

[54] **RECIPROCATING DOCUMENT CARRIAGE FOR PHOTOCOPIER**

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[58] Field of Search 355/8, 50

[56] **References Cited**

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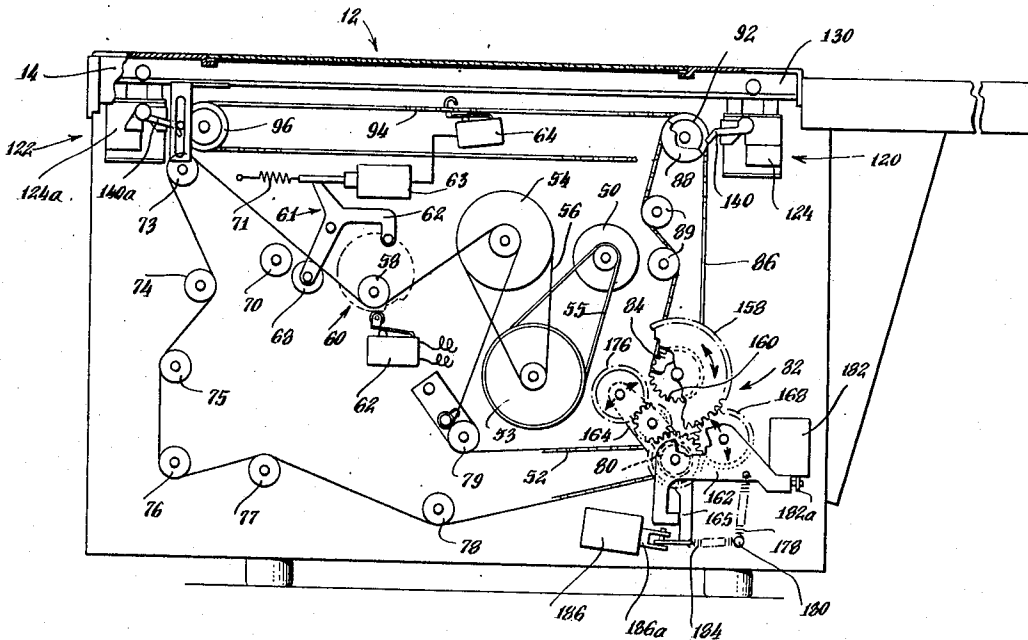
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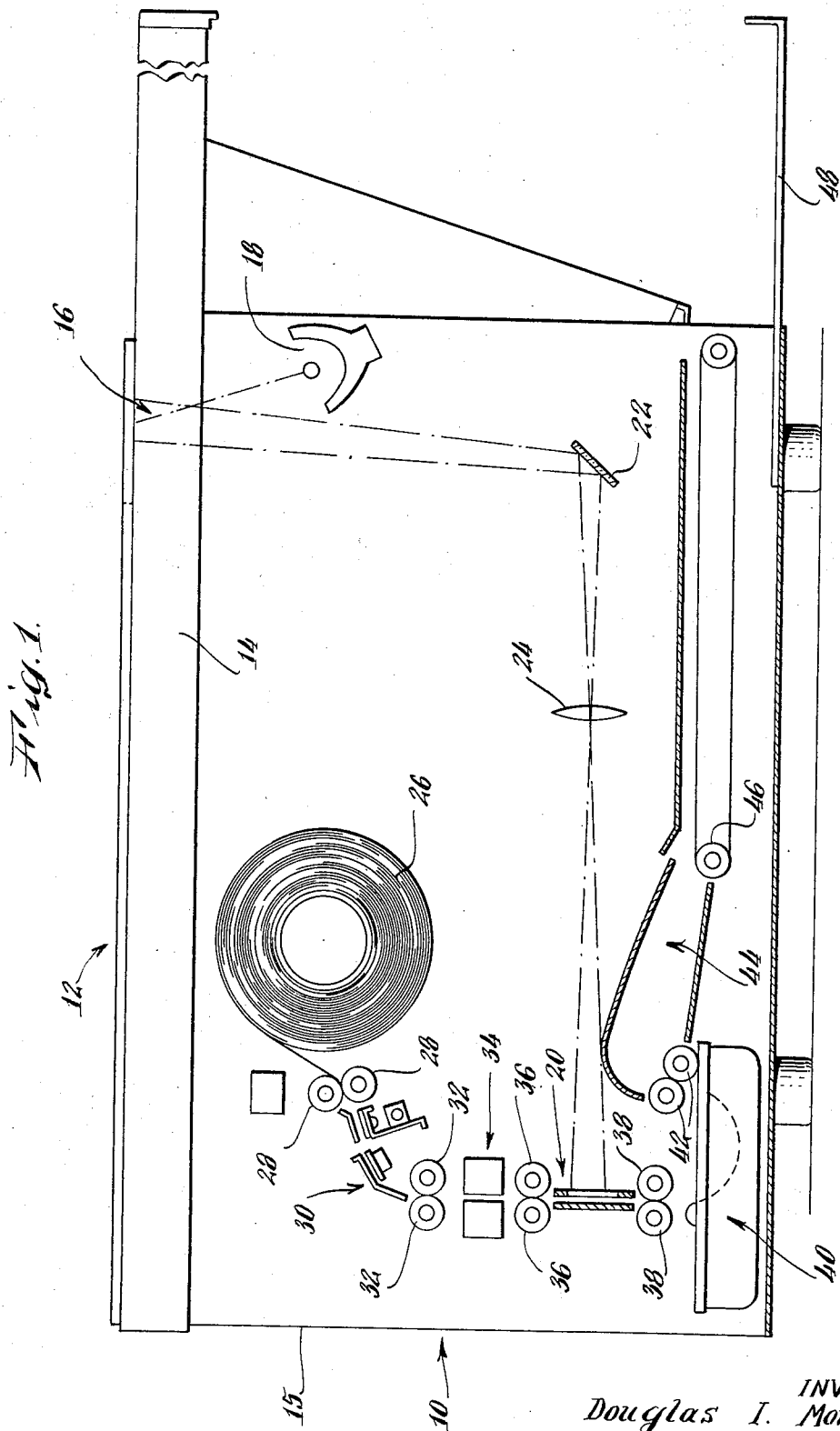
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ABSTRACT

A reciprocating carriage translates an original document sheet through an illuminating station in synchronism with the feeding of copy paper through an imaging station. Sensing switches actuated by the carriage movement control withdrawal of copy paper from a supply roll and severance thereof into sheet length corresponding to the document sheet length. A drive chain loop linked to the carriage is driven via a transmission to translate the carriage through a uniform forward stroke and a slower return, copy stroke. The linkage between the chain loop and carriage includes a lost-motion coupling to accommodate rapid deceleration and acceleration of the carriage as it is transferred from one stroke to the other.

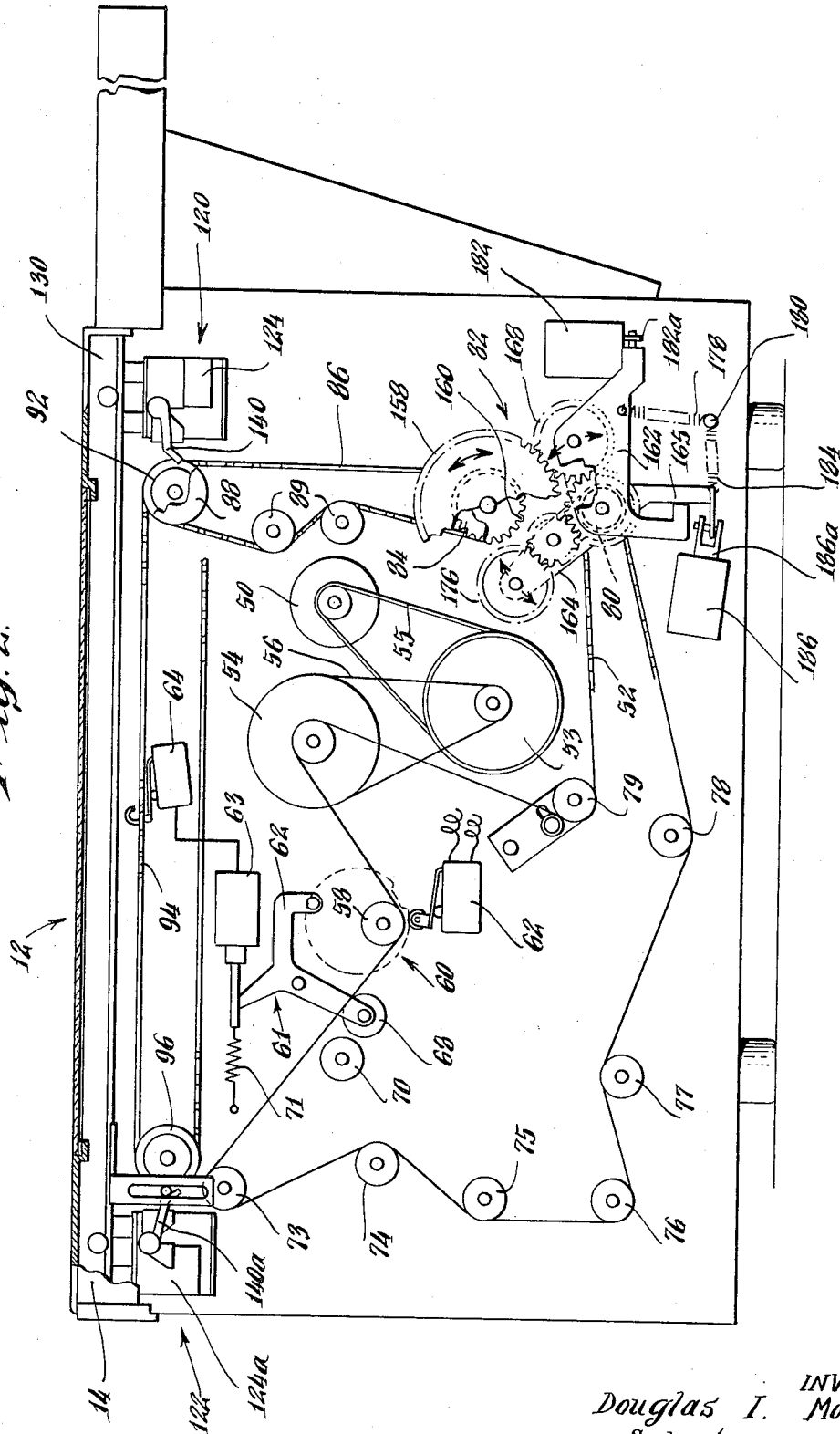
18 Claims, 8 Drawing Figures



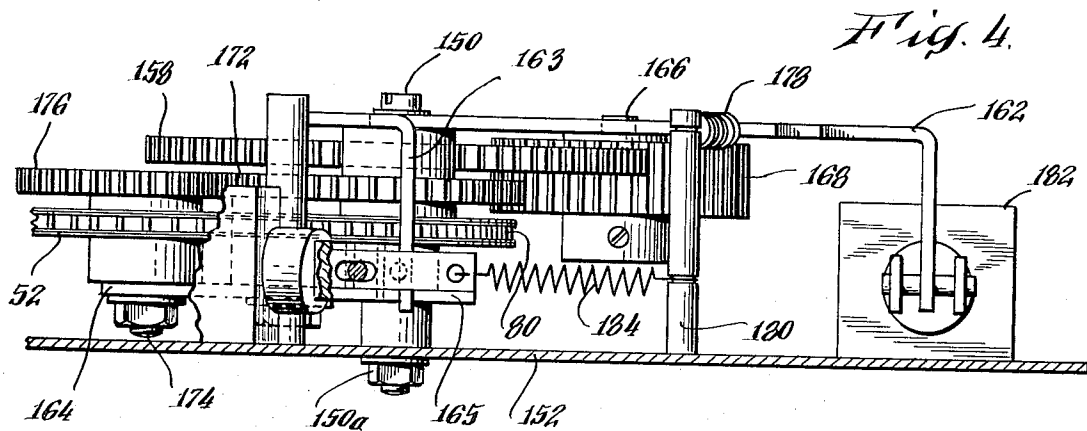
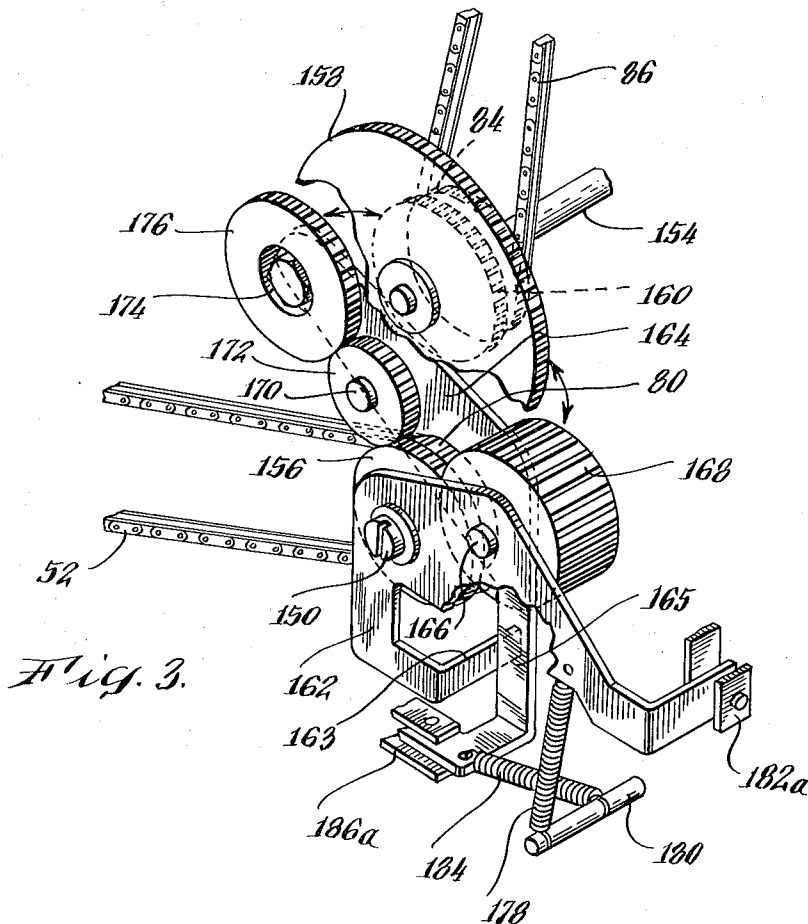


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Fig. 2.



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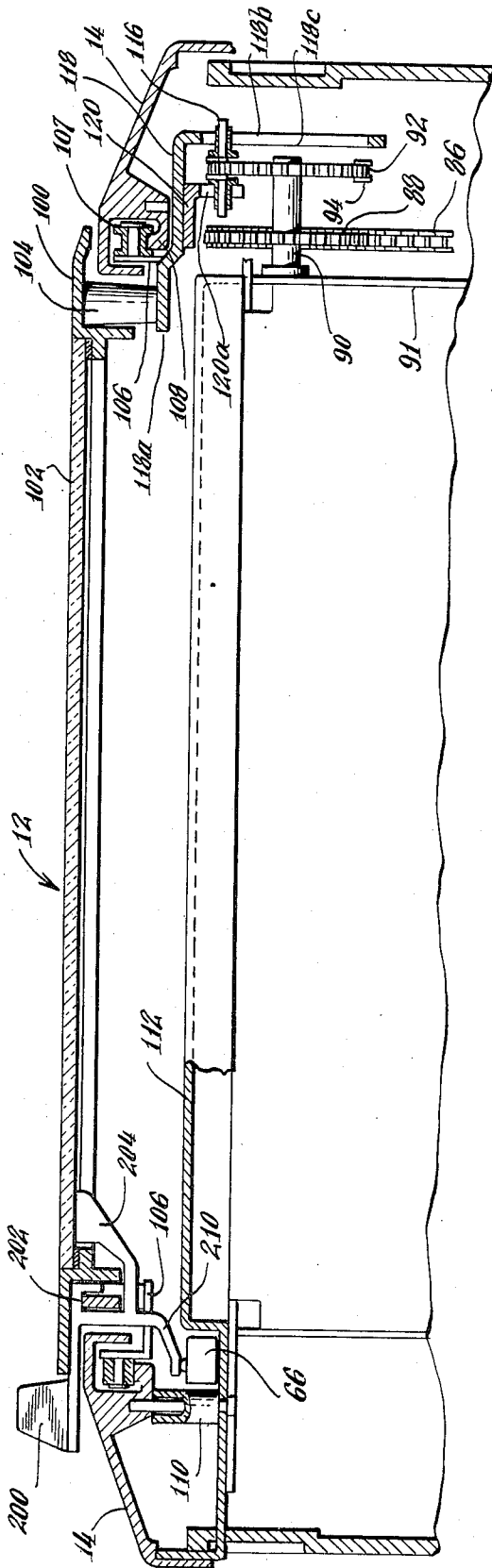


Fig. 5.

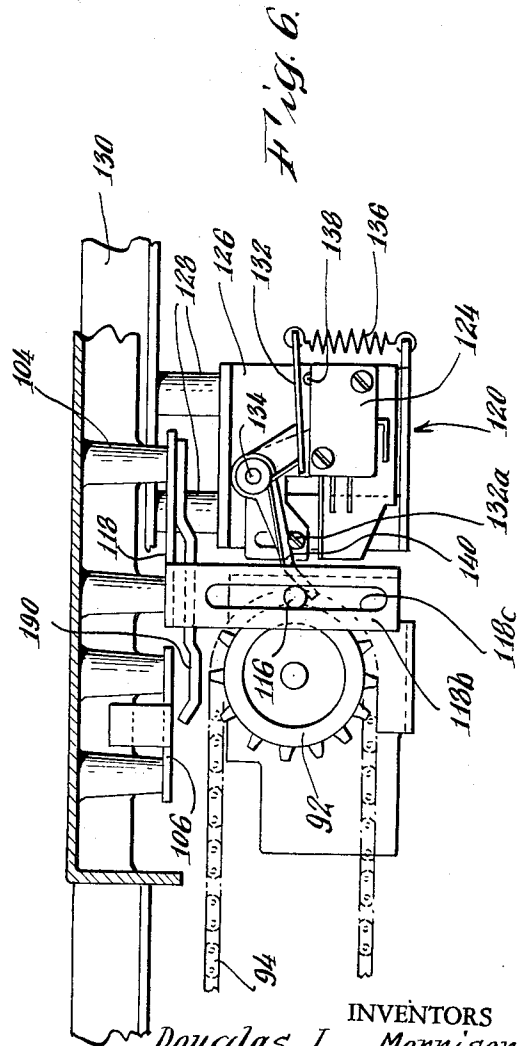
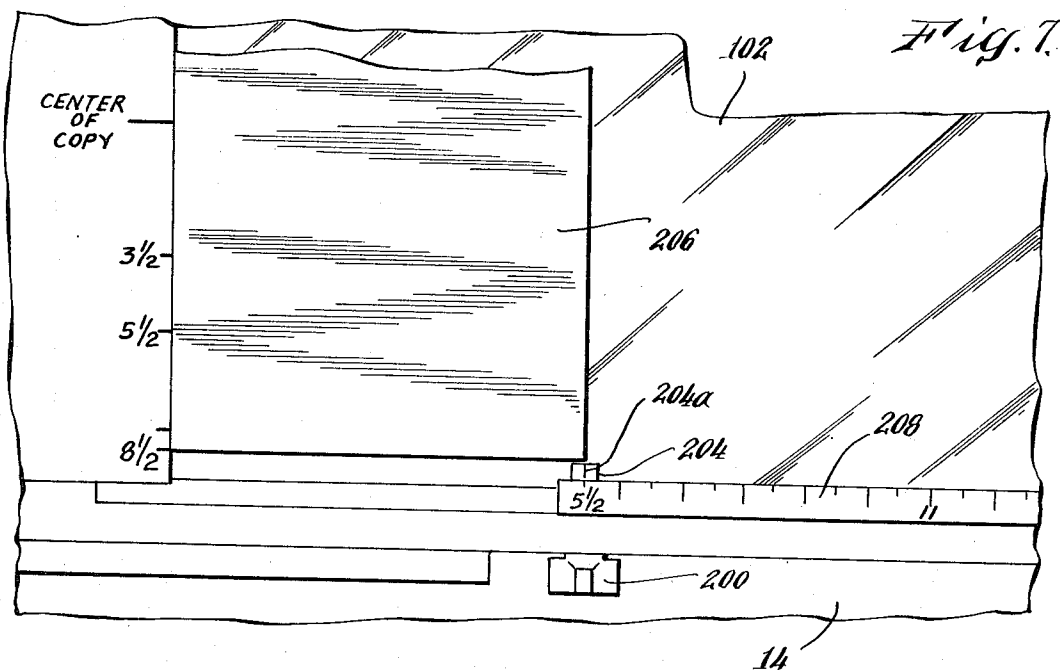
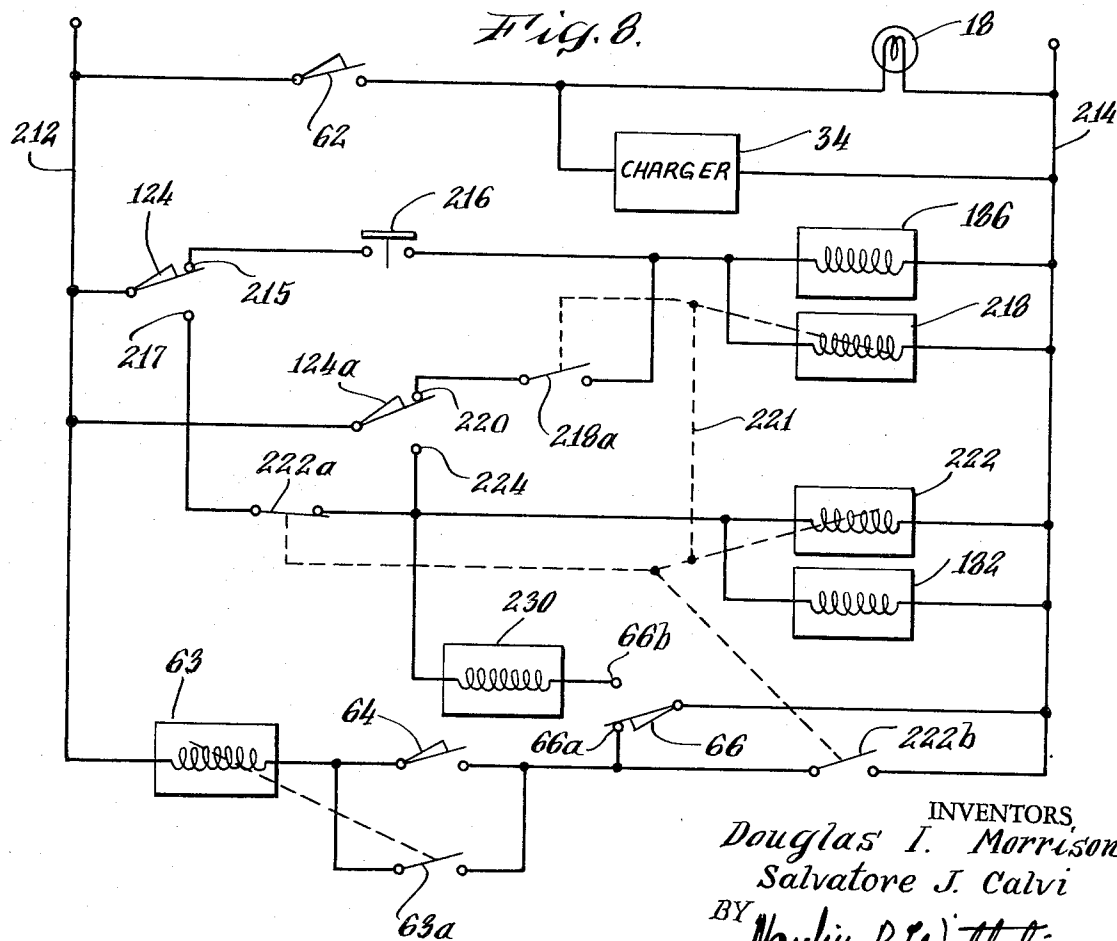


Fig. 6.

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RECIPROCATING DOCUMENT CARRIAGE FOR PHOTOCOPIER

BACKGROUND AND OBJECTS OF THE INVENTION

In one type of office photocopying machine, an original document sheet to be copied is fed into the machine along a feed path through an illuminating station in synchronism with the movement of a copy sheet along a separate feed path through an imaging station. The image borne by the original as it passes through the illuminating station is transformed into a latent electrostatic image on the copy sheet as it moves through the imaging station. The document sheet is then ultimately returned to the machine operator. The latent electrostatic image on the copy sheet is developed and fixed, and ultimately delivered to the operator. Such photocopiers necessarily require original sheet handling apparatus which include an assortment of feed rollers, guides, belt conveyors and diverters for translating the original document into, through and out of the machine.

There is understandably a certain reluctance among users to entrust a valuable original document to such sheet handling apparatus, fearing a malfunction or a jam will result in damage or destruction of the original. If there is a malfunction or jam, the operator may encounter considerable difficulty, particularly if it becomes stranded in the far reaches of its feed path through the interior of the machine. Considerably disassembly may be required to extract the original, necessitating a service call. In either case, considerably valuable time is lost.

An additional, and perhaps more important disadvantage of office photocopiers of this type is that it is physically impossible to copy pages from a book or pamphlet; the original sheet handling apparatus being capable of handling only single sheets. Office photocopiers having book copying capabilities are known, however, they are typically quite expensive and considerably larger than what is commonly considered "desk-top" size.

In one type of photocopier having book copying capabilities, the original document sheet or book page is placed on a stationary, flat glass bed, and the image to be copied is scanned by a movable light source in synchronism with movement of a photoconductive copy paper sheet through the imaging station as in the direct imaging process, or in synchronism with the movement of a photoconductive member for ultimate image transfer to plain copy paper sheets as in the indirect imaging process. Another alternative, is to provide a movable carriage for the original document sheet or book page which is then translated through an illuminating station where the image to be copied is scanned by a stationary light source. An example of a reciprocating document carriage adapted to an electrostatic photocopy machine is disclosed in U.S. Pat. No. 3,424,526, issued to L. D. Sacre.

It is a general object of the present invention to provide an improved office photocopier having book copying capabilities.

A further object of the invention is to provide a photocopier of the above character having a reciprocating carriage for translating an original sheet and bookbound or otherwise assembled sheets through a stationary illuminating station.

Yet another object of the present invention is to provide a photocopier of the above character having improved drive means for reciprocating an original document carrier.

A further object to provide a photocopier of the above character wherein the carriage is capable of being translated through its non-copying stroke at a more rapid rate that has heretofore been possible with known reciprocating document carriage photocopiers.

Still another object of the present invention is to provide a photocopier of the above character wherein the various operating functions of the photocopier are fully synchronized to the movement of the document carriage in an efficient and reliable manner.

Yet another object of the present invention is to provide a photocopier of the above character, which is simple in design, inexpensive to manufacture, efficient, and reliable in operation.

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

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided an office photocopier of compact, desk-top size having a reciprocating carriage for accommodating original document sheets and bound pages alike for movement through an illuminating station. The carriage is mounted on top of the photocopier machine and includes a transparent bed plate on which the document sheet to be copied is placed face down. Upon the initiation of a print cycle, the carriage is moved from a home position through a forward stroke at a uniform, rapid rate. When the carriage reaches a fixed transfer or reversal position concluding the forward stroke, its direction of movement is reversed for a return stroke to bring the carriage back to its original, home position. During the return stroke, which is carried out at a slower rate, the illuminating station is activated and the document is scanned during its passage therethrough.

The passage of the original document through the illuminating station must be synchronized to the movement of the copy paper through the imaging station, and to this end sensing means triggered by movement of the carriage initiates feeding of the copy paper so that the leading edge of the copy paper arrives at the imaging station at the same time that the leading edge of the document sheet arrives at the illuminating station during the return carriage stroke. The return carriage stroke is carried out at the same rate as the copy paper is translated through the imaging station.

An improved drive mechanism for reciprocating the document carriage includes a transmission which is driven off the main copying machine drive train. The output of the transmission is connected to an elongated chain loop with one reach thereof extending in close proximity along the path of reciprocating carriage movement. The carriage is linked to the drive chain loop in a manner so as to provide a lost motion coupling therebetween which is automatically rendered operative when the carriage reaches each of its direction reversal positions, i.e., its transfer and home positions. This lost motion coupling accommodates rapid deceleration and acceleration of the carriage so that the transfer from one stroke to the other is effected smoothly and efficiently.

More specifically, a drive chain loop is mounted on sprockets positioned adjacent the carriage transfer and home positions. A link secured to the carriage is formed having a downwardly elongated slot which receives an elongated chain link pin. So long as the elongated chain link pin engaged in the link slot is traveling in a horizontal direction, there is a positive driving connection between the carriage and the copier drive train. As the chain link pin starts around the periphery of one of the sprockets, the pin moves downwardly in the link slot, thus smoothly and rapidly decelerating the carriage movement to a stop coinciding with the arrival of the chain link pin at the point on the sprocket where it begins to pass around the underside of the sprocket for movement in the opposite horizontal direction. At this precise moment of reversal in horizontal direction of movement of the chain link pin, it engages a switch effective to shift the transmission so that the drive chain loop is driven in the opposite direction. The action of the chain link pin in the carriage link slot reverses to provide smooth an rapid acceleration of the carriage in the opposite direction.

By virtue of this arrangement, it is seen that the carriage direction is reversed to transfer from one stroke to the other at a moment when the carriage velocity is substantially zero. Thus, the inertia of the carriage is largely dissipated at the moment of direction reversal and the transfers are effected quietly and without undue stress on the mechanical drive elements.

As an additional feature of the invention, the document carriage is adapted with a copy sheet length selector which is typically adjustably positioned in accordance with the length of the original document sheet. The copy paper used in the disclosed copier embodiment is withdrawn from a supply roll and thus must be severed into sheet lengths. As the carriage is being translated through its return, copy stroke, the copy sheet length selector actuates a knife switch, which in turn triggers a severing mechanism to sever the copy paper to the selected sheet length.

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

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

FIG. 1 is a schematic view of the principal operating features of an electrostatic photocopy machine in which the present invention is utilized;

FIG. 2 is a side elevational view of the photocopy machine of FIG. 1 illustrating the reciprocating document carriage and the drive and control means therefor;

FIG. 3 is a perspective view of the transmission incorporated in the drive mechanism of FIG. 2;

FIG. 4 is a bottom plan view of the transmission of FIGS. 2 and 3;

FIG. 5 is an enlarged transverse sectional view of the reciprocating document carriage of FIG. 2;

FIG. 6 is an enlarged side elevational view of one of the switch stations for sensing the arrival of the reciprocating document carriage at its home and

transfer positions and controlling the transmission accordingly;

FIG. 7 is a fragmentary top plan view of a portion of the reciprocating document carriage of FIG. 2; and

FIG. 8 is an electrical schematic diagram of the control means of FIG. 2.

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

DETAILED DESCRIPTION

FIG. 1 illustrates schematically one type of office photocopier, generally indicated at 10, to which the reciprocating document carriage of the invention, generally indicated at 12, may be adapted. As will be seen from FIGS. 2 and 5, the document carriage 12 is mounted by elongated, horizontal side rails 14 atop the photocopier 10 for reciprocating movement between a home position at the extreme right of FIG. 1 and a transfer position at the extreme left. It will be appreciated that a portion of the side rails 14 extending to the right beyond the main housing 15 of the photocopier 10 has been broken away in the interest of conserving space. An original document sheet bearing the image to be copied is placed face down on the carriage 12 and reciprocated through an illuminating station, generally indicated at 16. The illuminating station is illuminated by a light source 18 during the return stroke of the carriage 12 from its transfer position to its home position to project the original document image onto an imaging station, generally indicated at 20, by way of a mirror 22 and a lense system schematically indicated at 24.

Copy paper having a suitable photoconductive coating, such as Electrofax paper having a zinc oxide coating on one side, is withdrawn from a supply roll 26 by initial feed rollers 28. The copy paper is cut into a selected sheet length, typically corresponding to the sheet length of the original document, by a severing mechanism, generally indicated at 30. The copy paper is conveyed by feed rollers 32 through a corona charger unit, generally indicated at 34, which operates to place a uniform electrostatic charge on the photoconductive coating of the copy paper. Feed rollers 36 convey the copy paper through the imaging station 20 at the same time and at the same rate as the original document passes through the illuminating station 16 during the return carriage stroke.

In accordance with well-known electrostatic copying techniques, the image to be copied is projected on the photoconductive coating in contact 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 accordance with the image light intensity projected by the lense system 24. The image of the indicia borne by the original document is transformed into a corresponding latent electrostatic image on the zinc oxide coating of the copy paper. The copy paper is then fed by feed rollers 38 through a development station, generally indicated at 40, where the latent electrostatic image is developed using a suitable toner. From the development station 40, feed rollers 42 convey the copy sheet to a drying station, generally indicated at 44, where the developed image is fixed. Feed rollers 46 mounting belts 47 convey the copy sheet to a tray 48

where successive copies may be accumulated for ultimate removal by the operator.

Referring now to FIG. 2, a motor 50 drives a continuous copier drive chain 52 through suitable gear reduction elements 53 and 54 and interconnecting drive chains or belts 55 and 56. The main drive chain 52 engages a sprocket 58 which is, in turn, drivingly coupled to a timing mechanism, generally indicated at 60, to control the actuation of a switch 62 connected in the energization circuit for the lamp 18 and charger unit 34, as seen in FIG. 8. The timing mechanism 60 is in turn under the control of a clutch mechanism, generally indicated at 61, which is suitably conditioned by a feed solenoid 63 energized under the control of a feed switch 64 and de-energized in response to actuation of a knife switch 66 (FIGS. 5 and 8); both switches being positioned for actuation by movement of the reciprocating carriage 12. Solenoid 63 selectively positions a pivotally mounted lever 62 carrying a sprocket 68 which remains in driving engagement with the main drive chain 52 as the lever is rocked between its two clutch positions. When solenoid 63 is energized, the lever is rocked in the clockwise direction to bring a gear (not shown) rotating with sprocket 68 into meshing engagement with a gear 70 drivingly connected to the initial feed rollers 28 seen in FIG. 1, thereby withdrawing copy paper from the supply roll 26.

For a more detailed description of the timing mechanism 60 and of the clutch mechanism 61 reference should be had to Hanson, U.S. Pat. No. 3,457,011, which is assigned to the assignee of the instant application. However, for purposes of the present disclosure, it is believed sufficient to state that when feed switch 64 is actuated by movement of the carriage 12, solenoid 63 is energized to initiate feeding rotation of the initial feed rollers 28 and withdrawal of copy paper from the supply roll 26 (FIG. 1). Contemporaneously, lever 62 releases the timing mechanism 60 to achieve ultimate actuation of the switch 62 and appropriately timed energization of the illuminating lamp 18 and charging unit 34. As will be seen, knife switch 66 is also actuated by the carriage 12 to initiate actuation of the severing mechanism 30 to sever the copy paper into a sheet of appropriate length and also to drop out feed solenoid 63. A spring 71 included in the clutch mechanism 61 pivots the lever 62 in the counter-clockwise direction to decouple the initial feed rollers 28 from the main copier drive chain 52.

Continuing the description of the apparatus of FIG. 2, the drive chain 52 further engages various idler and drive sprockets 73 through 79; the drive sprockets being drivingly connected to the various feed roller pairs operating to convey the copy paper through its various processing stations as described in connection with FIG. 1. Main copier drive chain 52 further drivingly engages a sprocket 80, seen in FIGS. 2 through 4, which constitutes the input drive element for a transmission, generally indicated at 82. The output drive element for transmission 82 is a sprocket 84 which drives a chain loop 86 in turn drivingly engaging a sprocket 88 included in the drive mechanism for reciprocating the carriage 12. Suitable idler sprockets 89 impart proper tension and direction to chain loop 86.

Turning to FIG. 5, sprocket 88 is keyed on a stub shaft 90 rotatably mounted by an upright frame member 91. A second sprocket 92 is keyed on the end of shaft 90 such that it is driven via chain loop 86 and sprocket 88. Sprocket 92, in turn, drives a carriage drive chain loop 94 having upper and lower horizontal reaches extending along and just below the path of reciprocating movement of carriage 12. The other end of the carriage drive chain 94 is looped around a sprocket 96 rotatably mounted adjacent the transfer position of the document carriage 12 (FIG. 2).

Still referring to FIG. 5, the carriage 12, seen in cross-section, comprises an open rectangular frame member 100 for mounting a glass bed plate 102 on which the original document is placed face down and through which the document image is scanned as it moves through the illuminating station 16 (FIG. 1). A series of posts 104 spaced along each side of the carriage and depending from the carriage frame 100 serve to mount roller brackets 106 which in turn rotatably mount rollers 107 adapted to ride on longitudinal rails 108 carried by each side rail 14. Side rails 14 are in turn adjustably mounted by a series of feet 110 upstanding from a horizontal copier frame member 112. Suitable adjustment of the mountings for side rail members 14 are made to ensure that the upper surface of the glass bed plate 102 is properly oriented relative to the projection optics of the copy machine. Preferably, the rollers 107 on the right side of the carriage 12 seen in FIG. 5 are flanged so as to control lateral sway of the carriage as it rides on rails 108 during reciprocating movement.

To drivingly couple carriage 12 to the carriage drive chain loop 94, one of the chain link pins is extended on each side as indicated at 116. An L-shaped link 118 is secured at the free end of its horizontal leg 118a to one of the posts 104 depending from the carriage frame 100. The horizontal leg 118a extends to the right or outward to a point beyond the sprocket 92 where link 118 is bent downwardly into a vertically extending leg 118b, which is slotted, as indicated at 118c, to receive the outer or right extension of elongated link pin 116. For stability, a second smaller L-shaped link 120 is secured to the underside of horizontal leg 118a of link 118 and has a vertical depending leg. The vertical depending leg of link 120 is bifurcated, as indicated at 120a, to receive the inner or left extension of elongated link pin 116.

From FIG. 2, it is seen that if sprocket 92 is rotated via transmission 82 and sprocket 88 in the counter-clockwise direction, chain loop 94 via the elongated link pin 116 and slotted link 118 draws the carriage 12 to the left from its home position toward its transfer position. Conversely, if the direction of rotation of sprocket 92 is reversed by operation of transmission 82, chain loop 94 draws the carriage in the opposite direction to the right from its transfer position toward its home position.

Still referring to FIG. 2, shifting of transmission 82 so as to drive sprocket 92 in opposite directions and thus in turn, drive the carriage 12 through either a forward stroke or a return, copy stroke is under the control of a home switch station, generally indicated at 120, and a transfer switch station, generally indicated at 122. Home switch station 120 is positioned to the right of

sprocket 92 whereas the transfer switch station 122 is positioned just to the left and beyond the carriage drive chain loop sprocket 96.

Home switch station 120 seen in FIG. 6 and the transfer switch station 122 are constructed in corresponding fashion. Specifically, as seen in FIG. 6, home switch station 120 comprises a switch 124 which is secured to a plate 126 supported by brackets 128 depending from a stationary copier frame member 130. A primary switch actuating lever 132 is pivotally mounted on a post 134 carried by mounting plate 126. A spring 136 connected between the free right end of primary lever 132 and a lower horizontal extension of mounting plate 126 normally pivots the right portion of primary lever 132 downwardly about pivot post 134 into depressing engagement with the switch button 138. A secondary switch actuating lever 140, also pivotally mounted on post 134, extends to the left to a point where its free end is engaged by the inner extension of the elongated chain link pin 116 as it moves around the periphery of drive sprocket 92 upon clockwise rotation thereof.

When the elongated chain link pin 116 depresses secondary lever 140, it engages an abutment 132a carried by primary lever 132 to pivot the latter in a counterclockwise direction against the force of spring 136 and release the switch button 138. A spring 142 is carried by pivot post 134 and bears downwardly on the secondary lever 140 to maintain it in contacting engagement with abutment 132a.

The arrangement of two switch actuating levers 132 and 140 is resorted to in order to avoid damage to the home and transfer switch stations should the elongated chain link pin 116 pass downwardly beyond the free end of secondary lever 140. This situation should not normally arise since slight downward pivoting of secondary lever 140 by the elongated chain link pin 116 is sufficient to pivot the primary lever 132 sufficiently to release switch button 138. The moment the switch button 138 is released, switch actuation is achieved and, as will be seen, transmission 82 disengages the drive sprocket 92 from the copier drive chain 52. Thus, during normal operation, the elongated chain link pin 116 should remain above the free, left end of secondary lever 140. If however the pin 116 passes below secondary lever 140, it can readily return to its appropriate position, since the spring 142 will yield permitting the lever 140 to lift upwardly and allow the elongated chain link pin to pass without exerting rotational forces on the primary switch actuating lever 132.

The transfer switch station 122 is the mirror image of the home switch station 120 and operates in the identical fashion.

The transmission 82, as seen in FIGS. 2 through 4, receives its drive input by way of the main copier drive chain 52 and sprocket 80, and operates to selectively drive its output sprocket 84 in either direction to reciprocate the carriage 12. Input drive sprocket 80 is journaled on a stub shaft 150 which is mounted at its inner end 150a to a side frame member 152. Similarly, output drive sprocket 84 is journaled on a stub shaft 154, best seen in FIG. 3, which is also mounted by side frame 152. Stub shaft 150 also rotatably mounts a gear 156 which is integrally formed with or otherwise drivingly connected to input drive sprocket 80. A large

diameter gear 158 and a smaller diameter gear 160 are journaled on stub shaft 154 and are drivingly connected to each other and also to the output drive sprocket 84. Thus, gears 158, 160 and output drive sprocket 84 rotate in unison on stub shaft 154, as does gear 156 and input drive sprocket 80 on stub shaft 150.

Stub shaft 150 also pivotally mounts a pair of levers 162 and 164. Lever 162 carries a stub shaft 166 for rotatably mounting a gear 168 in continuous meshing engagement with gear 156. Lever 164 carries a stub shaft 170 rotatably mounting an idler gear 172 also in continuous meshing engagement with gear 156. A second stub shaft 174 carried by lever 164 journals a gear 176 which is in continuous meshing engagement with the idler gear 172. It is thus seen that while the copier drive chain 52 is driven, gear 156 rotates gear 168 in one direction and gear 176 in the opposite direction via the reversing idler gear 172.

Lever 162 is normally urged in a clockwise direction by a spring 178 anchored to a stationary post 180 so that the rotating gear 168 is removed from meshing engagement with the large diameter gear 158. A solenoid 182, whose armature 182a is linked to lever 162 is effective, when energized, to pivot the lever 162 in the counterclockwise direction to bring the rotating gear 168 into meshing engagement with gear 158. As will be seen, energization of solenoid 182 is under the control of the transfer switch station 122 to drive the carriage 12 through a return, copy stroke from its transfer position to its home position.

Lever 164 is normally urged in the counterclockwise direction about shaft 150 by a spring 184 anchored to post 180 to remove gear 176 from meshing engagement with gear 160 drivingly connected to larger gear 158 and output drive sprocket 84 on stub shaft 154. A solenoid 186, whose armature 186a is linked to lever 164, is energized under the control of the home switch station 120 to pivot lever 164 in the clockwise direction so as to drivingly engage gear 176 with gear 160. Since gear 160 is of a smaller diameter than gear 158 and since gear 176 is driven in the opposite direction from gear 168 due to the presence of idler gear 172, carriage 12 is driven through its forward stroke at a faster rate than it is driven through its return, copy stroke, thus speeding up the copy cycle. It is also seen that when neither of the solenoids 182 or 186 are energized, gear 168 is disengaged from gear 158 and gear 176 is disengaged from gear 160, and the carriage 12 is thus decoupled from the main copier drive chain 52.

As best seen in FIG. 3, to guard against the possibility of simultaneous application of both forward and reverse drive to the gears 158 and 160, lever 162 is formed having an inwardly turned tab 163 extending into engaging relation with the depending leg portion 165 of lever 164. Tab 163 serves as a mechanical interlock to prevent the pivotal movement of one lever into its drive engaging position if the other lever has already assumed its drive engaging position. Specifically, if lever 162 is pivoted in the counterclockwise direction by solenoid 182 to engage gear 168 with gear 158, tab 163 prevents solenoid 186 from pivoting lever 164 in the clockwise direction to engage gear 176 with gear 160 without first causing disengagement of gears 158 and 168. It is also seen that the reverse situation obtains in that if lever 164 is in its clockwise drive engaging

position, lever 162 cannot be pivoted counterclockwise into its drive engaging position without first disengaging gear 176 from gear 160. As will be seen from FIG. 8, there is also provided an electrical interlock so as to prevent simultaneous energization of solenoids 182 and 186.

From the description thus far, it is seen that when solenoid 186 is energized, the driven gear 176 moves into engagement with gear 160. Carriage 112 is thus driven from its home position through a forward stroke toward its transfer position. At a predetermined point along its forward stroke travel, a tab 190 secured to one of the depending posts 104 of the carriage from 100, as seen in FIG. 6, triggers feed switch 64 to engage clutch mechanism 61 (FIG. 2) so as to couple drive from the main copier drive chain 52 to the initial feed rollers 28. Withdrawal of copy paper from the supply roll 26 is thus initiated. As the carriage 12 approaches its transfer position, the elongated chain link pin 116 arrives at sprocket 96. As the link pin starts around the periphery of sprocket 96, it slides downwardly in slot 118c of carriage link 118. This lost motion coupling automatically produces a rapid, but smooth deceleration of the carriage during its final approach to the transfer position. When the elongated chain link pin 116 moves around the sprocket diameter 90° to the 9 o'clock position shown in FIG. 2, the forward stroke movement of the carriage 12 is terminated at precisely its transfer position signalled by engagement of the chain link pin with the secondary actuating lever 140a for transfer switch 124a of transfer switch station 122, as seen in FIG. 2. As will be seen from FIG. 8, the transfer switch 124a initiates energization of solenoid 182 and simultaneous de-energization of solenoid 186, shifting transmission 82 into reverse to begin the return, copy stroke of the carriage 12.

It should be noted that the carriage 12 begins its return stroke from a state of virtual rest. As carriage chain loop 94 is driven in the opposite direction, chain link pin 116 slides upwardly in carriage link slot 118c to induce a rapid, but smooth acceleration into its return stroke. When the chain link pin reaches the 12 o'clock position on the diameter of sprocket 96, carriage 12 achieves its maximum return stroke velocity. At a preselected point during the carriage return, copy stroke, knife switch 66 is actuated to energize the severing mechanism 30 and also effect decoupling of the initial feed rollers 28 from the main drive chain 52.

As carriage 12 approaches its home position, the elongated chain link pin 116 starts around the periphery of sprocket 92 and descends in carriage link slot 118c to effect carriage deceleration. Home switch 124 is actuated as the carriage comes to rest at its home position to de-energize solenoid 182, shifting transmission 82 to neutral. In a multi-copy mode, home switch 124 would be additionally rendered effective to energize solenoid 186, automatically initiating an immediate forward stroke.

It will occur to the reader that carriage reversal could be achieved without reversing the drive direction of carriage chain loop 94. It has been found preferably to maintain the drive coupling (pin 116) between the carriage and chain loop in the upper chain reach between sprockets 92 and 96 which is nearest the carriage and also less subject to sag and oscillation, thus insuring a

more positive and uniform application of drive to the carriage.

Referring to FIGS. 5 and 7, a copy sheet length selector 200 is slidably an elongated bracket 202 (FIG. 5) secured to the frame 100 of the carriage 12. Selector 200 carries a pointer 204 having a score line 204a viewable through the glass bed plate 102. The operator normally manipulates the selector 200 to align the score line 204a with the trailing edge of the document 206 placed face down on the glass bed plate 102, or, if desired, with a selected graduation on a copy sheet length scale 208 suitably secured to the carriage frame 100. The selector 200 carries an arm 210 which is oriented to trigger the copy paper sheet length or knife switch 66, as seen in FIG. 5. When the stationary switch 66 is actuated by the actuator arm 210 of the selector 200 during the return, copy stroke of the carriage 12, the severing mechanism 30 is energized to sever the copy paper into a sheet length selected by the positioning of selector 200. It will be appreciated that the copy paper may be severed into sheet lengths differing from the document sheet length.

Turning now to FIG. 8, the lamp 18 and charger 34 are selectively connected across power buses 212 and 214 by switch 62 of the timing mechanism 60 operating in a manner previously described. Home switch 124 is normally in contact with its contact 215 to supply energizing power to solenoid 186 of the transmission 82 upon closure of a copy push button switch 216. A latch relay 218 is connected in parallel with solenoid 186 such that it is energized concurrently therewith. Upon energization of latch relay 218, it operates to close one of its contacts 218a so as to complete a holding circuit for itself and solenoid 186 through the transfer switch 124a which normally engages its upper contact 220.

When the carriage 12 is in its home position, awaiting the next copy cycle, the elongated chain link pin 116 engages home switch 124, positioning it to contact 215. Thus upon depression of copy switch 216, to initiate a copy cycle, solenoid 186 is energized, as is latch relay 218, and the carriage 12 is propelled through a forward stroke. As the carriage leaves its home position, home switch 124 moves into engagement with its lower contact 217, but solenoid 186 and latch relay 218 remain energized through the holding circuit including transfer switch 124a and the now closed latch relay contacts 218a.

The armature of latch relay 218 is mechanically coupled, as diagrammatically indicated at 221, to the armature of a second latch relay 222 whose relay contacts are 222a and 222b. Latch relay 222 is electrically connected in parallel with solenoid 182 of the transmission 82, which are both energized initially via the transfer switch 124a when it is moved to its lower contact 224 upon arrival of the carriage 12 at its transfer position and thereafter through latch relay contacts 222a and home switch 124.

By virtue of the mechanical interconnection 221 between the latch relays 218 and 222, when the former is energized at the beginning of a forward stroke, it not only closes its own relay contacts 218a but it also simultaneously opens relay contacts 222a and closes relay contacts 222b of latch relay 222. Thus, when the carriage 12 moves off its home position and home switch 124 closes on contact 217, latch relay contacts 222a

have already opened to prevent energization of latch relay 222 and solenoid 182 at this time.

As carriage 12 moves through its forward stroke, actuating arm 190, carried thereby, engages feed switch 64 to complete the energization circuit for feed solenoid 63 through either the knife switch 66 or latch relay contacts 222b. Energization of the feed solenoid 63 closes self-latching contacts 63a, shunting feed switch 64, so that only momentary closure of the feed switch is required to initiate and sustain feeding of the copy paper from the copy paper supply roll 26.

When the carriage 12 reaches the transfer position, transfer switch 124a closes on its contact 224, breaking the holding circuit for solenoid 186 and latch relay 218 and completing an energization circuit for solenoid 182 and latch relay 222. Solenoid 186 drops out and solenoid 182 pulls in to reverse the drive to the carriage 12 while latch relay contacts 222a of latch relay 222 close to complete a holding circuit through home switch 124. Latch relay contacts 222b open so that the only thing sustaining the energization circuit for the feed solenoid 63 is knife switch 66.

When the carriage leaves the transfer position for its return, copy stroke through the illuminating station 16, now activated by closure of switch 62, transfer switch 124a closes on its contact 220. When the actuator arm 210 of the copy sheet length selector 200 encounters the knife switch 66 during the return, copy stroke, it disengages from contact 66a and closes on contact 66b. This has the joint affect of pulsing the severing mechanism solenoid 230 to sever the copy paper to the appropriate sheet length and also to break the energization circuit for the feed solenoid 63. Clutch mechanism 61 is disengaged to decouple the initial feed rollers 28 from the main copier drive chain 52 to terminate further withdrawal of copy paper from the supply roll 26.

When the carriage 12 arrives at its home position, the home switch 124 is returned to its contact 215, breaking the holding circuit for solenoid 182 and latch relay 222. Since the print push button switch 216 is open, the carriage 12 remains in its home position.

It will be appreciated that provisions may be made to provide a multi-copy operating mode wherein the copy switch 216 is bypassed to immediately initiate additional copy cycles until a suitable countdown mechanism has counted down the pre-selected number of copy cycles, whereupon control of the initiation of energization of solenoid 186 and latch relay 218 is returned to the copy push button switch 216.

Since the knife switch 66 is actuated during both the forward and return strokes, latch relay contacts 222b are closed during the forward stroke of the carriage 12 so as to sustain the energization circuit for feed solenoid 63 when the knife switch 66 disengages from contact 66a during the forward carriage stroke. During the return carriage stroke, latch relay contacts 222b are open so that the feed solenoid energization circuit is totally under the control of the knife switch 66. It will be recalled that the knife solenoid 230 is not energized when the knife switch 66 is actuated during the forward carriage stroke since latch relay contacts 222a are open and transfer switch 124a is closed on contact 224 only while the carriage is in the transfer position.

The latch relays 218 and 222 are preferably of the type wherein their armatures have no return springs. When one of the latch relays is energized to pull its armature to an energized position, the armature is returned to its non-energized position only by energization of the other latch relay. By virtue of this feature, the control circuitry of FIG. 8 is capable of remembering which stroke, forward or reverse, the carriage is involved should power be disrupted. When power is restored, the latch relay contacts are not disturbed, so that the copy cycle, in effect, picks up where it left off.

While the illustrated embodiment of the invention utilizes fixed home and transfer positions, it will be appreciated that sprocket 96 may be adapted for selective horizontal positioning relative to sprocket 92. This would have the effect of adjusting the horizontal spacing between the home and transfer positions. This technique may be used advantageously to tailor the copy stroke length to the document length, and thus affords the capability of providing faster copy cycles for documents of shorter lengths. To take up the resulting slack in chain 94, when sprocket 96 is moved toward sprocket 92, a third vertically adjustably positionable idler sprocket may be provided.

In addition, separate chains driven in opposite directions at different rates, may be provided to power each carriage stroke. When the carriage reaches its transfer and home positions, drive coupling is transferred from one chain to the other. Also, a third sprocket engaging the carriage drive chain may be positioned vertically below the transfer position sprocket. This would provide a rising drive chain reached between this third sprocket and the home position sprocket. If the chain is continuously driven in the direction such that its horizontal reach travels from the home position sprocket toward the transfer position sprocket, the carriage will automatically be driven through a slower copy stroke as the link pin the carriage is coupled to via an elongated drive fork or link moves in the rising chain reach returning to the home position sprocket.

It will be appreciated the feature of rapid and smooth deceleration and acceleration of the carriage during transfers from one stroke to the other may be incorporated in these various modifications.

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

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

1. In a photocopier, apparatus comprising, in combination:

- A. a carriage accommodating an original document and mounted for reciprocating movement through an illuminating station located intermediate a home carriage position and a transfer carriage position;
- B. a drive mechanism;
- C. a continuous, elongated drive element drivingly coupled to said drive mechanism and extending

- along the path of reciprocating movement of said carriage;
- D. means drivingly connecting said drive element to said carriage, said connecting means including
1. a first member carried by said drive element, and
 2. a second member carried by said carriage,
 3. said first and second members comprising means forming a lost motion connection therebetween for
 - a. providing a positive drive coupling between said carriage and said drive element to draw said carriage along a major portion of said path intermediate said home and transfer stations at a speed equal to the speed of said drive element, and
 - b. automatically providing a varying drive coupling between said carriage and said drive element such that said carriage is decelerated and accelerated by said drive element as said carriage approaches and leaves said home and transfer stations without varying the speed of said drive element.
- E. sensing means responsive to the arrival of said carriage at said home and transfer positions for controlling said drive mechanism.
2. The apparatus defined in claim 1, wherein said drive element comprises a chain loop engaged by sprockets stationed adjacent said home and transfer positions.
3. The apparatus defined in claim 2, wherein:
- A. said first member comprises a pin secured to a point on said chain loop moving in the chain loop half between said sprockets nearest said path; and
 - B. said second member comprises a link carried by said carriage, said link formed having a slot for receiving said pin to provide said lost motion connection,
 1. said slot being elongated in a direction normal to said path, whereby said pin slides in said slot as said pin moves on the periphery of either of said sprockets to automatically accelerate and decelerate said carriage.
4. The apparatus defined in claim 3, wherein said sensing means is actuated to effect decoupling of said drive mechanism from said chain loop substantially at the moment said pin arrives at the point on either of said sprocket peripheries where its direction of movement parallel to said path reverses, whereby said carriage is brought to rest at said home and transfer positions.
5. The apparatus defined in claim 4, wherein said sensing means operates upon the arrival of said carriage at said transfer position to immediately effect recoupling of said drive mechanism to said chain loop and movement of said carriage back toward said home position.
6. The apparatus defined in claim 1, wherein said drive mechanism operates to drive said carriage from said home position to said transfer position at a first rate and to drive said carriage from said transfer position back to said home position at a second, different rate.
7. The apparatus of claim 1, wherein said drive mechanism includes a transmission having a forward

drive condition, a neutral condition, and a reverse drive condition, all under the control of said sensing means.

8. The apparatus defined in claim 7, wherein

- A. said sensing means includes a first sensing switch located adjacent said home position and a second sensing switch located adjacent said transfer position; and
- B. said transmission includes a first solenoid operating a first lever to shift into said forward drive condition and a second solenoid operating a second lever to shift into said reverse drive condition,
 1. said first switch being conditioned while said carriage is in said home position to enable energization of said first solenoid for operation of said first lever, and
 2. said second switch conditioned by the arrival of said carriage at said transfer position to de-energize said first solenoid and energize said second solenoid for operation of said second lever.

9. The apparatus defined in claim 8, wherein one of said levers carries a mechanical interlock member adapted to prevent said transmission from being concurrently conditioned in said forward and reverse drive conditions.

10. The apparatus of claim 9, which further includes interlocking elements connected in electrical circuit with said first and second solenoids, said interlocking elements operating to prevent concurrent energization of said solenoids and to automatically reinstate a transmission drive condition interrupted by a power failure.

11. In a photocopier having an illuminating station where the image borne by an original document is scanned, and a copy paper feed path including an electrostatic charging station, an imaging station where the original document image is projected from the illuminating station onto copy paper withdrawn from a supply roll to create a latent electrostatic image thereon, and a developing station for developing and fixing the latent electrostatic image on the copy paper, apparatus comprising, in combination:

- A. a carriage for the original document, said carriage mounted for reciprocation to move the original document through the illuminating station;
- B. a reversible drive mechanism selectively coupled to drive said carriage through a forward stroke from a home position to a transfer position at a first rate and through a copy stroke from said transfer position back to said home position at a second, slower rate during each copy cycle, the movement of said carriage during said copy stroke being such that the original document moves through the illuminating station in synchronism with the movement of copy paper through the imaging station;
- C. first sensing means responsive to the arrival of said carriage at said transfer position to condition said drive mechanism to immediately drive said carriage through said copy stroke;
- D. second sensing means responsive to the return of said carriage to said home position to condition said drive mechanism to drive said carriage through said forward stroke upon the initiation of a next copy cycle;
- E. a first switch positioned along the path of reciprocating carriage movement and actuated by

passage of said carriage during said forward stroke to initiate feeding of the copy paper; and

- F. a second switch positioned along said path and actuated by passage of said carriage during said copy stroke to initiate severance of a sheet length of copy paper from the supply roll and termination of copy paper feed.

12. The apparatus of claim 11, which further includes a copy paper length selector slidably mounted by said carriage; said selector carrying an arm for actuating said second switch and being selectively positioned to provide a desired copy paper sheet length.

13. In a photocopier having an illuminating station where the image borne by an original document is scanned, and a copy paper feed path including an electrostatic charging station, and imaging station where the original document image is projected from the illuminating station onto a moving copy paper sheet to create a latent electrostatic image thereon, and a developing station for developing and fixing the latent electrostatic image on the copy paper sheet, apparatus comprising, in combination:

A. a carriage for the original document, said carriage mounted for reciprocation to move the original document through the illuminating station;

B. a reversible drive mechanism selectively coupled to drive said carriage through a forward stroke from a home position to a transfer position at a first rate and through a copy stroke from said transfer position back to said home position at a second, slower rate during each copy cycle, the movement of said carriage during said copy stroke being such that the original document moves through the illuminating station in synchronism with the movement of the copy sheet through the imaging station, said mechanism including

1. a transmission drivingly coupled to the photocopier drive train,

2. a chain loop engaged by sprockets located adjacent said home and transfer positions and extending along the path of reciprocating carriage movement, said chain loop being selectably coupled to the copier drive train by said transmission for driven movement in opposite directions,

3. a pin secured to a point on said chain loop moving in the chain loop half between said sprockets nearest said path, and

4. a link secured to said carriage and having a slot for receiving said pin, said slot being elongated in a direction normal to said path, whereby said pin slides in said slot as said pin moves on the periphery of either of said sprockets to automatically accelerate and decelerate said carriage during movement immediately adjacent said home and transfer positions;

C. first sensing means responsive to the arrival of said carriage as said transfer position to condition said transmission to immediately drive said carriage through said copy stroke; and

D. second sensing means responsive to the return of said carriage to said home position to condition said transmission to drive said carriage through said forward stroke upon the initiation of a next copy cycle.

14. The apparatus defined in claim 13, wherein said first and second sensing means are actuated to condition said transmission to decouple said chain loop from the photocopier drive train substantially at the moment said pin arrives at the point on either of said sprocket peripheries where its direction of movement parallel to said path reverses, whereby said carriage is brought to rest at said home and transfer positions, said first sensing means further operating after said carriage comes to rest at said transfer position to immediately condition said transmission to recouple said chain loop to the copier drive train and drive said carriage through said copy stroke.

15. The apparatus defined in claim 14, wherein said transmission includes a first solenoid operating when energized to shift said transmission to a forward drive condition for driving said carriage through said forward stroke and a second solenoid operating when energized to shift said transmission to a reverse drive condition for driving said carriage through said copy stroke, said second sensing means, while said carriage is in said home position, enabling energization of said first solenoid upon closure of a copy cycle switch and said first sensing means, while said carriage is in said transfer position, operating to de-energize said first solenoid and immediately energize said second solenoid.

16. The apparatus of claim 14, wherein said first and second sensing means are actuated upon engagement by said pin.

17. In a photocopier, apparatus comprising in combination:

A. a carriage accommodating an original document and mounted for reciprocating movement through an illuminating station located intermediate a home carriage position and a transfer carriage position;

B. a drive mechanism;

C. a continuous, elongated drive element drivingly coupled to said drive mechanism and extending along the path of reciprocating movement of said carriage; and

D. means drivingly connecting said drive element to said carriage, said connecting means including

1. a first member carried by said drive element, and

2. a second member carried by said carriage,

3. said first and second members comprising means forming a lost motion connection therebetween for

a. providing a positive drive coupling between said carriage and said drive element to draw said carriage along a major portion of said path intermediate said home and transfer stations at a speed equal to the speed of said drive element, and

b. automatically providing a varying drive coupling between said carriage and said drive element such that said carriage is decelerated and accelerated by said drive element as said carriage approaches and leaves said home and transfer stations without varying the speed of said drive element.

18. The apparatus defined in claim 17, wherein said drive element comprises a chain loop engaged by sprockets stationed adjacent said home and transfer positions, and

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- A. said first member comprises a pin secured to a point on said chain loop moving in the chain loop half between said sprockets nearest said path; and
- B. said second member comprises a link carried by said carriage, said link formed having a slot for receiving said pin to provide said lost motion connection,

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- 1. said slot being elongated in a direction normal to said path whereby said pin slides in said slot as said pin moves on a periphery of either of said sprockets to automatically accelerate and decelerate said carriage.

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