

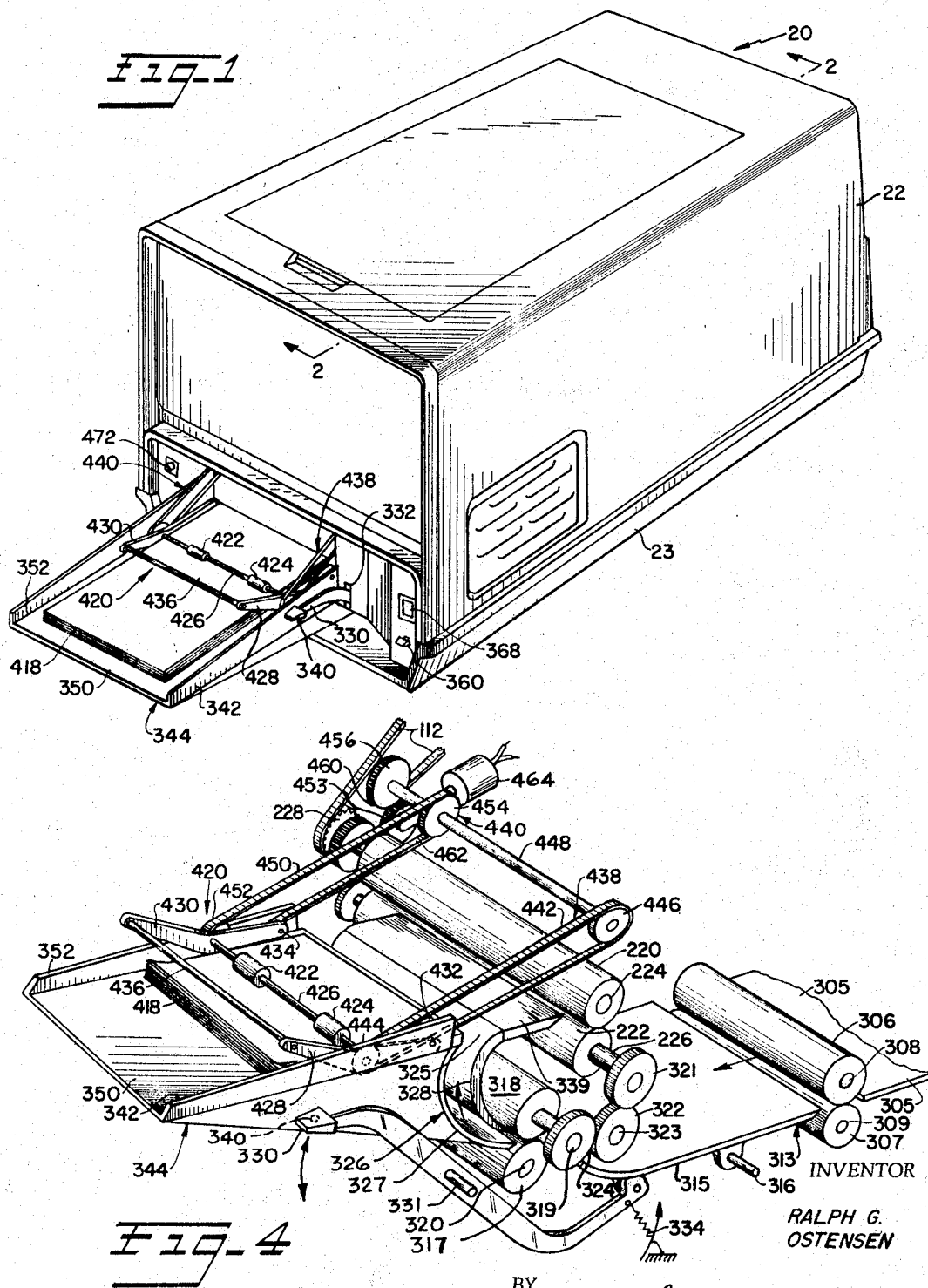
May 30, 1967

R. G. OSTENSEN
DUPLICATING APPARATUS

3,322,031

Filed Feb. 23, 1965

5 Sheets-Sheet 1



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DUPLICATING APPARATUS

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5 Sheets-Sheet 2

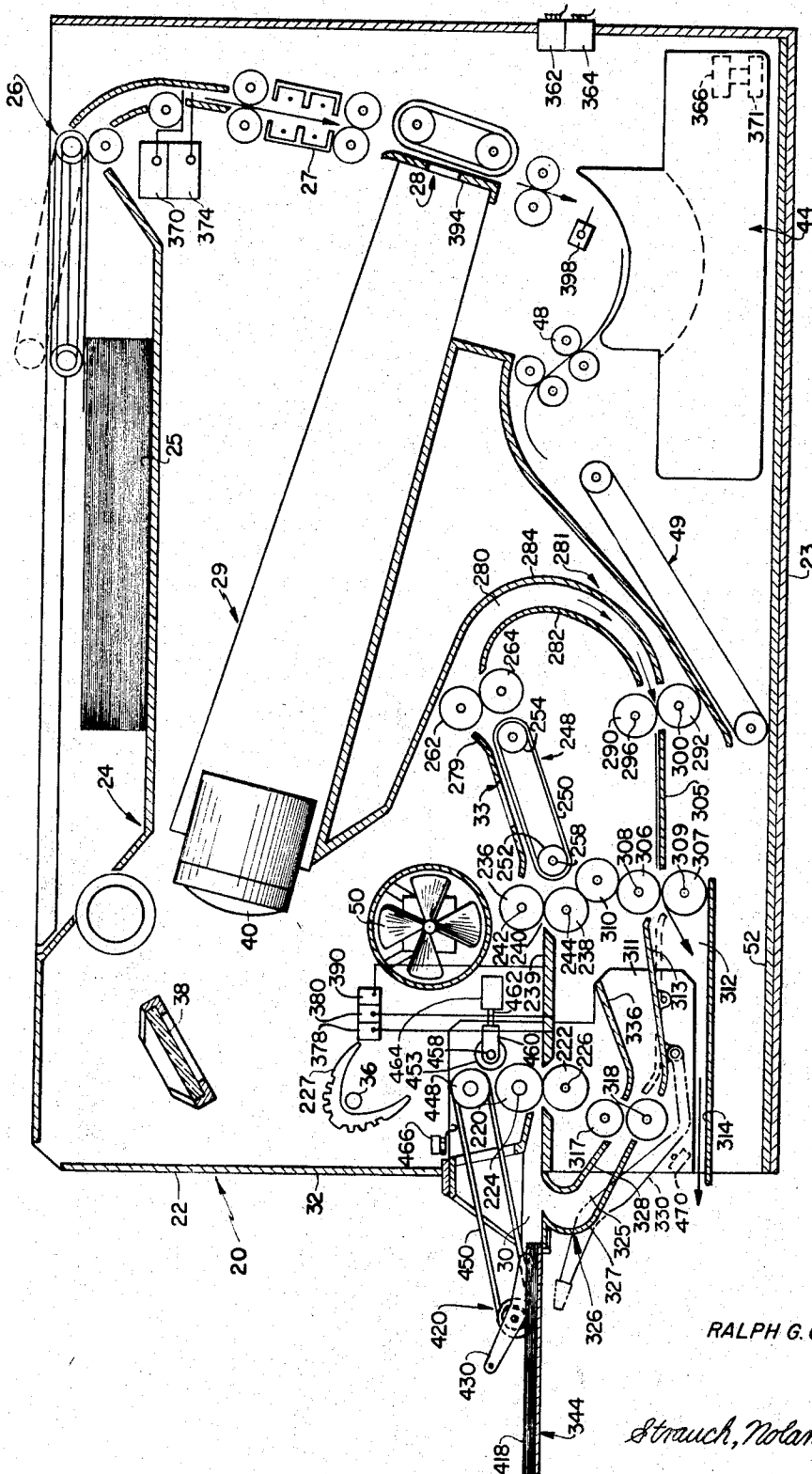


Fig. 2

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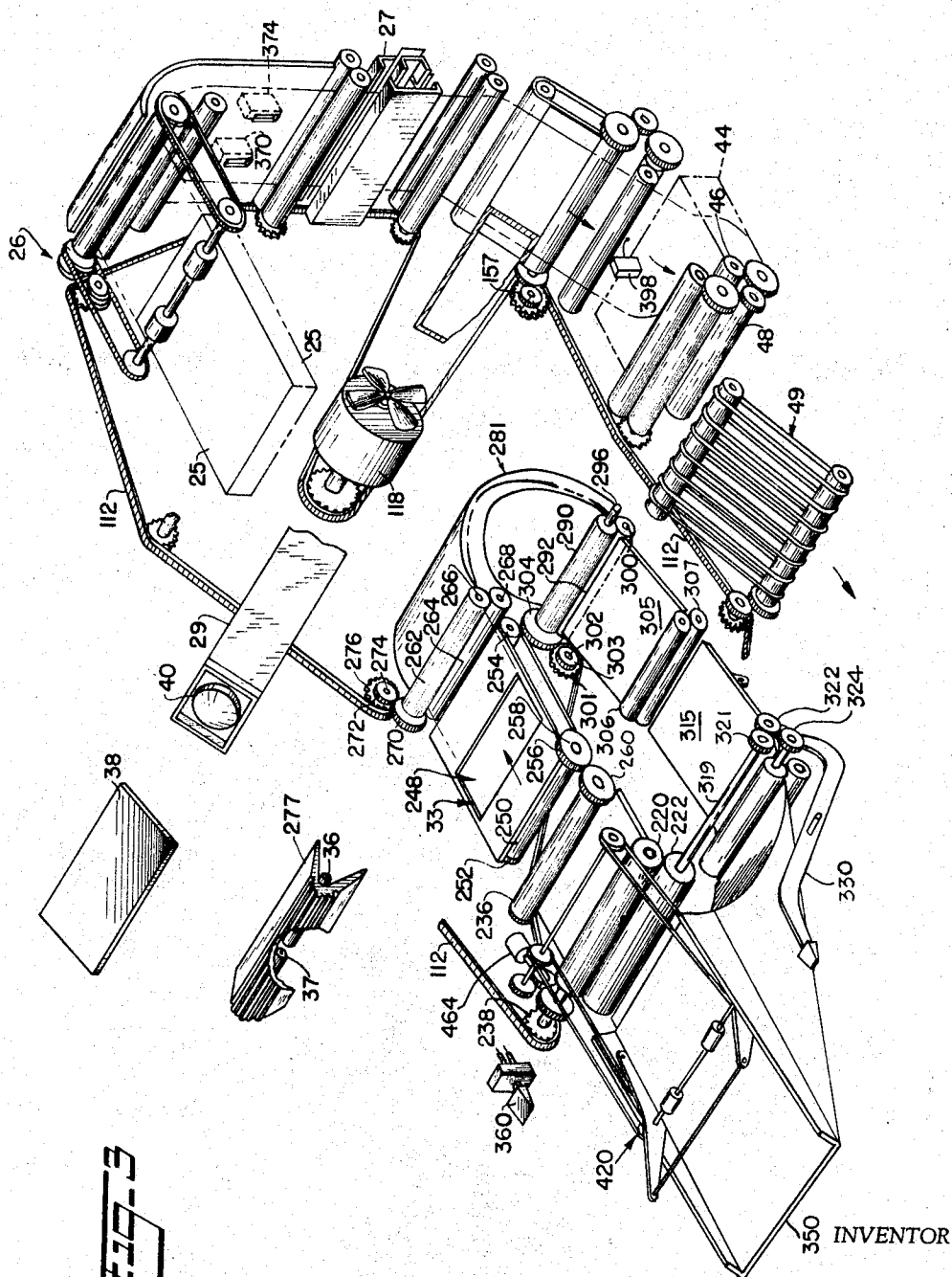
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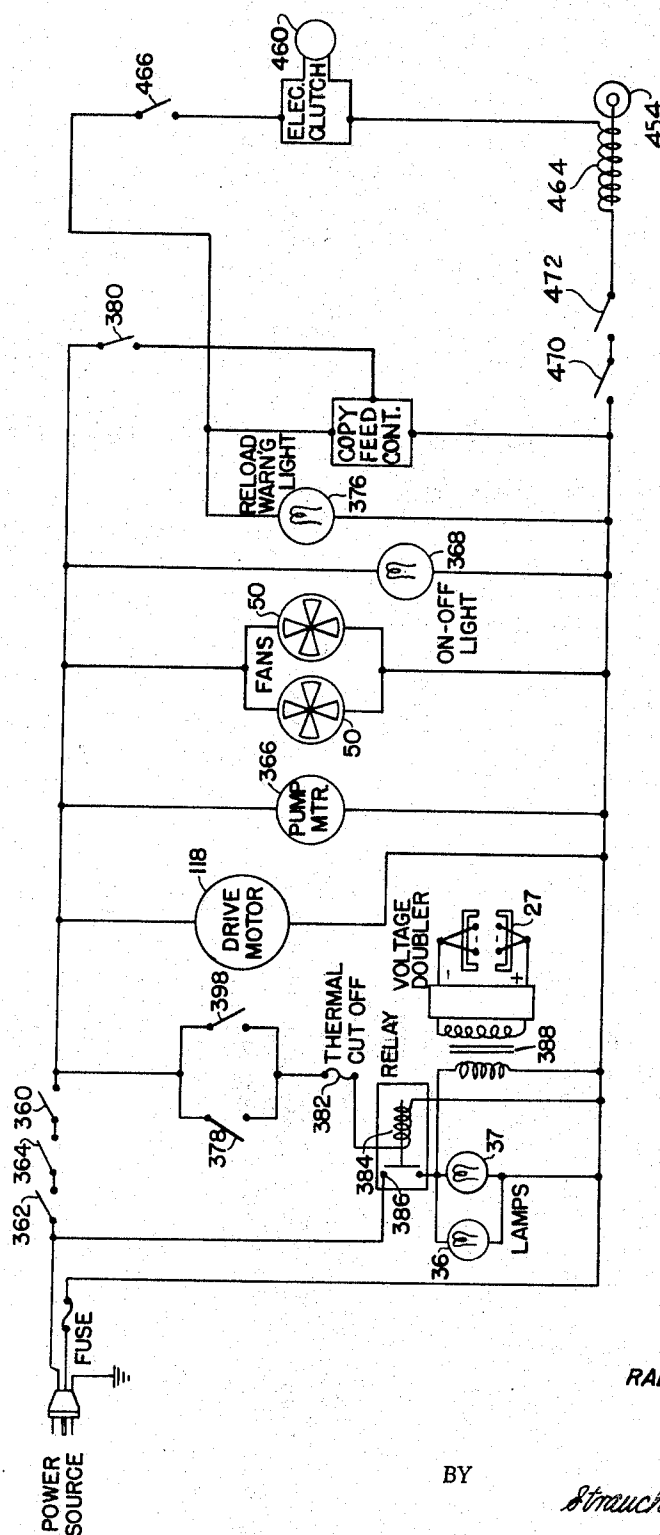
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5 Sheets-Sheet 4



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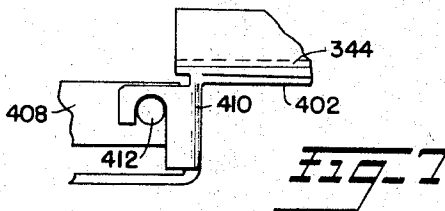
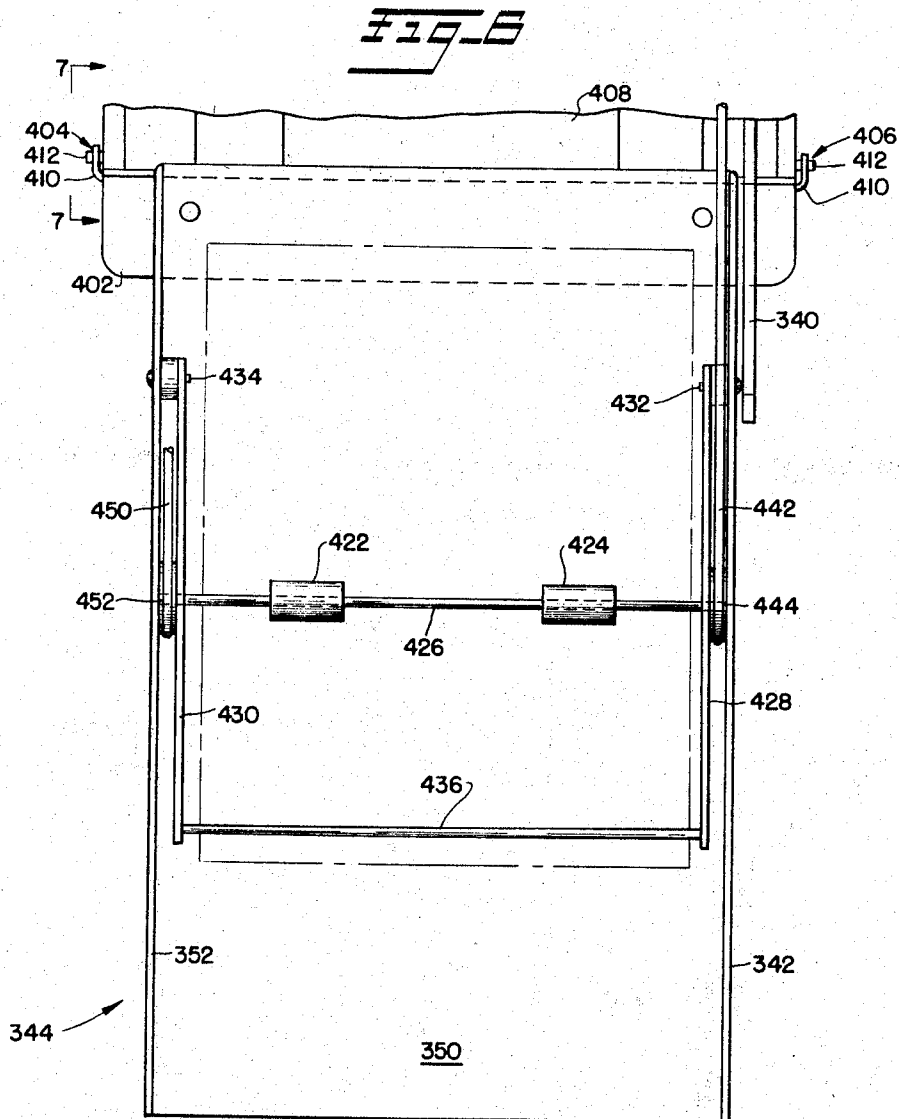
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5 Sheets-Sheet 5



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3,322,031

DUPLICATING APPARATUS

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10 Claims. (Cl. 88—24)

This application is a continuation-in-part of my copending application Ser. No. 390,127 filed Aug. 17, 1964, which, in turn, is a continuation of my now abandoned application Ser. No. 249,248 filed Jan. 3, 1963.

This invention relates to duplicating machines and is more particularly concerned with duplicating apparatus for making single or multiple copies of one or more original documents.

Although the invention herein will be described in its preferred embodiment as applied to an electrostatic printer, it will be understood by those skilled in the art that it may be applied with equal advantage to numerous types of duplicating machines.

In conventional office type duplicating machines where the original document to be copied is fed into the machine, there are two types of conveying mechanisms for transporting the original through an exposure or imaging station. One type of conveying mechanism comprises a rotatable exposure copy drum or cylinder to which the original document to be copied is releasably clamped or secured for rotation therewith. As the copy drum is rotated, copy paper is fed into the machine in timed relationship with the movement of the document on the copy drum to contact the document at the exposure station for effecting a transfer of the image on the document to the copy paper. Typical of this type of rotating carrier is the apparatus described in United States Letters Patent 3,100,112 issued to H. C. Davis et al. on August 6, 1963, for a Document Speed Mechanism. In a related form of document conveying mechanism of this first type mentioned above, the document to be copied is transported to and from the rotatable copy drum on one or more drive belts to which the document is secured by applying positive or negative air pressure to the document surface. With this latter form of conveying mechanism, the document is pressed between the copy paper and the periphery of the copy drum at the exposure zone and is trained around the copy drum by a motor driven belt.

A second type of mechanism for transporting an original document to be copied through an exposure or imaging station incorporates power driven guides, such as, for example, belts or rollers, which frictionally engage the document to transport it along a continuous path passing through the exposure station. In duplicating apparatus incorporating belt or roller document conveying mechanisms of this type, no rotatable copy drums are employed and the document to be copied and the copy paper are fed along separate, non-merging paths through remote imaging stations with the result that the document does not contact the copy paper to effect a transfer of the image on the document.

Duplicating machines incorporating this second type of conveying mechanism are described in U.S. Letters Patent No. 3,088,386 issued to M. L. Sugarman, Jr., on May 7, 1963, for an Electrophotographic Photocopy Machine and in my copending U.S. application Ser. No. 249,248, filed Jan. 3, 1963, for an Electrostatic Printer and now abandoned. In both of the conveyor mechanisms described in the aforesaid application and the aforesaid patent to M. L. Sugarman, Jr., the document is not clamped or secured to any of the parts of the machine, but is frictionally impelled through the guide path by the belts or rollers which are driven by a motor. As a result, belt or roller guide conveyors are preferred over the type

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of conveyor mechanism incorporating a rotating drum since, inter alia, the problem of properly aligning and then clamping the original document on the copy drum or securing the document for transportation around the copy drum is eliminated. With duplicating machines incorporating a copy drum, however, once the document to be copied is clamped or secured in place, many of the problems involved in making multiple copies of a single original document are obviated since a selected number of copies may easily be produced by successively feeding sheets of copy paper into the machine in timed relation with the recycling movement of the original.

As distinguished from the first type of document conveyor mechanism mentioned above which usually offers no serious difficulties in producing multiple copies after the document is secured in place, this invention, in one of its more important aspects, relates to a duplicating machine of the second type, incorporating a novel document conveying structure for producing a selected number of copies of an original document or a series of original documents.

Accordingly, one of the major objects of this invention is to provide for a novel duplicating machine for producing multiple copies of an original document by cyclically routing the document to be copied along an endless path with a conveyor mechanism of the second type mentioned above.

Another object of this invention is to provide a novel document guide structure for a duplicating machine of the type wherein the copy paper does not contact the document to be copied; wherein said guide structure routes the document through an endless path and ejects the traveling document from its endless path after a selected number of copies of the document are made.

A further object of this invention is to provide a duplicating machine wherein the document to be copied is not secured or clamped to any parts of a novel document conveyor mechanism and guide structure which cyclically routes the document along an endless path in the production of multiple copies. In this invention, the document is impelled along the endless path solely by frictional engagement with motor driven rollers, belts, or the like.

Still another object of this invention is to provide a duplicating machine with a novel document guide structure defining an endless path along which a document is cyclically routed to produce multiple copies and including a gate which is actuatable to a position for ejecting a document traveling in the endless path. According to a preferred embodiment of this invention the gate for ejecting the document guides and supports the document in an unactuated, multiple copy producing, recycling position. The guide structure in this preferred embodiment comprises a first turn-around document deflecting guide for substantially reversing the direction of movement after the document leaves the exposure station to direct it into a recycling section of the endless path and a second turn-around document deflecting guide for substantially reversing the direction of a document traveling in the cycling path section to re-direct the document through the exposure station. The gate, according to this invention, is disposed in the recycling path section between the two turn-around guides and is swingable between recycling and ejecting positions. These and other features of the invention to be described herein provide for a compact, simplified construction which is especially dependable in operation for making multiple copies with the second type of conveyor mechanism mentioned above.

A further object of this invention is to provide a duplicating machine with a novel document feed and guide mechanism wherein the operator may preselect modes of operation for producing a number of copies of a single

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document or producing single copies of a series of stacked documents fed one by one into the machine.

Yet another object of this invention is to provide a document feed mechanism for a duplicating machine for feeding stacked documents seriatim into the machine.

Further objects of the invention will presently appear as the description proceeds in connection with the appended claims and the annexed drawings wherein:

FIGURE 1 is a perspective view of the electrostatic printer of this invention as seen from the front, right corner;

FIGURE 2 is a partially schematic longitudinal sectional view taken substantially along lines 2—2 of FIGURE 1;

FIGURE 3 is a partially exploded perspective view as seen from the front, right corner of the printer of FIGURE 1 with the casing removed;

FIGURE 4 is a perspective view of the document feed mechanism and feed shelf as seen from the front, right corner of the printer in FIGURE 1 with the casing removed;

FIGURE 5 is a schematic diagram of the sequencing and control circuit for the printer shown in FIGURE 1;

FIGURE 6 is a fragmentary plan view of the feed shelf and document feed mechanism shown in FIGURES 3 and 4; and

FIGURE 7 is a section taken substantially along lines 7—7 of FIGURE 6.

Referring now to the drawings, and more particularly to FIGURES 1 and 2, the reference numeral 20 generally designates an electrostatic printing machine comprising a casing 22 removably mounted on a rigid frame 23. Preferably, casing 22 is slidably mounted on suitable up-standing tracks (not shown) so that it may be raised clear of frame 23 and the structure supported thereon.

Arranged within casing 22 is a copy paper supply compartment 24 comprising a shallow sheet metal tray into which photoconductive paper may be loaded in a stack 25. A paper feed mechanism generally indicated at 26 removes sheets of the copy paper from stack 25 in compartment 24 and transports them one at a time through a corona charging unit 27 where a uniform charge of approximately —400 volts is applied to the surface of the copy paper. From charging unit 27, each sheet of copy paper is fed through an imaging station 28 located adjacent the lower end of an imaging projector 29.

The original document to be copied may be manually inserted through a horizontal slot 30 provided in a panel 32 which forms the front wall of casing 22. The document fed through slot 30 is conveyed through an imaging station 33 by means to be described later on. The copy paper is advanced through its imaging station 28 synchronously and in timed relation to the movement of the document through station 33.

Imaging station 33, as shown in FIGURE 2 is located below the forward end of image projector 29. Light is focused on imaging station 33 as by a pair of projection lamps 36 and 37 (FIGURE 3), and an image is reflected from the surface of the original document into an objective lens 40 of projector 29 by a mirror 38. Lens 40 projects the reflected image onto the surface of the sheet of copy paper passing through its imaging station 28. As the image strikes the copy paper, the charge on the paper is reduced by an amount determined by the intensity of the reflected light. The black portions of the original will reflect such a relatively small light intensity as to affect the charge very little, while the light portions of the original will reflect sufficient light intensity as to almost completely release the latent electrostatic charge on the copy paper as is well known in the art.

With continued reference to FIGURE 2, the exposed copy sheet containing the latent charge pattern is developed to provide a visible image as by being passed through a developing tank 44. A liquid developer contained in tank 44 and having charged particles is applied to the

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latent image bearing surface of the copy paper. These charge particles, which may have a positive polarity, are attracted to negatively charged areas on the copy sheet to a degree determined by the charge at each region on the surface on the copy paper, thereby producing a graphic image. The copy paper feed mechanism then moves the developed copy paper between squeegee rollers 46 and 48 which remove the excess developer from the copy paper and which, if desired, may provide a direct voltage relatively low magnitude to control the density of the image and/or the cleanliness of the background of the developed copy paper.

The radiant heat of projection lamps 36 and 37 together with the air warmed by lamps 36 and 37 is blown across the copy paper by fans indicated at 50 to effect the removal of substantially all of the moisture from the surface of the copy paper. Thereafter, the developed copy paper is discharged by a conveyor 49 onto a tray surface 52 located near the bottom of printer 20 adjacent to panel 32. The sheets of copy paper deposited on surface 52 may be removed by an operator through an opening in panel 32.

Referring now to FIGURES 2, 3 and 4 the original document which is inserted through slot 30 for transportation through imaging station 33 is fed between a pair of pick-up rollers 220 and 222. Rollers 220 and 222 are respectively fixed on parallel shafts 224 and 226 which are mounted by suitable bearings (not shown) on frame 23. To rotate roller 220, chain 112 is trained over a sprocket wheel 228 which is fixed on shaft 224. Roller 222 is driven by frictional engagement with roller 220.

The document to be copied is advanced by rollers 220 and 222 horizontally toward a further pair of pick-up rollers 236 and 238 which are parallel to rollers 220 and 222 and which are separated from rollers 220 and 222 by a metal guide 239 suitably fixed in place on frame 23 and defining a document guide path 240 (FIGURE 2) extending horizontally between rollers 220 and 222 and rollers 236 and 238. Pick-up rollers 236 and 238 are respectively fixed on parallel shafts 242 and 244 which are rotatably mounted by suitable bearings (not shown) on frame 23. Roller 238 is continuously rotated by drive chain 112 which is trained over a sprocket wheel fixed on one end of shaft 244. Roller 236, which is mounted vertically above roller 238, is rotated by frictional engagement with roller 238.

Pick-up rollers 236 and 238 feed the document to be copied onto a conveyor 248 which comprises an endless belt 250 trained around parallel, spaced apart rollers 252 and 254. Belt 250 supports the document to be copied as it passes through imaging station 33 below the forward upper end of image projector 29.

As best shown in FIGURE 3, roller 252 is fixedly mounted on a shaft 258 which is rotatably supported by suitable bearings (not shown) on frame 23. A spur gear 256 fixed on one end of shaft 258 constantly meshes with a spur gear 260 fixed on shaft 242 with the result that advancement of chain 112 continuously rotates rollers 252 to drive belt 250. The rearward movement of the document on conveyor belt 250 is synchronized with the movement of the copy sheet by drive chain 112, which drives the copy feed train as well as the document feed.

As the document travels off the rear end of belt 250, it passes between a further pair of pick-up rollers 262 and 264 respectively fixed on parallel shafts 266 and 268 which are rotatably mounted by suitable bearings (not shown) on frame 23. Pick-up roller 262 is driven by a gear 270 fixed on one end of shaft 266 and constantly meshing with a gear 272. Gear 272 is fixed on a shaft 274 which is rotatably mounted on frame 23 and which mounts a sprocket wheel 276. Drive chain 112 is trained over sprocket wheel 276 to continuously revolve roller 262 when motor 118 is energized. Roller 264, which is vertically below roller 262, is driven by frictional engagement with roller 262.

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With continuing reference to FIGURES 2 and 3, the document fed through imaging station 33 is advanced by rollers 262 and 264 onto a throat 280 formed by a rear turn-around guide 281. Guide 281 comprises forward and rearward arcuate walls 282 and 284 which are fixed on frame 23 in spaced, parallel relationship. As shown, guide 281 deflects the rearwardly moving document into a path traveling toward the front of printer 20.

Still referring to FIGURES 2 and 3, the copied document is withdrawn from guide 281 by a pair of pick-up rollers 290 and 292 which are respectively fixedly mounted on rotatable, parallel shafts 296 and 300.

As shown in FIGURE 3, drive chain 112 is trained around a sprocket wheel 301 which is fixed on a rotatably mounted shaft 302. A gear 303 fixed on shaft 302 constantly meshes with a further gear 304 fixedly mounted on one end of shaft 296 to rotate rollers 290. Roller 292 is driven by frictional engagement with roller 290.

As shown in FIGURES 2 and 4, rollers 290 and 292 advance the copied document over a fixed metal guide 305 to a further pair of pick-up rollers 306 and 307 which are respectively fixed on rotatably mounted parallel shafts 308 and 309. Roller 306 is driven by frictional engagement with a parallel idler roller 310 (FIGURE 2) which, in turn, is driven by frictional engagement with roller 238. Roller 307 is driven by frictional engagement with roller 306.

In accordance with this invention, the copied document advanced toward the front of printer 20 by rollers 306 and 307 is transferred either into an ejection path 312 or into a recycling path 311 by a gate or flipper 313. The document routed through path 311, as will be explained in greater detail below, is recycled through imaging station 33 for producing multiple copies. The document routed through ejection path 312 is deposited on a tray 314 for removal from printer 20 by the operator.

As best shown in FIGURE 4, flipper 313 may comprise a plate 315 which is pivotally mounted on a fixed shaft 316 for swinging movement about an axis extending between and parallel to rollers 306 and 307 at one side and a pair of document recycling rollers 317 and 318 at the other side. Rollers 317 and 318 are respectively fixed on parallel shafts 319 and 320 which are rotatably supported on frame 23 by suitable unshown bearings.

With continued reference to FIGURE 4, a gear 321 fixed on shaft 226 constantly meshes with a gear 322. Gear 322 is fixed on a rotatably mounted idler shaft 323 and is in constant meshing engagement with a gear 324 which is fixed on shaft 319. As a result, advancement of drive chain 112 imparts rotation to roller 317 through the drive train formed by gears 321, 322, and 324. Roller 318 is driven by frictional engagement with roller 317.

As shown in FIGURES 2 and 4, rollers 317 and 318 advance the copied document into a throat 325 formed by a forward turn around guide 326. Guide 325 comprises forward and rearward arcuate guide walls 327 and 328 which are fixed on frame 23 in spaced, parallel relationship. As shown, guide wall 327 deflects the forwardly moving document upwardly and rearwardly to reverse its direction by approximately 180 degrees and route it into the nip between rollers 220 and 222. The recycled document is thus advanced by rollers 220 and 222 along path 240 where it is picked up again by rollers 236 and 238 which feed the document to conveyor 248 for transportation through imaging station 33. In this manner, the document may be cyclically routed along an endless path passing through imaging station 33 by maintaining flipper 313 in its phantom line position shown in FIGURE 2. The rotational axes of rollers 220, 222, 236, 238, 262, 264, 290, 292, 306, 307, 317 and 318 are all parallel and are substantially at right angles to the direction of movement of the document through printer 20.

With continued reference to FIGURES 2 and 4, a lever 330 pivotally connected at one end to flipper 313 forwardly of shaft 316 is rotatably mounted on frame 23 by a pin 331 and extends forwardly through an elongated

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aperture 332 (FIGURE 1) in frame 23. Pin 331 is disposed along an axis that is parallel to that of shaft 316 and is about midway between the opposite ends of lever 330. A spring 334 connected at opposite ends respectively to frame 23 and to lever 330 biases lever 330 to its raised position shown in FIGURE 4 where flipper 313 is held in a position for routing the document advanced by rollers 306 and 307 into ejection path 312.

By depressing the forward end of lever 330 to rotate lever 330 in a counterclockwise direction as viewed from FIGURES 2 and 4, flipper 313 is swung in clockwise direction about the axis of shaft 316 to a recycling position illustrated in phantom lines in FIGURE 2. In its recycling position, flipper 313 extends substantially horizontally between rollers 306 and 307 at one end and rollers 317 and 318 at the other end. As shown, flipper 313 when in its recycling position, is disposed closely adjacent to the exit throat of rollers 306 and 307 and the entrance mouth to rollers 317 and 318 and delimits path 311 to supportingly guide the document advanced by rollers 306 and 307 to a region where the document is picked up by rollers 317 and 318. A fixed guide plate 336 above flipper 313 delimits the upper boundary of path 311 and cooperates with flipper 313 to guide the document routed through path 311. Thus it is clear that when flipper 313 is rocked to its recycling position, the document advanced by rollers 306 and 307 is supported and guided by flipper 313 into the entrance mouth of rollers 316 and 317 which advance the document into turn around guide 326. Guide 326 deflects the document to rollers 220 and 222 which recycle the document through imaging station 33.

A conventional ball and detent assembly for releasably holding lever 330 in its depressed recycling position comprises a detent (not shown) formed in a side wall of the forward end of lever 330 which co-operates with a suitable spring biased ball 340 carried in an upstanding side wall 342 of document feed shelf 344. The spring-biased ball mechanism can be operationally attached to conventional counting mechanisms so as to release lever 330 after a selected number of copies has been made.

When lever 330 is manipulated to release it from its depressed, recycling position, spring 334 biases lever 330 in a clockwise direction about the axis of pin 331 to swing flipper 313 in a counterclockwise position (as viewed from FIGURE 2) for ejecting the moving document from its endless path in the printer. In this position, the rearward end of flipper 313 is raised above the exit throat of rollers 306 and 307 with the result that the document is advanced under flipper 313 and into ejection path 312 for deposit on tray 314.

With continued reference to FIGURES 1 and 4, feed shelf 344 extends forwardly from panel 32 and is detachably mounted on frame 23 by means to be described later on. Feed shelf 344 is formed with a flat document support plate section 350 extending horizontally between wall 342 and a further upstanding side wall 352. Walls 342 and 352 are parallel and respectively extend along the left and right-hand edges of plate section 350 as viewed from the front of the printer.

Referring now to FIGURE 5, operation of printer 20 is started by closing a main on-off switch 360 which is mounted on the front of frame 23 (see FIGURE 1). Switch 360 is connected in series with a pair of interlock switches 362 and 364 which are also mounted on frame 23 as shown in FIGURE 2. Switches 362 and 364 open when casing 22 is removed, thus preventing operation of the printer unless the casing is in place. With casing 22 in place, switches 362 and 364 are closed. As a result, the closing of main switch 360 completes circuits through motor 118, a pump motor 366, exhaust fans 50, and an on-off lamp 368 mounted on the front of the printer (see FIGURE 1).

Pump motor 366 drives a pump 371 which circulates a liquid developer or toner solution in tank 44. This

toner solution in tank 44 carries pigment particles that adhere to the charged portion of the copy paper as it passes through the solution.

Energization of fans 50, as was indicated above, circulates air in printer 20 to remove heat of operation from the printer and to assist in drying the developed copy paper after it leaves tank 44 and passes through squeegee rollers 46 and 48.

Energization of motor 118 sets drive chain 112 in motion for transporting the copy paper through the printer. In addition, chain 112 also will continuously drive rollers 220, 222, 236, 238, 262, 264, 290, 292, 306, 307, 317, and 318 and conveyor 48 for transporting the original document to be copied through the printer.

As the document to be copied is inserted through the slot 30 in the front panel of printer 20, it is picked up and fed into path 240 by rollers 220 and 222. Shortly after the document passes between rollers 220 and 222, the leading edge of the document simultaneously engages and trips normally open switch 380 which is mounted within casing 22 with its actuator in the path of the inwardly moving original.

The closing of normally open switch 380 completes a circuit which, in turn, activates the copy paper feed. As a result, a drive connection is established the moment that the leading edge of the traveling document actuates switch 380. This control of the copy paper feed by the advancement of the original document towards imaging station 33 thus establishes a timed relationship with the movement of the document to be copied to assure that the copy paper and the document pass through their respective imaging stations 28 and 33 at the same time.

After engaging switch 380 the document is fed through rollers 236 and 238 past imaging station 33 and through rollers 262 and 264 into turn-around guide 281.

As the document emerges from guide 281, it is picked up by rollers 290 and 292 which feed the document forwardly over guide 305. The document advanced over guide 305 is picked up by rollers 306 and 307 which continue to feed it towards the front of the printer.

With flipper 313 in its tilted, full line, single copy position shown in FIGURE 2, the document advanced by rollers 306 and 307 is guided under flipper 313 and is deposited on tray 314 for removal by the operator. As a result, the printing cycle for producing a single copy is completed. Thus, with flipper 313 in its tilted, single copy position, the same or another document must be inserted through slot 30 in the front panel of casing 22 to close switch 380 and reactivate the copy feed mechanism.

To make more than one copy of the original document, lever 330 is depressed by the operator to rotate flipper 313 in a clockwise direction as viewed from FIGURE 2 to its substantially horizontal, multiple copy producing position illustrated in phantom lines in FIGURE 2.

With flipper 313 in its multiple copy producing position, a document advanced toward the front of printer 20 by rollers 306 and 307 is supportingly guided by flipper 313 into path 311 where it is picked up by roller 317 and 318. Rollers 317 and 318 feed the document into throat 325 of forward turn-around guide 326 which deflects the document upwardly and rearwardly toward rollers 220 and 222.

Rollers 220 and 222 again advance the recycled document along path 240 where the leading edge of the document trips switch 380 to its closed position. Closing of switch 380 again energizes the copy feed mechanism.

By retaining flipper 313 in its recycling position, the document is recycled to produce as many copies as desired. When a selected number of copies is produced in this manner, lever 330 may be released to rotate flipper 313 in a counterclockwise direction to its tilted single copy position shown in full lines in FIGURE 2 with the result that the recycling document advanced by rollers

306 and 307 is then ejected from its endless path as previously described.

As shown in FIGURES 6 and 7, feed shelf 344 is mounted on a bracket 402 which is preferably detachably supported by post and ear assemblies 404 and 406 from a shelf portion 408 mounted rigid with frame 23. Assembly 404 comprises a notched ear 410 which detachably hooks over a post 412 fixed to and extending laterally from the side edge of shelf portion 408. Assembly 406 is of the same construction as assembly 404, like reference numerals being used to identify like parts. With this construction, bracket 402 and feed shelf 344 are detachable as a unit by tilting the forward end of feed shelf 344 upwardly until ears 410 of assemblies 404 and 406 are raised clear of post 412.

As best shown in FIGURE 4, documents in a stack 418 on feed shelf 344 may be advanced successively through slot 30 by a document feed mechanism 420. Mechanism 420 is especially constructed for incorporation in printer 20 as an accessory so that it may be employed with conventional printers as well as the printer of this invention.

With continuing reference to FIGURE 4, document feed mechanism 420 comprises a pair of rubber covered, document engaging rollers 422 and 424 which are fixed in axially spaced apart relationship on a shaft 426. Shaft 426 extends transversely across the top of feed shelf 344 and is rotatably supported at opposite ends on a pair of identically constructed arms 428 and 430. Arms 428 and 430 are pivotally mounted by axially aligned pins 432 and 434 on walls 342 and 352 of feed shelf 344. A rod 436 rigidly fixed at opposite ends to the forward ends of arms 428 and 430 is adapted to be gripped by the operator to rock arms 428 and 430 about their axially aligned axes. The axis of shaft 426, as shown, is spaced forwardly from and extends parallel with the aligned pivot axes of arms 428 and 430 whereby shaft 426 and rollers 422 and 424 may be raised and lowered by swinging arms 428 and 430 up and down. The axes of shaft 426 and pins 432 and 434 are parallel with the rotational axes of rollers 220 and 222.

With continuing reference to FIGURE 4, shaft 426 is driven by a pair of belt and pulley assemblies 438 and 440 disposed at opposite sides of feed shelf 344. Belt and pulley assembly 438 comprises an endless belt 442 trained around a pair of pulleys 444 and 446 respectively fixed on corresponding ends of shaft 426 and a shaft 448. Similarly, belt and pulley assembly 440 comprises a belt 450 trained around a pair of pulleys 452 and 454 respectively fixed on the opposite ends of shafts 426 and 448. Shaft 448 is journaled on frame 23 by suitable bearings (not shown) vertically above roller 220 and in parallel relation with shaft 426.

Shaft 448, in turn, is driven through roller 456 thereon by an idler roller mechanism 452 presently to be described, which in turn contacts roller 220 fixed on shaft 224. By this construction shaft 426 and, consequently, rollers 422 and 424 can be rotated through the drive train formed by belt and pulley assemblies 438 and 440, shaft 448, roller 456, idler roller mechanism 452, and roller 220 on shaft 224 when motor 118 is energized.

Now referring more specifically to idler roller mechanism 452, mechanism 452 comprises idler roller 453 which is of relatively short length and fixed on shaft 458. Shaft 458 is journaled on fork member 460. Fork member 460 has a shaft portion 462 which acts as the plunger member of a solenoid 464. Activation of solenoid 464 thrusts fork member 460 and idler roller 453 thereon into engagement with roller 456 and roller 220. A spring (not shown) interconnecting fork member 460, and the frame 23 biases idler roller 453 away from roller 456 and roller 220 when solenoid 464 is deactivated.

Now referring to FIGURE 5, solenoid 464 is connected in parallel to reload warning light 376. As previously described tripping of switch 380 by a document

activates the copy paper feed mechanism of the apparatus. While a more complete description of this mechanism can be had by referring to my co-pending application Serial Number 249,248, filed January 3, 1963, and now abandoned, it is sufficient to explain the operation of the mechanism as requiring a time delay between the feeding of successive documents, to allow time for feeding of successive copy sheets. This is reflected by reload warning light 376 which is lighted only when the apparatus is ready for the next document. While this light acts as a guide to the operator using the apparatus of Serial Number 249,248, filed January 3, 1963, and now abandoned for manually making single copies its circuitry can also be utilized with the apparatus of this invention by electrically connecting solenoid 464 in parallel with reload warning light 376. Thus, when the reload warning light is lit, the solenoid will be activated causing the various members of document feed mechanism 420 described to feed another document into the apparatus.

Still referring to FIGURE 5, it will be seen that several other electrical components have been illustrated as wired in series with solenoid 464 to provide additional optional control over the document feed apparatus. Switch 466 provides for disengagement of the drive mechanism when arms 428 and 430 are raised to add more document on feed shelf 344. The raising of arms 428 and 430 cause belt 450 to engage switch 466 deactivating solenoid 464.

Likewise switch 470, which is a normally closed switch positioned beneath lever 330, will open the circuit to solenoid 464, deactivating same if lever 330 is accidentally depressed to put the mechanism into the multiple copy mode. This prevents the apparatus from operating in both multiple copy and document feed modes simultaneously.

Switch 472 is a mode selector switch which can be located on the front panel of the machine and turned on and off manually by the operator when it is desired to activate or deactivate the document feed mechanism.

With the foregoing document feed mechanism, it will be appreciated that document feed mechanism 420 may easily be installed on a conventional duplicating machine by mounting the assembly of feed shelf 344, arms 428 and 430, shaft 426, and rollers 422 and 424 on the frame of the conventional machine. Shaft 448 and roller 456 thereon are easily mounted in the conventional printer along with the idler roller mechanism. Switches 466, 470 and 472 then may be connected in series with solenoid 464 across the reload warning light circuit to control the operation of the document feed mechanism in the manner previously described.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. In a duplicating machine, a duplicating station, guide means defining a path for routing a document to be copied through an exposure zone in said duplicating station, means for moving said document along said path and for feeding copy paper through said duplicating station in timed relation with the movement of said document therethrough to enable transfer of an image from the document to said copy paper as they pass through said duplicating station, means for feeding at least one document into said path comprising a shelf supported on the machine and adapted to support a stack of documents to be copied, rotatable motor driven roller means forming a part of said document feeding means and normally adapted to engage and move the topmost document into said path, drive means for rotating said roller means,

means mounting said roller means for upward and downward movement with respect to said shelf, and means effective when said roller means is raised a predetermined distance from said shelf for interrupting rotation of said roller means by said drive means.

2. The duplicating machine defined in claim 1 wherein said means for interrupting rotation of said roller means comprises a solenoid, an energizing circuit for said solenoid, a switch in said circuit and being actuatable by raising said roller means to effect operation of said solenoid, and an element operatively connected to said solenoid, said element forming a part of said drive means and being effective by the switch-actuated operation of said solenoid to interrupt the motor driven rotation of said roller means.

3. The duplicating machine defined in claim 2 wherein said element comprises an idler displaceable between power transmitting and power interrupting positions by switching-controlled energization and de-energization of said solenoid.

4. In a duplicating machine, a duplicating station, guide means defining a path for routing a document to be copied through an exposure zone in said duplicating station, means for moving the document along said path and for feeding copy paper through said duplicating station in timed relation with the movement of the document therethrough to enable the transfer of an image from the document to the copy paper as they pass through said duplicating station, means for feeding at least one document into said path comprising a shelf supported on the machine and adapted to support a stack of documents to be copied, rotatable roller means forming a part of said document feed means for engaging and moving a document from said shelf into said path, motor driven means for rotating said roller means, means for selectively recycling the document through said exposure zone in said duplicating station, an idler element forming a part of said motor driven means, a solenoid for actuating said idler element to interrupt motor driven rotation of said roller means, a switch actuated by said recycling means when said recycling means is set to recycle the document for operating said solenoid to prevent another document from being fed into said path by said roller means.

5. In a duplicating machine, a duplicating station, guide means defining a path for routing a document to be copied through an exposure zone in said duplicating station, means for moving said document along said path and for feeding copy paper through said duplication station in timed relation with the movement of the document therethrough to enable transfer of an image from the document to the copy paper as they pass through the duplicating station, means for feeding at least one document into said path comprising a shelf supported on said machine and adapted to support a stack of documents to be copied, roller means forming a part of said document feed means for engaging and moving a document from said shelf into said path, motor driven means for rotating said roller means, gate means displaceable to recycle the document through said exposure zone, means operatively connected to said gate means and being selectively operable to displace said gate means to its document recycling position, and means including a control switch actuated when said gate means is displaced to its document recycling position for operatively disconnecting said roller means from said motor driven means to prevent another document from being fed into said path by said roller means when a document is being recycled by said gate means.

6. A sheet feed apparatus for a duplicating machine comprising surface means adapted to support a stack of sheets to be fed into a part of said machine, a rotatable sheet feed shaft, roller means mounted on said sheet feed shaft, means pivotally supporting said sheet feed shaft for upward and downward swinging movement about an axis extending in parallel spaced apart relation to the

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shaft rotational axis, the assembly of said shaft and said roller means being disposed above said surface means and being downwardly pivotable to a position where said roller means engages at least one sheet on said surface means for urging said sheet into said part of said machine, a power driven shaft rotatably mounted about an axis that is in parallel, spaced apart relation to the rotational axis of said sheet feed shaft, and belt drive means operatively connecting each end of said power driven shaft to a corresponding end of said sheet feed shaft and enabling said sheet feed shaft to be raised and lowered relative to said power driven shaft.

7. The sheet feed apparatus defined in claim 6 wherein said belt drive means comprises a pair of parallel spaced apart belt and pulley assemblies extending between corresponding ends of said shafts.

8. The sheet feed apparatus defined in claim 6 comprising motor drive means for rotating said power driven shaft and means for operatively disconnecting said power driven shaft from said motor drive means to interrupt motor driven rotation of said roller means.

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9. The sheet feed apparatus defined in claim 6 wherein said surface means comprises a shelf adapted to be mounted on said machine and wherein said means pivotally supporting said sheet feed shaft comprises a pair of parallel spaced apart arms rotatably carrying said sheet feed shaft and being pivotally mounted on said shelf about axially aligned axes.

10. The sheet feed apparatus defined in claim 9 comprising a member mounted on said arms and being manually grippable for raising the assembly of said sheet feed shaft and said roller means.

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