

[54] **MULTIPLE COPY ARRANGEMENT FOR PHOTOCOPY MACHINE**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 750,912, Aug. 7, 1968, abandoned.
[52] U.S. Cl. 355/102, 271/64, 355/11, 355/14, 355/51
[51] Int. Cl. G03b 27/06
[58] Field of Search 355/102, 109, 50, 355/51, 11, 12, 14; 271/64, 51

[56] **References Cited**

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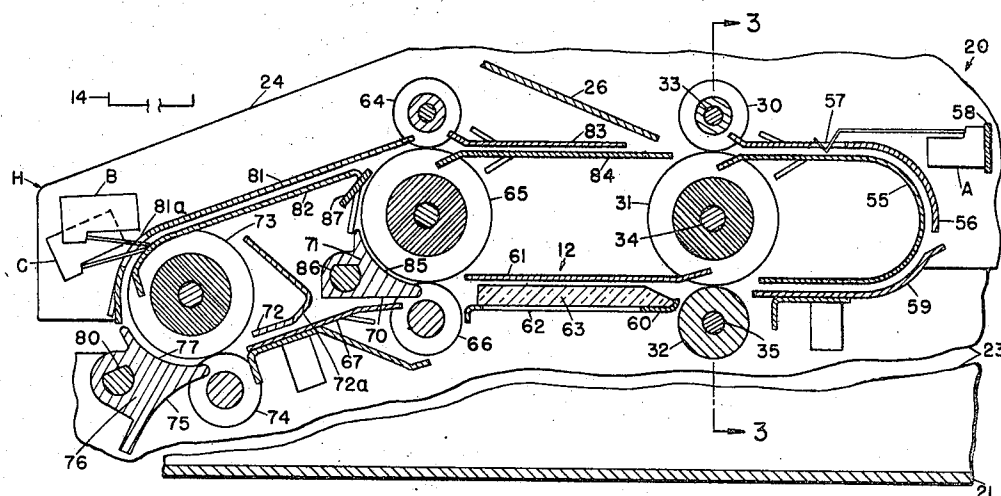
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[57] **ABSTRACT**

Original documents are recycled through a photocopy machine a preselected number of times along a selected one of a plurality of paths of different lengths as determined by the length of the original document being recycled. The plurality of paths include a single copy document path and a first and second recycling document path. Each of the feed paths are so arranged that there is a portion which is common to the single copy feed path, the relatively long first recycling document path and the relatively short second recycling document path. The common portion is traversed along all of these paths by an original document regardless of which of the feed paths the original document initially or ultimately traverses, thereby necessitating only a single set or bank of control switches for controlling the several operating functions of the photocopy machine. Control apparatus which is located in the common portion is situated in advance of the illuminating station and guides are positioned for directing a document to be copied into the common portion prior to the document passing the control apparatus.

5 Claims, 8 Drawing Figures



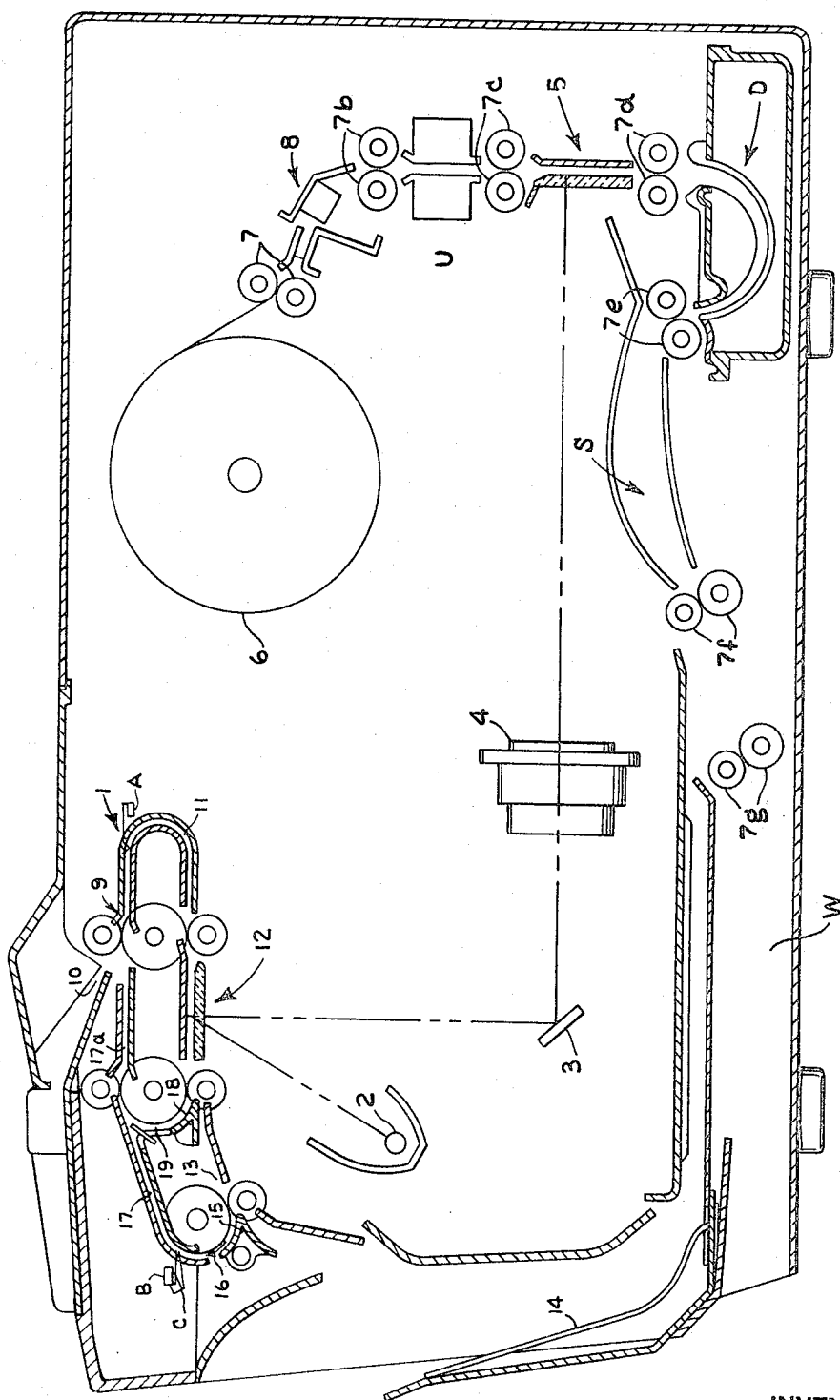
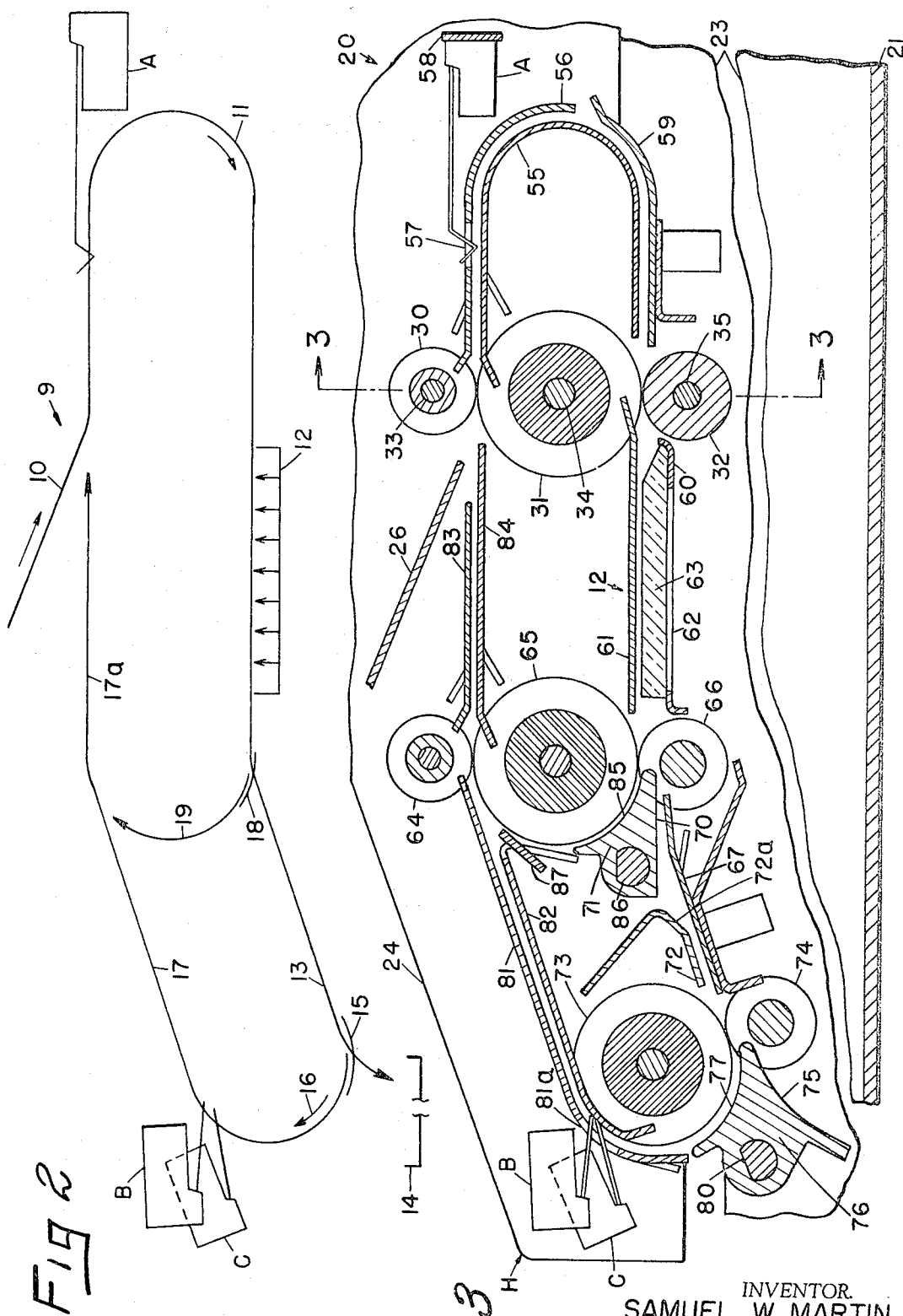
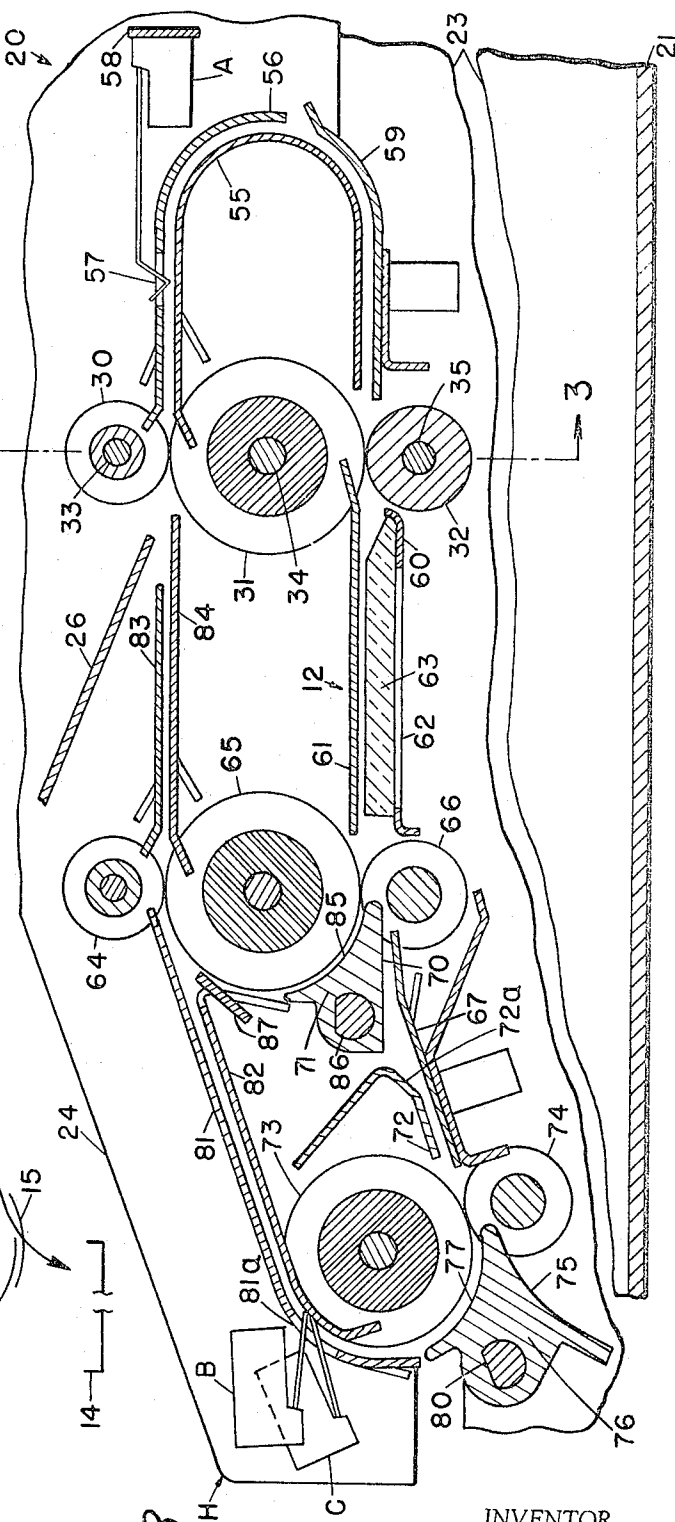


FIG. 1

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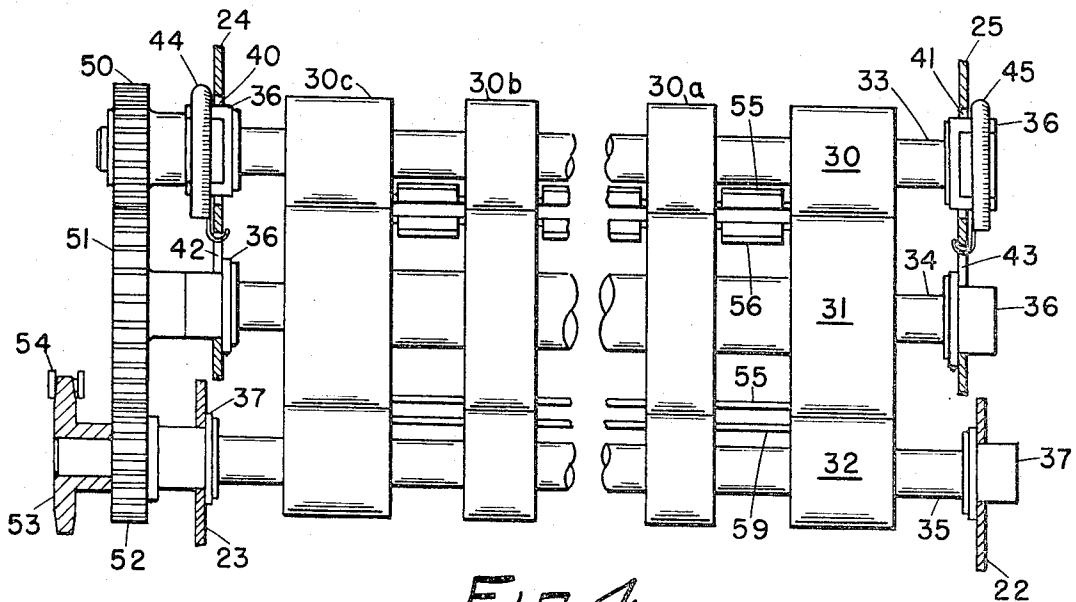


Fig 4

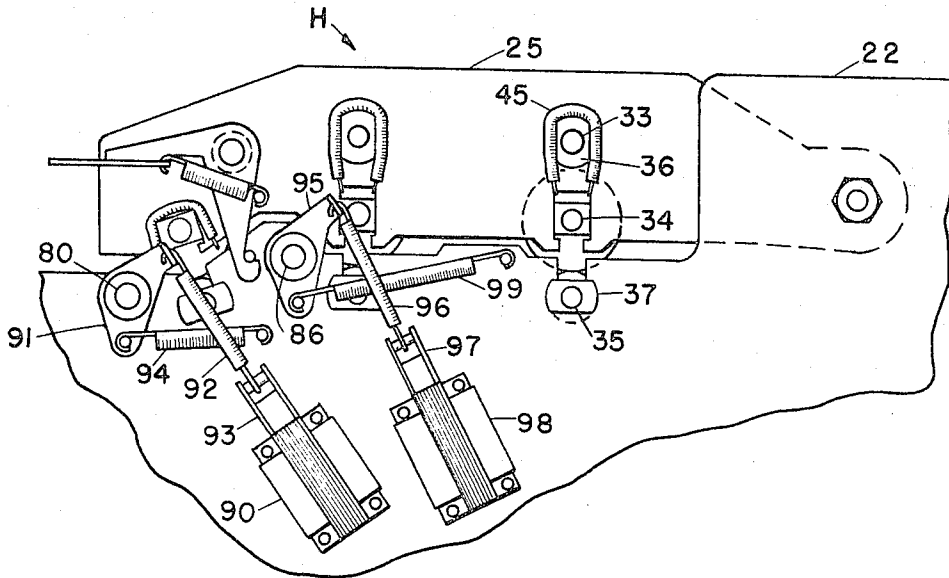


Fig 5

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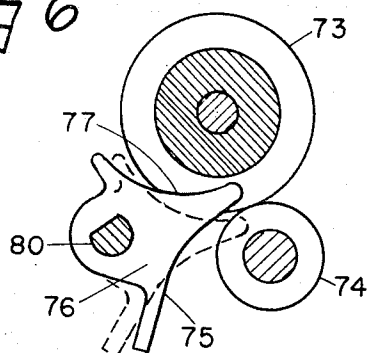
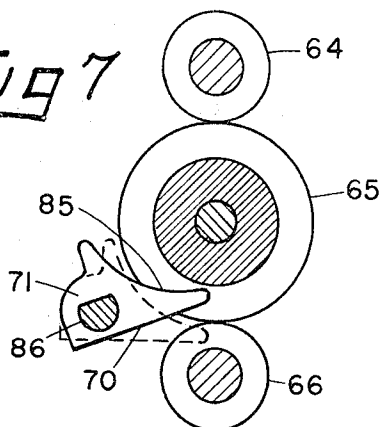
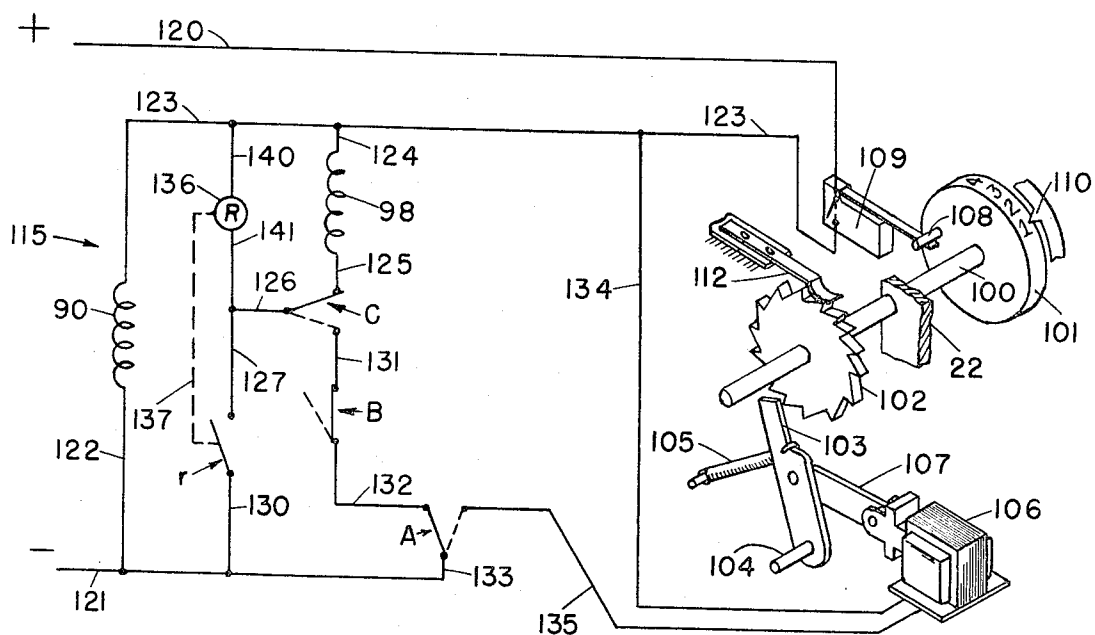


Fig 8

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MULTIPLE COPY ARRANGEMENT FOR PHOTOCOPY MACHINE

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of co-pending U.S. Pat. application Ser. No. 750,912, now abandoned filed Aug. 7, 1968, and assigned to the assignee of this application.

This invention relates to a novel arrangement for recirculating originals through a photocopy machine. More particularly the invention relates to an improved multiple copy arrangement for photocopy machines whereby an original may be selectively recirculated along one of a plurality of possible original sheet feed paths.

Some known types of photocopy machines provide means for automatically recirculating an original through an illuminating station to thereby automatically obtain a desired number of repeat copies of the same original. Such machines have a single effectively closed-loop original sheet feed path which can accommodate originals having variable lengths up to a predetermined maximum. One difficulty associated with such conventional type original recirculating arrangements is that it takes just about as long to obtain a given number of automatic repeat copies of a relatively short-length original as it does to obtain the same number of automatic repeat copies of a relatively long-length original. This condition is imposed by the fact that all originals, short or long, must travel through the machine along the same single recirculating sheet feed path. Thus when several automatic repeat copies of a relatively short-length original are desired there may be only a relatively short total length of time when the machine is actually producing copy; considerable wasted time being consumed in merely transporting the short original over long "dead" portions of the recirculating sheet feed path. The time delay apparent here can be bothersome to a machine operator who in this situation must simply wait for the photocopy machine to slowly generate the desired number of repeat copies.

One proposal for overcoming the necessity for accommodating such time delays is described in U.S. Pat. No. 3,409,366 and entitled "Multiple Copy Arrangement for Photocopy Machines." This device may be efficiently used in many photocopy machine applications; however difficulty may be encountered in some cases where the structural environments and/or the control logic existant in a particular photocopy machine does not lend itself for use with the device shown in the above-mentioned patent. The instant invention contemplates the provision of an alternate improved long and short feed path arrangement for multiple copy photocopy machines in which the arrangement of the recirculating feed paths is such that the control logic of the photocopy machine is greatly simplified in terms of construction, complexity, cost and maintenance.

More precisely, when there is a requisite duplication of switches such as in the above-mentioned patent which requires paper actuated control switches at a number of locations to operate the usual functions of a photocopy machine, such as illumination, charging, copy paper feed and knife, there is a higher initial construction cost, increased maintenance to tend the duplicate switches in the photocopy machine, and a greater complexity to the circuitry of the photocopy machine.

What is desired is a photocopy machine which provides a choice of paths of different length but avoids the complex switching arrangement of the above-mentioned patent. The present application solves this problem in a novel and unobvious manner which will be described below.

BRIEF SUMMARY OF THE INVENTION

In accordance therewith, the present invention provides a photocopy machine having guide and transport means which both define an illumination station for an original document to be copied and an exposing station for copy paper, and for transporting an original document and copy paper through their respective stations. Means are provided for simultaneously illuminating an original document onto copy paper while the original document and copy paper are fed through their respective stations by the transport means, and there are means for feeding copy paper from a supply thereof. Control means are provided which are responsive to the movement of a document therepast for actuating the illuminating means and the copy paper feeding means, and there are means for directing an original document past the illuminating station for making a single copy of the document and for recycling original documents of varying length past the illuminating station along a selected one of a plurality of paths of different length as determined by the length of an original document for making a plurality of copies of the original document.

The improvement in the present invention is provided in the document directing means which comprise means for defining a single copy document path, a first recycling document path and a second recycling document path having a shorter effective length than the first recycling document path, each of the document paths having a portion in common, and including guide means for directing a document to be copied into the common portion prior to the document passing the control means, and the control means being located in the common portion of the paths, in advance of the illuminating station.

The present invention additionally provides that the document directing means include gating means for causing an original document partaking of its first recirculating cycle to always move along the first recycling document path.

Also included in the present invention is sensing means for operatively conditioning at least a portion of the gating means to repeatedly direct the original document along the second recycling document path when the original is shorter in length than a preselected minimum short recycle length.

The present invention also includes that the sensing means retain the portion of the gating means in the operative condition during the second and subsequent automatic recirculating cycles of the original document in the machine.

Having briefly described the broad aspects of the present invention, it is a principal object thereof to provide a new and improved document directing means with single copy and multiple copy recycling document paths for a photocopy machine.

One object of the instant invention is to provide an improved original sheet handling arrangement for photocopy machines wherein the time required to auto-

matically obtain a plurality of copies from the same original may be significantly reduced.

It is another object of the present invention to provide a gating means for causing an original document partaking of its first recirculating cycle to always move along the longer recycling document path.

It is a further object of the present invention to provide a sensing means for operatively conditioning at least a portion of a gating means to repeatedly direct the original document along a shorter recycling document path when the original is shorter in length than a preselected maximum short recycle length.

It is a still further object of the invention to provide a novel original recirculating system for photocopy machines whereby an original from which multiple copies are to be obtained is transported along a relatively long sheet feed path during the first recycle of the machine, and during the second and subsequent recycles thereof is transported along the same relatively long sheet feed path or along a different relatively short sheet feed path depending on whether the original is respectively longer or shorter than a predetermined length.

It is an additional object of the invention to provide an improved original sheet handling control system for photocopy machines which is arranged to more efficiently cooperate with the other control portions of the photocopy machine.

It is another additional object of the invention to provide an improved original sheet recirculating arrangement for photocopy machines whereby a plurality of original recirculating sheet feed paths and associated sheet transport means are provided and are arranged so as to simplify the associated structural nature of the machine by reducing to one the number of locations at which paper actuated control switches are required.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more readily apparent from an understanding of the following detailed description of one embodiment of the present invention when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a simplified side elevational view of an electrostatic photocopy machine adapted with a multiple original document path system constructed according to an embodiment of the invention;

FIG. 2 is a diagrammatic sketch illustrating the operational concept of the instant original sheet feed path arrangement;

FIG. 3 is a cross-sectional side elevational view showing the structural nature and arrangement of the instant apparatus for recirculating an original through one of a plurality of original sheet feed paths;

FIG. 4 is a fragmentary front elevational view in partial section taken along section line 4—4 of FIG. 3;

FIG. 5 is a fragmentary side elevational view showing the gate actuating means for the instant apparatus;

FIGS. 6 and 7 are fragmentary side elevational views in partial section and illustrate the two operative positions of each of the sheet feed path gating means; and

FIG. 8 illustrates a circuit diagram and related control apparatus for the instant device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown an embodiment of the invention which is generally indicated at 1 and

is shown integrated into an electrostatic photocopy machine of the direct imaging type. An original document is carried by guide and transport means defining an illuminating station 12 wherein the original document is copied by being illuminated or scanned by an illuminating means or light source 2 and the reflected image thereof including the indicia (not shown) borne thereon is simultaneously projected or directed by a mirror 3 and a lens system 4 for imaging the indicia onto copy paper at an exposing station also defined by the guide and transport means and is generally indicated at 5. The guide and transport means conventionally transport the original document and copy paper through their respective stations. The original document is transported past a conventional switch means at A which is responsive to the movement of an original document therepast for actuating a gang of switches which operate the light source 2, a corona discharge unit U, and the conventional means for feeding copy paper.

Thus when the switch A is actuated by the original document passing the contact arm for switch A, copy paper having a suitable photoconductive coating, such as Electrofax paper having a zinc oxide coating on one side, is drawn by the conventional means for feeding copy paper from a supply shown as supply roll 6 by feed rollers 7. The copy paper is cut into sheet length corresponding to the sheet length of the original document by a cutter mechanism, generally indicated at 8. The copy paper is conveyed by feed rollers 7b to the corona discharge unit U, operating to place a uniform electrostatic charge on the photoconductive coating of the copy sheet. From the corona discharge unit U, the copy sheet is conveyed by feed rollers 7c past the exposing station 5 while the original document is being illuminated by the light source 2.

In accordance with well-known electrostatic copying techniques, the image to be copied is projected onto the photoconductive layer in contacting engagement with a conductive substrate of the copy paper sheet. The conductive substrate is effective to selectively discharge the uniform electrostatic charge on the photoconductive coating in correspondence with the image light intensity projected by the lens system 4. Thus an image of the indicia borne by the original document is transformed into a corresponding latent electrostatic image on the zinc oxide layer of the copy paper sheet. The sheet is then fed by feed rollers 7d through a development station, generally indicated at D, where the latent electrostatic image is developed using a suitable toner. From the development station D, feed rollers 7e convey the sheet to a drying station, generally indicated at S, where the developed image is fixed. Feed rollers 7f and 7g convey the copy sheet to a compartment W, where successive copies are accumulated for ultimate removal by the operator.

While the copy sheet is being developed, the document sheet is conveyed, as will be described below, through the machine.

It should be noted that conventional means are provided which will be described below, for directing the original document past the illuminating station 12 for making a single copy of the document and for recycling original documents of varying length past the illuminating station 12 along a selected one of a plurality of paths shown as two paths of different length as determined by the length of the original document. The

length of the original document is sensed and accordingly directed along the shorted or longer path for making a plurality of copies of the original document.

The foregoing description of the disclosed photocopy machine and its various working components is intended to set forth the environment in which the multiple copy arrangement of the invention is adapted, and therefore should not be interpreted in a limiting sense.

Referring now to FIG. 2 as well as FIG. 1, the instant machine, when conditioned to make a single copy of an original document, is adapted by the document directing means to direct an original document along a single copy document path from the inlet 9 of the machine having an initial portion 10 of a main sheet feed path 11, along the main sheet feed path 11 and through the conventional type illuminating station 12, and then towards and through a terminal portion 13 of the main feed path to the outlet station 14 of the machine. This type of operation and arrangement is similar to that described in the aforementioned U.S. Pat. No. 3,409,366 and need not be further explained here.

Means are provided in the document directing means for automatically recirculating an original back to and through the main feed path when it is desired to automatically produce several copies of the same original, such means including a control means operable to cause a recycle gating means 15 which is disposed adjacent the terminal portion 13 of the main feed path and which may be conditioned so that the original after passing the illuminating station 12 will be recycled along a path indicated at 16 so as to enable the original document to be conducted back along feed path portions 17, 17a and then into the single copy document path or main path so as to be moved through the illuminating station 12 a second, third or more desired number of times. A second gating means 18 is provided so that an original may take a second different possible feed path in being recirculated two or more times past the illuminating station 12. Gating means 18 are normally set in a first inoperative position so as to normally direct the original along a first recycling document path which is a relatively long recirculating feed path, as represented by path portions 11, 12, 16, 17, 17a, but may be set to a second operative position so as to direct the original along a second recycling document path which is a relatively short recirculating feed path as represented by feed path portions 11, 12, 19, 17a. Which one of these two possible feed paths is taken by a given original is determined by a physical condition, e.g. length of the original. If the original from which multiple copies are to be made is longer than a predetermined length then such an original will be recirculated along the relatively long sheet feed path. On the other hand if the original is shorter than the predetermined length then considerable time will be saved by having such a short original recirculate through the relatively short feed path. Path portions 11, 12 and 17a are common to all three paths, i.e., the single copy document path and the first and second recycling document path.

A sensing means is included in the control means and is provided for first sensing the length of a recirculated original document and then accordingly actuating the control means to set the gating means 18 to the proper position; this sensing means includes three electrical switches A, B and C that are operatively positioned along the sheet feed path, as shown in FIGS. 1 and 2.

The switches A and B are located a predetermined effective distance apart which is greater than the maximum length of the original document to be recirculated along the second recycling document path. Switch C is located closely adjacent to and effectively slightly upstream from switch B so as to be operated by the leading edge of an original document at a time slightly before that of switch B. When the machine is conditioned to make multiple copies and an original document is initially inserted into the machine inlet 9 the positions of the gating means 15 and 18 will cause this original document to move along the relatively long feed path so that the length of the original document may be sensed by the switches A and B. In this connection if the leading edge of the original document, after having first operated switch A, subsequently operates switch B before the trailing edge thereof runs off switch A, then it will thereby be determined that the original document is longer than the effective distance between switches A and B and hence will need to follow the relatively long path through the machine. Under these conditions gating means 18 will remain in an inoperative position. On the other hand if by the time the leading edge of the original document operates switch B the trailing edge thereof has already run off switch A then it will thereby be determined that the original document is relatively short, i.e., is shorter than the effective distance between the switches A and B, and the gating means 18 will be thereby shifted so that the short original document may follow the relatively short feed path. After the prescribed number of copies of a long or a short original document have been made the gating means 15 (and gating means 18 if required) is restored to its inoperative position so that the original document is directed to the outlet station 14. Suitable electrical means to be described are provided to afford the above-noted sequencing and control for the gating means 15 and 18. By this arrangement it will be seen that an original document may be conducted along the appropriate one of a plurality of possible recirculating paths, thereby avoiding the heretofore bothersome time delays incurred when feeding a relatively short length original document over a relatively long recycle feed path.

FIGS. 3-8 illustrate one specific embodiment of the instant invention which provides a multiple recycle path arrangement and operation corresponding to that generally described above in connection with FIGS. 1 and 2. Only that much of the structure of a photocopy machine which is pertinent to the instant recycling apparatus is shown in the drawings and it will be understood that unless otherwise stated the various parts illustrated may be constructed, supported and/or arranged in any suitable manner wellknown in the art. Referring particularly to FIGS. 3-7 there is shown a machine frame 20 comprising a base 21 having fixedly secured thereto a pair of parallel upstanding side frames 22 and 23 which support a sheet feed head H. The head H comprises a parallel pair of mounting plates 24 and 25 that are mutually secured together by, inter alia, an inclined upper deck plate 26 which provides an entry guide means for the manual feeding of originals into the machine. A first set of three feed rolls 30, 31 and 32 being secured to shafts 33, 34 and 35, respectively and each having axially spaced portions corresponding to the portions 30a, 30b and 30c, FIG. 3, for roll 30. Shafts 33 and 34 are rotatably mounted on

the mounting plates 24 and 25 by means suitable bushings 36 while shaft 35 is rotatably mounted on the fixed machine side frames 22 and 23 by means of suitable bushings 37. Bushings 36 are located in two sets of opposed slots 40, 41, 42 and 43 formed in the mounting plates 24 and 25, the axes of the holes in each such set being disposed in a substantially vertical plane, the upper set of bushings 36 being spring biased downwardly towards the bottom of slots 40 and 41 by means of tension springs 44 and 45. The ends of springs 44 and 45 are secured in the upper portion of slots 42 and 43 so as to urge the peripheral portions of roll 30 into engagement with the corresponding portions of roll 31 as is illustrated in FIG. 4. Roll 31, being carried by mounting plates 24 and 25, is held in similar engagement with roll 32 by reason of the head H being secured in a position adjacent the mounting plates 24 and 25. The three rolls 30, 31 and 32 are rotatably interconnected by gears 50, 51 and 52, (FIG. 4), secured to the respective roll shafts 33, 34 and 35 and are adapted to be driven by a sprocket and chain arrangement 53, 54 that is operatively coupled to the left end (as seen in FIG. 4) of shaft 35.

The downstream end of the upper deck plate 26 terminates adjacent the nip of rolls 30 and 31. Disposed immediately downstream from said roll nip is a pair of mutually conforming spaced arcuate guide plates 55 and 56, FIG. 3, that are mounted on and between said mounting plates 24 and 25 and are flared slightly outwards at their respective upstream ends so as to facilitate entry therebetween of an original that is emerging from between said rolls 30 and 31. The outer guide plate 56 is centrally slotted as at 57 so as to permit the operating arm of a switch A to protrude therethrough and into the path of an original passing between the plates 55 and 56; switch A being centrally mounted between the side frames by any suitable bracket means 58. Complimenting the outer guide plate 56 is a deflector plate 59 that is mounted on and between the side frames 22 and 23 in such a manner as to conform to the shape of the inner guide plate 55. The downstream ends of the guide plate 55 and the deflector plate 59 are disposed adjacent the nip of rolls 31 and 32. Disposed immediately downstream from the nip of rolls 31 and 32 is a horizontally disposed pair of guide members 60 and 61, member 60 being supported on and between the side frames 22 and 23 while member 61 is supported on and between the mounting plates 24, 25. The lower member 60 is formed with a wide transverse slot 62 that extends throughout most of the length of member 60 extending between the side frames. A glass plate 63 disposed over the slot is secured by any suitable means to the upper surface of guide member 60 so as to support an original moving thereover while still permitting the lower face of the original to be irradiated or illuminated from below as illustrated by the arrows at the illuminating station 12 of FIG. 2. The upstream ends of the guide member 61 and the glass plate 63 that are located adjacent the downstream side of the nip of rolls 31 and 32 are flared slightly so as to facilitate entry therebetween of an original that is emerging from between the rolls 31 and 32. Disposed adjacent the downstream ends of the guide member 61 and glass plate 63 is another set of three cooperating feed rolls 64, 65 and 66 which are constructed, supported, intergearing and driven in a manner similar to that described above for rolls 30, 31 and 32 respectively. Disposed im-

mediately downstream from the nip of rolls 65 and 66 is a guide plate 67 that is mounted on and between the side frames 22 and 23 and is flared slightly downward at its upstream end so as to facilitate guiding of an original that is emerging from between the rolls 65 and 66. Cooperating with guide plate 67 to form a feed path for the original is surface 70 of a gating member 71 that is pivotally mounted on and between the side frames 22 and 23. Downstream from the gating member 71 is another cooperating guide plate 72 that is mounted on and between mounting plates 24 and 25 and is operatively flared as to 72a so as to facilitate further guiding of an original that is approaching along the surface 70. The downstream ends of the guide plates 67 and 72 are disposed adjacent the nip of a pair of cooperating feed rolls 73 and 74 which are arranged, supported, intergearing and driven in a manner similar to that described above for rolls 31 and 32 respectively. Disposed immediately downstream from the nip of rolls 73 and 74 is an arcuate surface 75 of a gating member 76 that is mounted on and between the side frames 22 and 23 and is adapted to conduct an original to the machine output station 14, FIG. 2.

When the machine is conditioned for operation the feed rolls 32, 66 and 74 will be continuously driven from a common chain, such as illustrated at 54, FIG. 4, and hence the other feed rolls 31, 30, 65 and 64, and 73 will also be continuously rotated through gearing such as 52, 51 and 50, etc. As will be apparent when an original to be copied is manually inserted into the machine, i.e., along deck plate 26, the leading edge thereof will first move into the nip between rolls 30 and 31 and will be thereafter advanced between the successive roll pairs 31 and 32, 65 and 66, and 73 and 74 and the associated guide means and finally out to the machine output station 14 (FIG. 2). This main original sheet feed path or single copy document path is illustrated by reference numerals 11 and 13 of FIG. 2 and represents the predetermined feed path to be followed by an original that is to be copied only once. It will be understood that during such single-copy operations of the machine the gating means 71 and 76 are both disposed in their counter clockwise positions away from their FIG. 3 positions so that their respective surfaces 70 and 75 are operative to guide the original to the output station 14 (FIG. 2).

When more than one copy of an original is to be automatically made the gating means 76, corresponding to 15 of FIG. 2, together with additional guide means to be described will cause the original to be automatically recirculated through the machine a number of times corresponding to the number of copies desired. This arrangement comprises the gating means 76 which has an additional guide surface 77 formed thereon and which is fixed to a shaft 80 that is pivotally mounted by suitable bushings on the side frames 22 and 23. As will be apparent, the arcuate surface 77 is swingable from a normal retracted or inoperative position shown by the solid lines of FIG. 6 to an active position shown by the dotted lines of FIG. 6 wherein the upstream edge of the arcuate surface 77 extends into the main original feed path so that an original may be guided into a recirculating feed path as indicated by arrow 16 of FIG. 2. Disposed adjacent to the gating member 76 is a pair of parallel guide plates 81 and 82 that are mounted on and between the mounting plates 24 and 25 and form adjacent their upstream ends an arcuate portion cooperat-

ing with the closely adjacent cylindrical outer surfaces of roll 73. The upstream ends of guides 81, 82 have slightly flared portions to facilitate entry therebetween of an original approaching from along the arcuate surface 77 and roll 73, the guide plates 81 and 82 terminating adjacent to the nip of the rolls 64 and 65. The guide plate 81 is centrally slotted as at 81a so as to receive the two operating arms of two electrical switches B and C that are centrally mounted on and between the mounting plates 24 and 25 and disposed immediately downstream from the nip of the rolls 64 and 65 is a co-operating horizontal pair of guide plates 83 and 84, the upstream ends of the plates 83 and 84 being slightly flared as shown so as to facilitate entry therebetween of an original that is emerging from between rolls 64 and 65, the downstream ends thereof being disposed adjacent the end of deck plate 26. It will be understood that certain terminal portions of the various guide means and gating members extend into the regions between the coaxial grooved portions of the various feed rolls as may be seen in FIGS. 2 and 3.

The gating means corresponding to 18 of FIG. 2 includes the gating member 71 which is provided with the guiding surface 70 and also with an arcuate guide surface 85. The gating member 71 is fixed to a shaft 86 that is pivotally mounted by suitable bushings, not shown, on the side frames 22 and 23. The gating member 71 is swingable between a normal position and an operative position as shown respectively by the solid and dotted lines in FIG. 7 so as to be determinative of whether an original that is being recirculated will move along a relatively long recycle path around feed roll 73 (corresponding to arrow 16 of FIG. 2) or along a relatively short recycle path around feed roll 65 (corresponding to arrow 19 of FIG. 2). A guide plate 87 mounted on and between the mounting plates 24 and 25 cooperates with the closely adjacent cylindrical surfaces of roll 65 so as to guide an original that is following along the relatively short feed path into the nip between feed rolls 64 and 65. As will be apparent when the recycle gating member 76 is in the operative position shown in FIG. 3 any original that is manually fed into the machine will be automatically recirculated through the machine so that thereafter, depending on the position of gating member 71, it may move along a short or a long sheet feed path so as to thereby automatically repeatedly move through the illuminating station of the machine a desired number of times in order to produce a corresponding number of copies thereof.

The means for actuating the gating members 71 and 76 will now be described. Gating member 76 is adapted to be operated by a sensing means or solenoid 90, FIG. 5, that is mounted on the machine side frame 22 by any suitable means. Affixed to the outboard end of the shaft 80 carrying gating member 76 is an actuating arm 91 that is connected by means of a spring 92, acting as a yieldable link to the armature 93 of the solenoid 90. A spring 94 yieldably biases the actuating arm 91 and thus the gating member 76 to a normal or inoperative position shown by the solid line of FIG. 6, the armature 93 here being in a normal extended or outward position shown in FIG. 5. When solenoid 90 is energized the gating member 76 will be pivoted to its dotted solid line position shown in FIG. 6, the spring 92 now being effectively stronger than spring 94, whereby an original will be recycled through the machine as illustrated by the arrow 16 of FIG. 2. In a similar fashion, the gating

member 71 fixed to a cross shaft 86 that is rotatably mounted by any suitable means in side frames 22, 23. Secured to the outer end of shaft 86 is an actuating arm 95 that is connected by means of a spring 96 to the armature 97 of the solenoid 98. A spring 99 yieldably biases actuating arm 95 in a counter clockwise direction as seen in FIG. 5 and thus the gating member 71 to the normal or inoperative position shown by the solid lines of FIG. 7. When solenoid 98 is energized the gating member 71 will be pivoted to its dotted line position as shown in FIG. 7, the spring 96 now being effectively stronger than spring 99, whereby any recirculated original after passing through the illuminating station 12 the second time will be diverted into the relatively short feed path as indicated by the arrow 19 of FIG. 2. Any suitable stop means are provided to insure the proper location on the gating members in each of their respective operative and inoperative positions.

The conditioning of the photocopy machine for multiple copies required not only a conditioning of the controls that operate the two gating means as above-described but also necessitates the setting of a counting means whereby the machine will be automatically recycled a preselected number of times corresponding to the number of copies desired. To this end the instant machine is provided with a counter which is functionally tied in with the gate control circuit as will now be described in connection with FIG. 8. A shaft 100, FIG. 8, is rotatably supported in side frame 22 by any suitable means and has a hand wheel 101 secured to the outer end thereof. A manually set copy-counting ratchet wheel 102 also secured to the shaft 100 cooperates with an oscillatable pawl 103 which, upon being oscillated on a suitable support shaft 104 serves to incrementally rotatably index the shaft 100 in a counter clockwise direction as seen in FIG. 8, shaft 104 being mounted by any suitable means on the machine frame. The pawl 103 is biased in a counter clockwise direction by means of a suitable spring 105 and is oscillatably actuated in a clockwise direction by means of a solenoid 106 through a suitable link 107. The number and rotative position of the numerical indicia on the hand wheel 101 corresponds to that for the teeth of ratchet wheel 102.

The number of ratchet steps possible for ratchet 102 and thus for shaft 100 for any given setting of the hand wheel 101 corresponds to the number of copies that will be automatically produced as will be explained below. A pin 108 is fixed to the hand wheel 101 so that in a home position thereof it will contact the actuating arm of a normally closed electrical switch 109 thereby holding this switch in an open condition. When it is desired to automatically produce more than one copy of an original the hand wheel 101 is manually rotated in the clockwise direction, as seen in FIG. 8, so that the desired copy number of the periphery of the hand wheel 101 is opposite a fixed pointer 110, the latter being supported by any suitable means on the machine frame. This manual rotation of hand wheel 101 and the accompanying rotation of the shaft 100 will produce two actions. First the pin 108 will move out of contact with the actuating arm of the electrical switch 109 thereby closing switch 109 and producing electrical circuit changes as will be discussed later, and secondly, the ratchet wheel 102 is rotated through a tooth distance corresponding to the number of copies desired and is yieldably retained in this displaced position by a

detent leaf spring 112 that is suitably affixed at one end thereof to the machine frame.

Once the instant machine is conditioned to produce multiple copies the logic system must first determine whether the original thereafter inserted in the machine is a relatively long or a relatively short document, i.e., is respectively longer or shorter than the effective distance between switches A and B. Once the length of an original has been effectively measured then the gating member 71 must be accordingly set. If when the leading edge of an original effectively reaches the arm for switch B the trailing edge thereof has not yet ridden off the arm for switch A then this original is longer than the predetermined distance between switches A and B and thus will be too long to recirculate through the short feed path represented by reference numerals 11, 19 and 17a of FIG. 2 and hence must recirculate around the long feed path represented by reference numerals 11, 13, 16, 17 and 17a of FIG. 2. If on the other hand when the leading edge of the original reaches the arm for switch B the trailing edge thereof has already ridden off of the arm for switch A, then this document is shorter than the predetermined length and hence may recirculate round the short feed path. Each recirculation of the original through the machine causes the ratchet wheel to be advanced one step toward its home position until the desired number of copies have been made at which time the gating members 71 and 76 are restored to their normal inoperative positions and the original is directed to the output station 14 (FIG. 2) of the machine.

The circuit diagram for the instant control system is illustrated in FIG. 8. Here the multiple copy function control circuit 115 is effectively connected across the power supply lines 120, 121 through the switch 109. The gate control solenoid 90 is connected between line 121 and switch 109 by lines 122 and 123. The gate control solenoid 98 is connected between the lines 121 and 123 by lines 124, 125 switch C, line 126, 127, relay switch contacts r, and line 130. A line 131 is connected between switches C and B, and a line 132 is connected between switches B and A. The counter solenoid 106 is connected between the lines 123 and 121 by means of lines 134, 135, switch A, and line 133. The holding relay 136, which controls, as illustrated at 137, the switch contact r, is connected across lines 123 and 121 by lines 140, 141, 127, relay contact r, and the line 130.

A description of the overall operation of the instant original handling arrangement will now be made. When the machine is turned on, all the cooperating feed rolls shown in FIGS. 3 and 4 will be continuously driven by means of the chain 54. As long as the machine is conditioned to produce a single copy of an original, i.e., when the hand wheel 101 is in its home position shown in FIG. 8 the thumb wheel pin 108 will hold the switch arm of the normally closed switch 109 in a depressed condition so that switch 109 is held open. Thus the solenoids 90 and 98 remain de-energized and the gating means 71 and 76 remain in the elevated inoperative solid line positions shown in FIGS. 6 and 7, so that any original fed into the machine moves directly there through and into the output station 14 (FIG. 2) so as to produce a single copy thereof. When it is desired to condition the machine to make more than one copy of an original, the hand wheel 101 is manually turned in a clockwise direction, as seen in FIG. 8, until the number indicative of the duplicate copies desired is posi-

tioned adjacent the fixed pointer 110, the hand wheel being yieldably held in this position by said yieldable detent 112. This displacement of the wheel 101 will cause pin 108 to move away from the arm of switch 109 so that the latter will assume its normal closed position whereby the multiple copy circuit 115 will be placed in condition to be operated under the control switches A, B and C shown in FIG. 2. Here solenoid 90 is immediately energized so that the gating member 76 is swung to and held in the operative position indicated by the dotted lines in FIG. 6 whereby any original thereafter fed into the machine will be recirculated as indicated by arrow 16 of FIG. 2. When the machine operator inserts the original into the machine, the cooperating feed rolls 30, 31 will engage and advance the original so that the leading edge thereof will subsequently engage the arm for switch A and will place switch A in its dotted line condition illustrated in FIG. 8. This action will energize the solenoid 106 so that the counting ratchet 102 and wheel 101 will be arcuately displaced the equivalent of one tooth or counting space so that the next lower hand wheel number will now be adjacent the pointer 110. The original thus passes through the illuminating station 12 and moves along path 13 until it reaches the now operatively positioned gating member 76 which will redirect the original along the recirculating feed path toward switches B and C as indicated by arrow 16 of FIG. 2. Any original that is to be recirculated in the machine will always move around the long path on every first recycle of such original during which time the length thereof is sensed so that the gating means 71 may thereafter be appropriately selected and set for the second and subsequent recirculating cycles depending on the sensed length of the original. During the second and all subsequent recycles the original will always move along the long path except in the one case where during the first recycle the original is sensed to be relatively short in which case the gating member 71 will be shifted to an operative position for causing the second and subsequent recycles of the original to follow the short path. More specifically if an original to be recirculated in the machine is sensed to be relatively long, i.e., if the leading edge thereof reaches the normally closed switch B before the trailing end thereof rides off the switch A, then switch B will never be in a closed condition when switch A is in its solid line position shown in FIG. 8 and hence the holding relay 136 for causing energization of the short path control solenoid 98 will not be pulled in and the gating member 76 will remain in its inoperative position so that the original will continue to recirculate around the long feed path the prescribed number of times. After the ratchet wheel 102 has thus been successively advanced the number of times by the successive operation of switch A and solenoid 106 the hand wheel 101 will be restored to its normal FIG. 8 position wherein switch 109 will be opened so that the now inoperatively positioned gating member 76 will direct the original into the machine output station 14. If on the other hand the original that is initially recirculated in the machine is sensed to be relatively short, then the switch A will be restored to its normal solid line FIG. 8 position before the normally closed switch B is opened and in that switch C is always operated slightly before switch B, as seen in FIG. 2, there will be a short period when a circuit is established through the three switches A, B and C and the holding relay 136. Here then when the trail-

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ing end of a short original thus runs off of the arm for switch A the relay contact *r* will be closed and held closed even after the subsequent opening of any one of the three switches A, B or C. When the trailing edge of the short original runs off the arm for switch C the latter will be restored to its normal solid line condition of FIG. 8 whereby the short path solenoid 98 is energized through the now closed contact *r* and will remain energized thus holding the gating member 71 in its operative condition shown by the dotted lines of FIG. 7. Under these conditions after the short original subsequently passes by the illuminating station 12 (FIG. 2), the now operatively positioned gating member 71 will cause the original to repeatedly follow around the short feed path. When moving along the short feed path the original will not operate switches B or C but will cyclically operate only switch A. Thus the gating member 71 remains in its operative position until switch A has actuated the counter solenoid 106 the prescribed number of times corresponding to the number of copies desired whereupon switch 109 will be opened and the holding relay 136 will be de-energized. The machine is thereby restored to its normal condition and the short original is discharged into the machine output station 14.

As may be seen the instant original recirculating means and the controls therefor are simplified and reliably arranged for prolonged use over extended periods of time.

Since many changes could be made in the embodiment of the invention as particularly described and shown herein without departing from the scope of the invention, it is intended that this embodiment be considered as exemplary and that the invention not be limited except as warranted by the following claims.

I claim:

1. A photocopy machine having:

A. guide and transport means defining an illuminating station for an original document to be copied and an exposing station for copy paper to be imaged and for transporting an original document and copy paper through their respective stations,

B. means for simultaneously illuminating an original document and for projecting an image of indicia thereon onto copy paper as the original document and copy paper are fed through their respective stations by said transport means,

C. means for feeding copy paper from a supply thereof,

D. switch means responsive to the movement of a document therepast for actuating said illuminating means and said copy paper feeding means, and

E. means for directing an original document past said illuminating station for making a single copy of the document and for recycling original documents of varying length past said illuminating station along a selected one of a plurality of paths of different length as determined by the length of an original document for making a plurality of copies of the

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original document, said document directing and recycling means comprising

a. means defining a single copy document path, a first recycling document path and a second recycling document path having a shorter effective length than said first recycling document path, each of said recycling document paths having a portion in common with said switch means and said illuminating station being located in said common portion of said recycling document paths, and said switch means being located therein in advance of said illuminating station,

b. guide means for directing a document to be copied into said common portion of said recirculating document paths at a location in advance of said switch means, and

c. control means operable to cause a document to be directed along a selected one of said recycling document paths in accordance with the length of the document.

2. A photocopy machine as defined by claim 1 wherein said control means includes gating means operable to cause an original document to move along said first or second recycling document path, said control means being operable to cause said gating means to direct an original document partaking of its first recirculating cycle to always move along the longer one of said first or second recycling document paths.

3. A photocopy machine as defined by claim 2 wherein said control means further includes sensing means for measuring the length of an original document passing through said first recycling document path and for actuating said control means to set said gating means to cause an original document to move along said first or second recycling document path in accordance with the measured length of the document on recirculating cycles subsequent to said first recirculating cycle.

4. A photocopy machine as defined by claim 3 wherein said sensing means comprises said first named switch means and another switch means spaced apart from said first switch means a distance greater than the maximum length of said second recycling document path.

5. A photocopy machine as defined by claim 2 wherein said control means includes said first named switch means and a second switch means both operatively disposed along said first recycling document path, one of said switch means being spaced from a second one of said switch means, whereby said spaced switch means are connected to control said gating means to pass said original along said longer one of said recycling document paths when said original simultaneously contacts both said spaced switch means at least momentarily and to pass said original along said shorter one of said recycling document paths when said original contacts both said spaced switch means one at a time.

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