge of the copy sheet, transport it past the transfer electrode 227 and the fuser 228 to the exit feed rolls. The continuously running exit feed rolls feed the completed copy out of the machine.

When cam contacts S12 close, a pulse is applied to the mechanical counter M1 which keeps a running total of all copies made.

Meanwhile, the original document has progressed through the scanning station until a point is reached at which the trailing edge of the document releases document feed switch contacts S2. The relay K2 drops out and its contacts K2a open the circuit to the cam control clutch solenoid L4. The clutch then latches up at the end of the revolution.

During the latter part of the timing cam cycle cam contacts S5 open to release K1 thereby permitting contacts K1a and K1b to open the circuits to the exposure lamps and developer motor B5. Also, cam contacts S12 open thus deenergizing the paper transport clutch and permitting it to latch up at the end of its cycle.

The above described operation comprises one complete machine cycle in the single copy mode. Within the next 20 seconds another document to be copied may be inserted into the entrance feed rolls at the scanning station and another cycle will begin. If another document is not inserted within 20 seconds, the motor B6 (FIG. 9c) drives cam 913 (FIG. 7) to close contacts S4 (FIG. 9a) thereby turning the machine off as previously described.

MULTIPLE COPY MODE

In order to make multiple copies, an operator sets the multiple copy dial 118 on the control panel to the number of copies desired. Rotation of this dial rotates two cams (not shown) that are driven by the multiple copy motor B4 (FIG. 9b). As the dial is set, one cam transfers switch contacts S10 and the other cam is positioned so that the switch contacts S8 are open. The forward feed clutch L1 is energized by a circuit extending from lead 910 through normally open contacts S10 (now closed), contacts S11, contacts S13, and CR1 to L1. The document to be copied is then inserted into the first set of feed rolls at the scanning station. The document is fed into the scanning station and as it enters the station the leading edge of the document closes switch contacts S1 to energize relay K1. Relay contacts K1a close to turn on the exposure lamps DS8 and DS9 while relay contacts K1b close to energize the developer drive motor B5.

The leading edge of the document passes the scanning window 209 and subsequently reaches the document feed switch S2. The leading edge of the document operates S2 thus completing a circuit to energize relay K2. Relay contacts K2a close to energize the timing cam clutch solenoid L4 thereby coupling mechanical drive power to the main timing cams. Relay contacts K2b close to provide an alternate circuit for energizing the forward feed clutch solenoid L1. This circuit extends from lead 910 through contacts S10, contacts S11, contacts K2b, and CR1 to the clutch solenoid L1.

When relay K2 is energized its contacts K2c close to energize relay K4. This circuit extends from line 910 through contacts S10 and contacts K2c to the coil of relay K4. The purpose of relay K4 is to provide alternate circuits for continuously energizing the exposure lamps and the developer drive motor throughout the time multiple copies are being made. Relay contacts K4b are connected in parallel with relay contacts K1b and provide a circuit for energizing the developer drive motor B5 even though relay K1 may be de-energized. In like manner, relay contacts K4c are connected in parallel with relay contacts K1a to provide an alternate circuit for energizing the exposure lamps DS8 and DS9.

Relay contacts K4a are connected in parallel with contacts K2c and thus provide a holding circuit for keeping relay K4 energized while the multiple copies are being made even though the relay K2 may be de-energized.

When the cam control clutch L4 is energized the main timing cams are driven through a cycle. Shortly after the beginning of this cycle a timing cam opens contacts S13 in one circuit to the forward drive clutch L1. However, the clutch remains energized at this time because of the parallel circuit through relay contacts K2b. Cam contacts S16 are closed to provide a circuit to energize the Not Ready indicator lamps DS 2 thereby indicating to the operator that the copier is not in condition for accepting another document.

Subsequently, another cam operates contacts S12 to energize the paper transport clutch L5 and the total copy counter M1. A further cam closes switch contacts S21 and the circuit to the reverse feed clutch but the clutch is not energized at this time because the contacts S11 are still in the normal position. Subsequently, a further cam transfers the contacts S11 thereby de-energizing the forward drive clutch L1 and energizing the reverse drive clutch L2. The circuit extends from the line 910 through switch contacts S10, switch contacts S11, switch contacts S21 and rectifier CR2 to the reverse clutch solenoid L2.

It should be noted that the timing of the cam which operates switch contacts S11 is such that the cam operates the switch contacts at a time during a cycle after which the trailing edge of a 14 inch document has passed the scanning window 209. When the reverse clutch solenoid L2 is energized, the document, which may be anywhere from 5 to 14 inches in length, is moved in the reverse direction and the leading edge of the document (as it moves in the reverse direction) again operates the switch contacts S1. A second circuit is thus formed for energizing the clutch solenoid L2. The circuit extends from line 910 through contacts S10, contacts S11, relay contacts K1c, and the rectifier CR2 to the clutch solenoid L2.

The timing cams are still rotating at this time and after this circuit is established cam contacts S21 open. The document continues its movement in the reverse direction because of the circuit through relay contacts K1c, and what is now the trailing edge of the document passes off the operating arm of the document feed switch S2 thereby releasing the relay K2. The contacts K2a open to de-energize the timing cam clutch L4 so that the clutch may latch up at the end of the cycle. Relay K4 remains energized because its contacts K4a bypass the now open contacts K2c.

Near the end of the timing cam cycle cam contacts S13 close and at the end of the timing cam cycle the contacts S11 are transferred. This breaks the circuit to the reverse feed clutch solenoid L2 and established a circuit to energize the forward feed clutch solenoid L1. The circuit extends from line 910 through cam contacts S10, cam contacts S11, cam contacts S13 and the rectifier CR1 to the solenoid L1.

The copier is now ready to begin a second cycle during which a second copy of the original document will be made. If the multiple copy control knob is set for 15 copies, 14 cycles like that just described will be carried out. During the 15th cycle reverse feed of the original document does not take place because during the normal forward feed portion of the cycle the multiple copy cam contacts S10 are returned to the position shown in FIG. 9b.

During the forward feed portion of each of the 14 copy cycles, that is, before the timing cam contacts S11 are transferred, timing cam contacts S9 are closed to

drive the multiple copy countdown motor B4. This motor drives two cams which operate the switch contacts S8 and S10. The cam which operates contacts S8 has 14 lobes thereon and the arrangement is such that when the multiple copy control knob is set to produce 15 copies the contacts S8 are closed by the 14th lobe the first time the motor B7 is energized through the contacts S9. The circuit for energizing the motor extends from lead 910 through contacts S10, timing cam contacts S9 to the motor. When the contacts S8 are closed a second circuit is provided to energize the motor B4 and this circuit extends from line 910 through contacts S10 and contacts S8 to the motor B4. This circuit drives the motor B4 until the cam which operates the contacts S8 is driven to a position where the operating arm of contacts S8 drops into the dwell between the 14th and 13th lobes on the cam. During the interval that the motor B4 is being driven by the circuit extending through contacts S8, the timing cam which drives contacts S9 permits these contacts to open. Thus, on each cycle the cam S9 initiates operation of the motor B4 so that the motor drives the multiple copy control knob one unit toward the single copy position.

The second cam driven by the motor B4 operates the contacts S10. This cam has a lobe which operates the contacts S10 any time the multiple copy control knob is not in the single copy position.

The timing of the cam which drives contacts S9 is such that on each copy cycle the countdown motor B4 completes its cycle of operation before the cam contacts S11 are transferred. Thus, from the foregoing description it is seen that if the multiple copy control knob is set to produce N copies, then on the Nth cycle the multiple copy control knob will return to its single copy position during the time the original document is still feeding in the forward direction. The contacts S10 return to the position shown in FIG. 9b so that no circuit can be established to energize the reverse feed clutch solenoid L2 when the cam contacts of S11 transfer. Instead, on the Nth cycle a circuit is established from line 910 through contacts S10, lead 918, and rectifier CR1 to the forward feed clutch solenoid L1. Therefore, on the Nth cycle the document is not reverse fed but continues its forward feed completely through the document scanning station.

As a document feeds out of the scanning station the trailing edge of the document releases the operating arm 207 and document feed switch contacts S2 open thereby releasing relay K2. Contacts K2a open thus de-energizing the cam control clutch solenoid L4 and permitting the clutch to latch up at the end of the cycle. Contacts K2c open and this releases relay K4 because a holding circuit is no longer established through contacts K4a and contacts S10. When relay K4 is released, the contacts K4b and K4c open thereby de-energizing the developer drive motor B5 and the exposure lamps DS8 and DS9.

Document feed switch contacts S1 are released by the trailing edge of the document prior to the release of the document feed switch contacts S2 and this energizes the motor B6 which begins to drive the cam 913 (FIG. 7). At the end of 20 seconds, this cam closes contacts S4 to energize the solenoid L3 and turn off the machine if, during the 20 second interval, a new document is not fed into the machine.

It should be noted that during the multiple copy mode the original document will feed out of the copier and the copier will enter the idle mode if there should be an over temperature condition, the cleaning web is exhausted, or the paper supply is completely exhausted. In FIG. 9b, any one of these three conditions opens the series circuit to the cam control clutch solenoid L4. The clutch latches up and remains latched. This holds the cams driven by the clutch in the position shown in the circuit diagram. S12 is open so the copy paper transport clutch solenoid L5 can't be energized to drive the copy paper transport. S11 is closed so a circuit is made from line 910 through the normally open contacts S10 (closed because of multiple copy) S11, S13 and CR1 to the forward feed clutch solenoid L1. This causes the document to be fed out of the copier.

If one of the three above-mentioned conditions exists and an operator inserts a document into the feed rolls with the machine set for the single copy mode, the clutch solenoid L4 is never energized and the original document feeds through the machine with a copy being made. In this case the forward feed clutch solenoid is directly energized from lead 910 through the closed contacts S10.

In summary, the present invention provides a simple, compact, desk-top xerographic copier wherein the document feed mechanism at the scanning station, the xerographic drum, and the copy paper transport mechanism are asynchronously operated relative to each other. The document feed mechanism operates in a forward or reverse feed mode while the drum is rotated continuously in one direction and the copy paper transport moves intermittently in one direction only. When feeding in the forward direction, the document feed mechanism moves at the same velocity as a point on the drum surface. When its movement is initiated, the copy paper transport carries a sheet of copy paper through a transfer station at the same linear velocity as a point on the drum moves through this station.

Since the document feed mechanism may accept a document at any time, an electrostatic image of the document may be laid down on any area of the drum surface, the particular area being determined by the time at which the document is transported through the scanning station. Operation of the copy paper transport is initiated by sensing means which senses the location of the document at the scanning station, the sensing means initiating the copy paper transport mechanism at a time such that a copy sheet arrives at the transfer station in registration with the developed electrostatic image.

While a preferred embodiment of the invention has been specifically described, it will be understood that various modifications and substitutions may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a xerographic copier of the type wherein a document is scanned to lay down an electrostatic image of the document on the surface of a rotating xerographic drum, the electrostatic image is developed to produce a visible image adhering to said drum surface, and said drum surface is rotated past a transfer station at which

the visible image is transferred to a copy sheet, the improvement comprising:

power drive means connected to continuously rotate said xerographic drum so that said surface moves at a predetermined speed;

document feed roll means for feeding a document through said scanning station;

means responsive to said power drive means for driving said document feed roll means,

said means responsive to said power drive means for driving said document feed roll means including forward feed clutch means for connecting said power drive means to rotate said feed roll means in one direction to feed said document in a forward direction in said scanning station, and,

reverse feed clutch means for connecting said power drive means to rotate said feed roll means in a second direction to feed said document in a reverse direction in said scanning station;

sensing means for sensing when a document being fed through said scanning station in a first direction has reached a first position;

a support for supporting a stack of copy sheets;

copy sheet transport means for transporting copy sheets one at a time from said stack and past said transfer station at said predetermined speed;

a copy sheet transport clutch means for connecting said power drive means to said copy sheet transport means;

means responsive to said sensing means for energizing said copy sheet transport clutch means at a time such that each copy is transported through said transfer station in registration with a visible image; and,

means for repetitively and alternately energizing said forward and said reverse feed clutch means whereby a document is repetitively fed through said scanning station and multiple electrostatic images of said document are laid down on said drum surface.

2. The improvement as claimed in claim 1 wherein the means responsive to said sensing means includes:

timing cam means;

timing cam control clutch means responsive to said sensing means for connecting said power drive means to said timing cam means; and,

switch means actuated by said timing cam means for energizing said copy sheet transport clutch.

3. The improvement as claimed in claim 1 wherein the means for repetitively and alternately energizing said forward and said reverse feed clutch means comprises:

second sensing means for sensing when a document being fed through said scanning station has reached a second position;

multiple copy cam means including means for manually rotating said multiple copy cam means from a single copy position to a desired multiple copy position;

multiple copy motor means for driving said multiple copy cam means toward said single copy position;

timing cam means;

timing cam control clutch means responsive to said sensing means for connecting said power drive means to said timing cam means;

switch means actuated by said timing cam means for energizing said multiple copy motor means; further switch means actuated by said multiple copy cam means; and, circuit means responsive said switch means and said further switch means for alternately energizing said forward or said reverse feed clutch means.

4. The improvement as claimed in claim 2 wherein said copy sheet transport means comprises: sheet grippers for gripping an edge of a copy sheet;

first and second chain means for supporting and transporting said sheet grippers; gear means, driven when said copy sheet transport clutch is energized, for driving said chains; and, means for delivering copy sheets one at a time to said sheet grippers.

5. The improvement as claimed in claim 4 wherein said means for delivering copy sheets to said sheet grippers comprises:

copy sheet feed roll means; bias means normally biasing said support whereby one sheet of said stack of copy sheets frictionally engages said copy sheet feed roll means; and, means driven by said timing cam means for rotating said copy sheet feed roll means to thereby drive said one sheet into said sheet grippers.

6. The improvement as claimed in claim 5 and further comprising:

an exit station including continuously rotating feed rolls for accepting a copy sheet transported by said sheet grippers; and, fuser means disposed adjacent the path of said sheet grippers, between said transfer and exit stations, for fusing transferred visible images onto copy sheets.

7. The improvement as claimed in claim 1 and further comprising:

lamps for illuminating said document as it passes through said scanning station; means projecting an image of said document onto said drum as said document is scanned to thereby lay down said electrostatic image; cascade developing means for cascading a developer material over said drum after said electrostatic

image is laid down to thereby develop said visible image;

further sensing means for sensing the presence of a document in said scanning station at a point before it is scanned; and,

means responsive to said further sensing means for illuminating said lamps and driving said cascade developing means.

8. In a xerographic copier of the type wherein a document is scanned to lay down an electrostatic image of the document on the surface of a rotating xerographic drum, the electrostatic image is developed to produce a visible image adhering to said drum surface, and said drum surface is rotated past a transfer station at which the visible image is transferred to a copy sheet, the improvement comprising:

power drive means connected to continuously rotate said xerographic drum so that said surface moves at a predetermined speed;

document feed means for moving a document through said scanning station in a forward direction at said predetermined speed;

copy sheet transport means for transporting copy sheets through said transfer station at said predetermined speed;

document feed clutch means for selectively connecting said power drive means to said document feed means so that it may selectively move a document through said scanning station;

a copy sheet transport clutch for selectively connecting said drive power means to said copy sheet transport means;

document sensing means for sensing the presence of a document at a predetermined position in said scanning station; and,

means responsive to said sensing means for selectively energizing said document feed clutch and said copy sheet transport clutch.

9. The improvement as claimed in claim 8 and further comprising:

means holding a stack of copy sheets, said copy sheet transport means including means for transporting one sheet at a time from said stack.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,834,805 Dated September 10, 1974
Inventor(s) Ronald F. Pichierri

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet item [19] "Griffin, Jr." should read -- Pichierri --; item [75] "Inventor: B. Franklin Griffin, Jr." should read -- Ronald F. Pichierri --.

Signed and sealed this 31st day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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