United States Patent

Murgas et al.

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[45] **Oct. 24, 1972**

[54] **SWITCH CONTROL MEANS FOR A PHOTOCOPY MACHINE**

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[73] Assignee: **ICP, Inc.,** Skokie, Ill.

[22] Filed: **Aug. 21, 1970**

[21] Appl. No.: **65,769**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 745,841, July 18, 1968, Pat. No. 3,597,074.

[52] **U.S. Cl.** **355/14**

[51] **Int. Cl.** **G03g 15/00**

[58] **Field of Search** 355/14, 3

[56] **References Cited**

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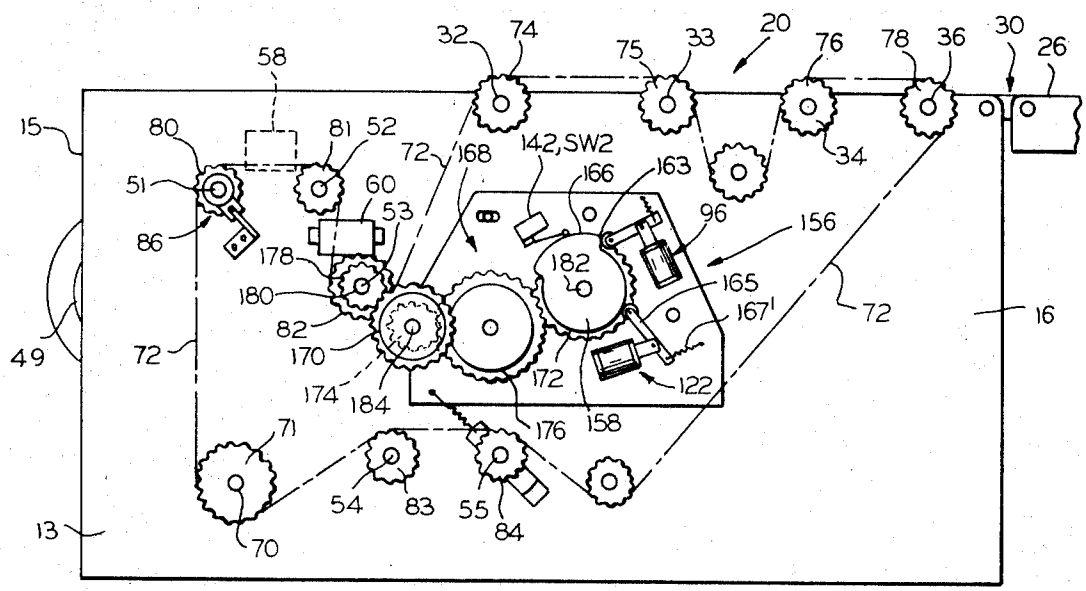
[57] **ABSTRACT**

An electrostatic photocopy machine comprising an original document transport means having a sheet copier position for reproducing an original document sheet of substantially any length and a book copier position for reproducing a book or other type original document of substantial thickness. In either the sheet or book copier position, increments of a moving original document are produced onto a simultaneously moving length of copy paper. A movable book carrier is removably attached to the machine when the original transport means is in the book copier position.

Switch control means, including a cam driven by a continuous chain, is used to turn the corona and the high intensity lamp on and off.

7 Claims, 11 Drawing Figures



Patented Oct. 24, 1972 3,700,326

4 Sheets-Sheet 1

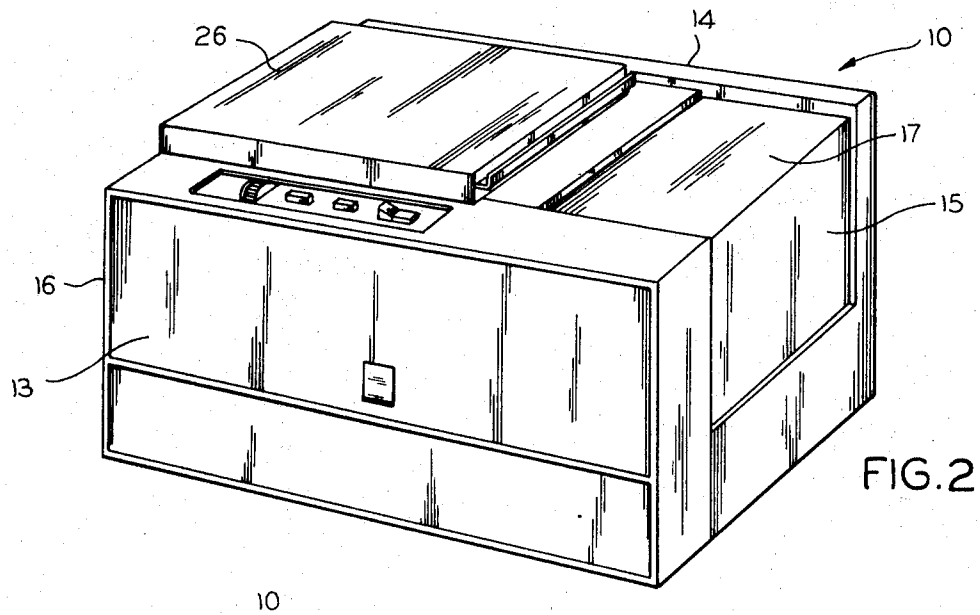


FIG. 2

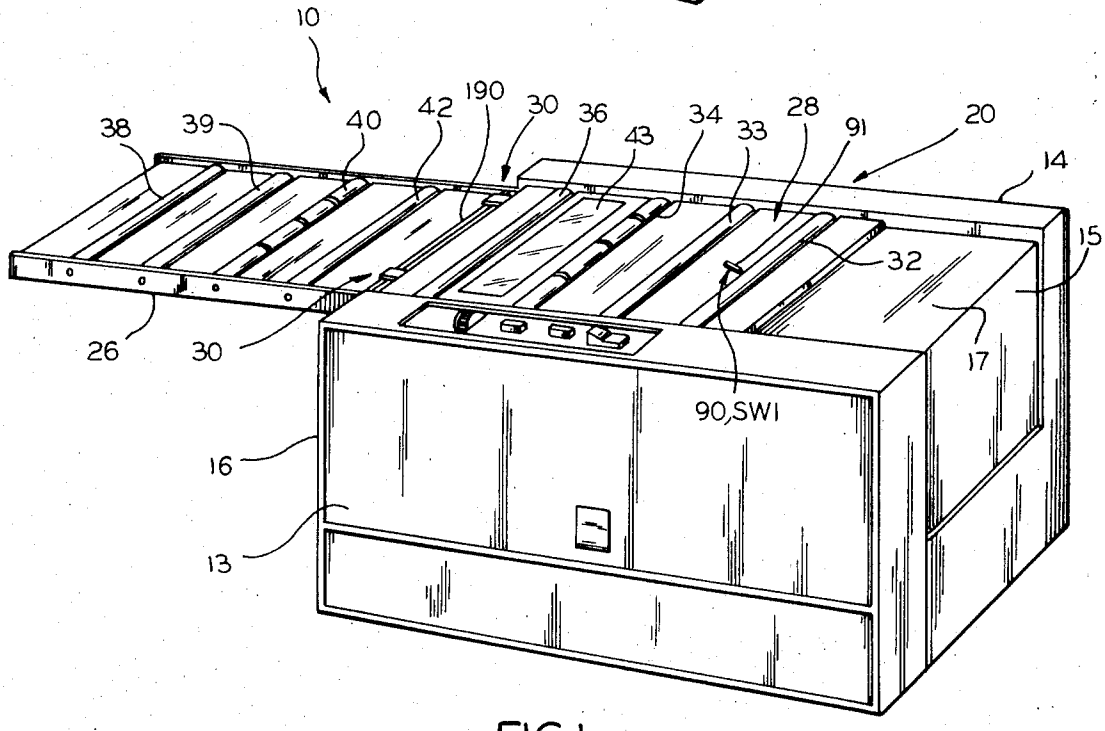


FIG. 1

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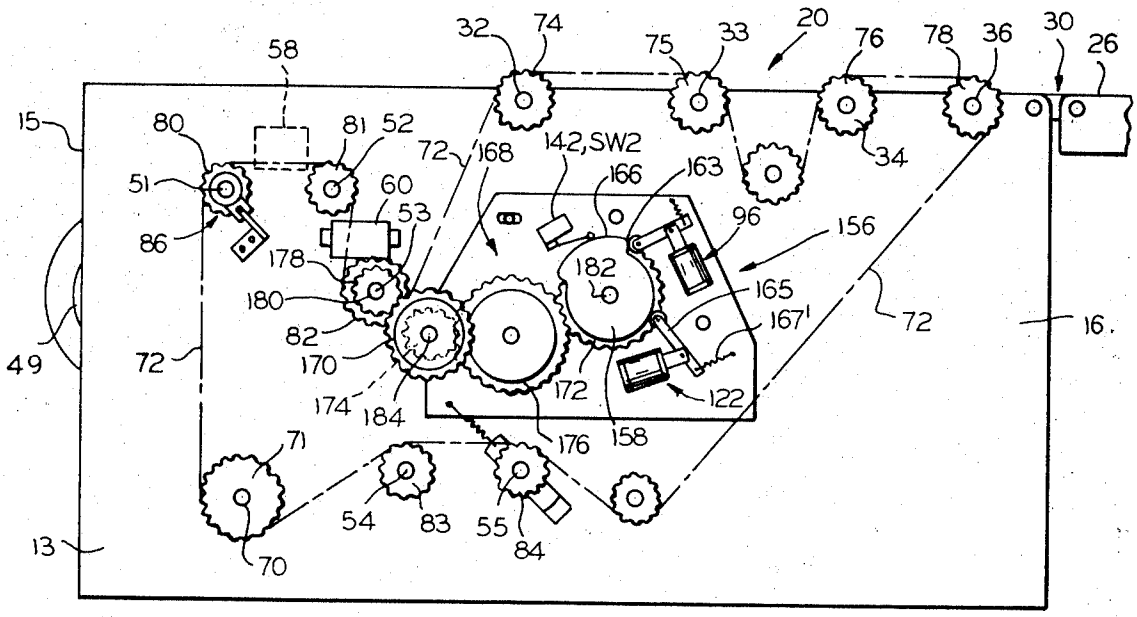

FIG.3

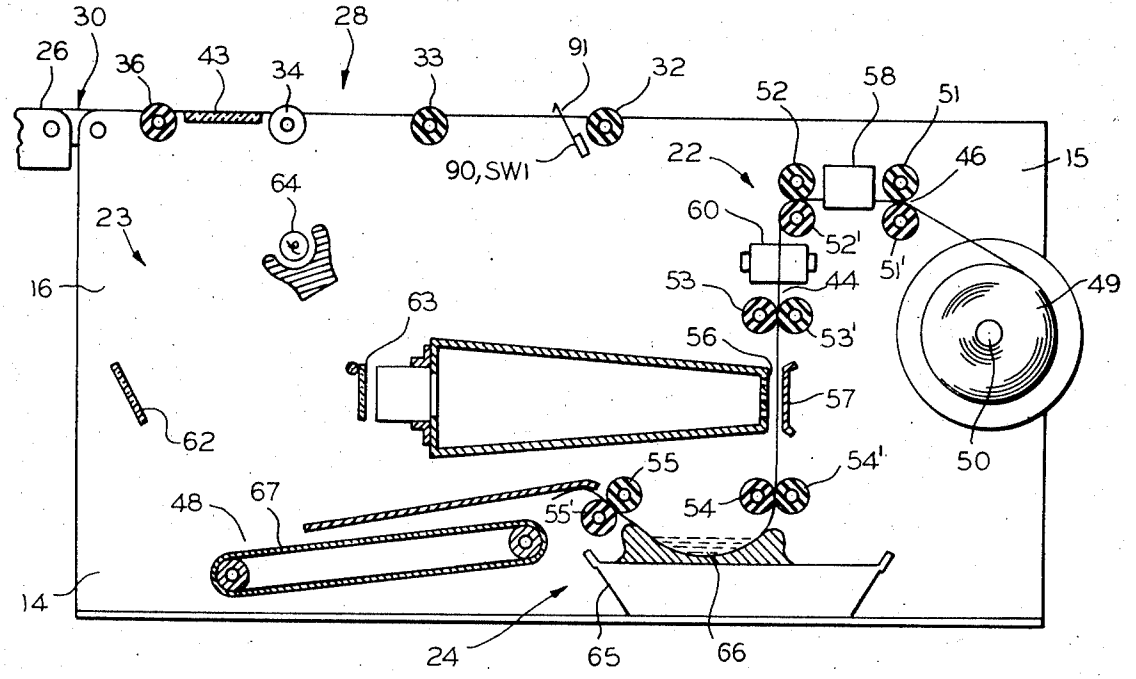

FIG.4

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Patented Oct. 24, 1972 3,700,326

4 Sheets-Sheet 3

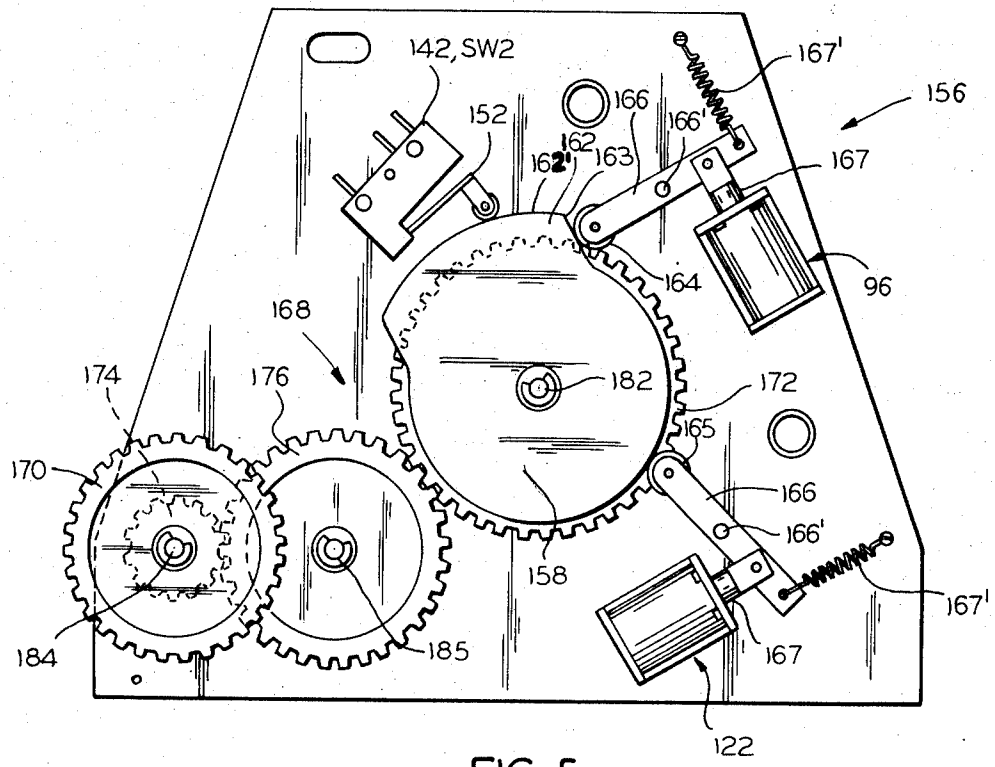

FIG. 5

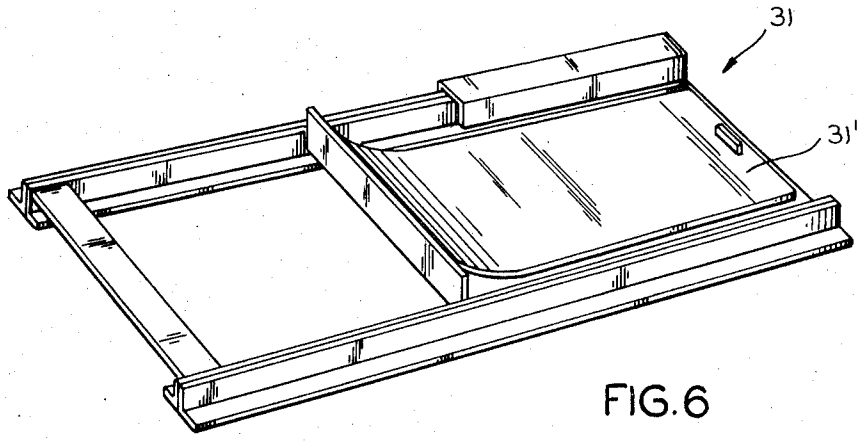

FIG. 6

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FIG.7

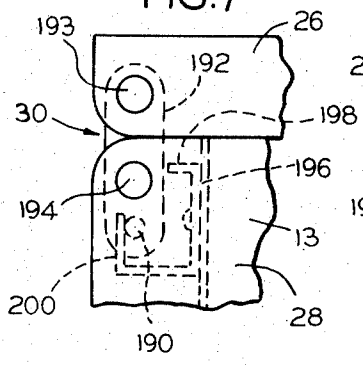


FIG.8

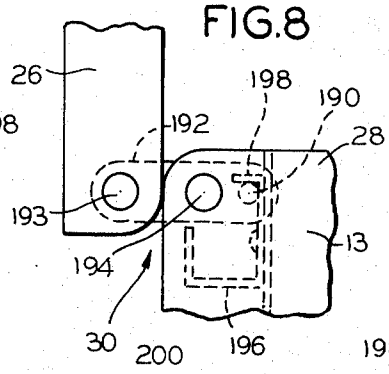


FIG.9

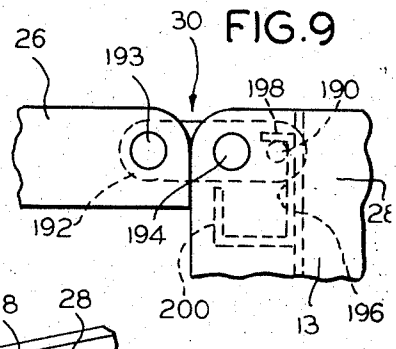
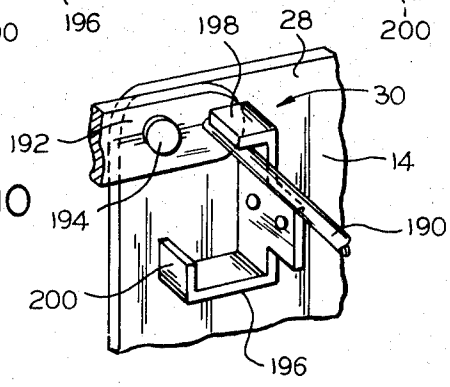


FIG.10



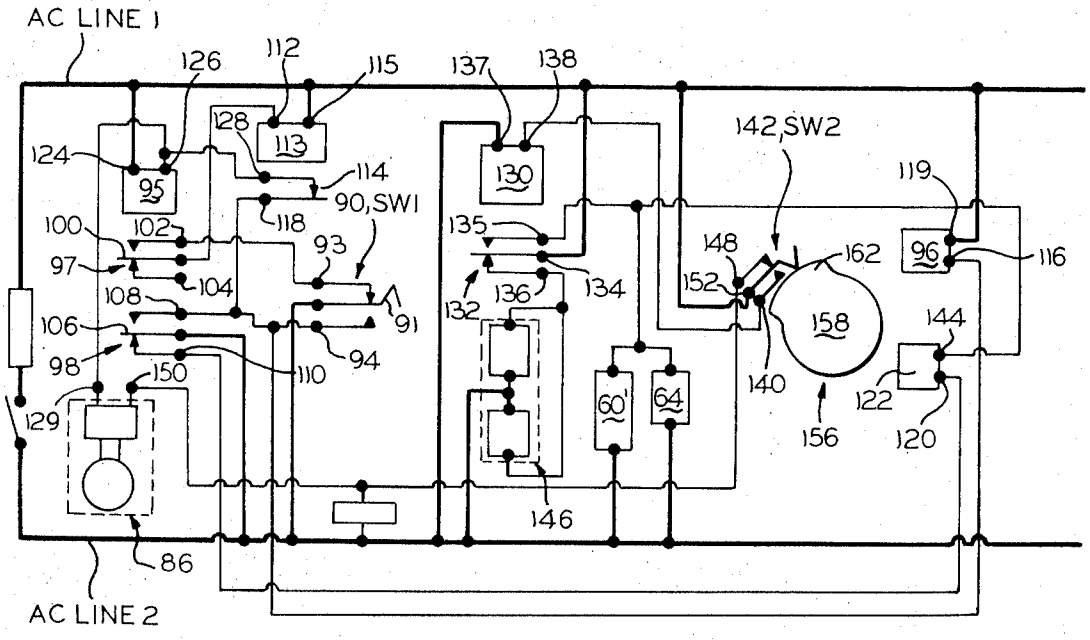


FIG.11

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SWITCH CONTROL MEANS FOR A PHOTOCOPY MACHINE

BACKGROUND OF THE INVENTION

The subject invention is a continuation-in-part of a U. S. Pat. application entitled "A Combination Sheet and Book Copy Machine," filed July 18, 1968 and having Ser. No. 745,841, now U.S. Pat. No. 3,597,074, granted Aug. 3, 1971.

The present invention relates generally to photocopy machines and more particularly to electrostatic photocopy machines for reproducing a moving original document sheet or book onto a length of simultaneously moving copy paper pulled from a rolled supply. Still more particularly, the invention relates to a switch control means for a photocopy machine.

Briefly, electrostatic photocopy machines are commonly constructed to initially charge specially coated copy paper, and then transfer the image of an original document through an optical camera system and onto the charged copy paper. Thereafter, the exposed copy paper is passed through a liquid toner solution which develops the image.

In many of the aforedescribed electrostatic photocopy machines, the leading edge of the copy paper was utilized for turning "on" switches disposed in the copy paper pathway. Recently, the copy paper generally used has been thinner and substantially lighter in weight than in the past. Due to this, the copy paper frequently was unable to depress the switches in the copy paper pathway, and thereby caused a "pile up" and jamming of the copy paper. The photocopy machine herein eliminates all the switches previously positioned in the copy paper pathway and provides a cam arrangement for positively controlling the on-off of these switches.

SUMMARY OF THE INVENTION

The present invention provides an electrostatic photocopy machine for reproducing increments of a moving document onto a moving length of sensitized copy paper. A switch control means is used to positively control the on-off of the corona power supply and the high intensity lamp.

The switch control means comprises a cam which moves in a single rotational direction from a start point determined by a first stop means to an operative point determined by a second stop means. Upon release of the first stop means, which occurs after the movement of the original document depresses a document-switch, the cam revolves and switches a copy-switch from an initial position to an operative position, to turn "on" the corona power supply and the high intensity exposure lamp. A second stop means blocks further rotation of the cam, the effect of which is to maintain the corona and lamp "on." The second stop means is released after the trailing edge of the original passes the document-switch. However, due to the speed of rotation of the cam, which was set by a predetermined gear ratio and the shape of the cam, the copy-switch is not switched back to its initial position until the trailing edge of the original document has passed the document scanning window.

Accordingly, a primary object of the invention is to provide a switch control means to control one or more of the operations required for reproducing an original document.

Another object is to provide a switch control means for controlling the "on and off" of the corona high voltage power supply and/or the high intensity exposure lamp of the camera means.

Another object is to provide a cam linked to the main chain drive of the machine, to control a switch functioning to turn the corona and exposure lamp "on and off."

Another object is to provide an automatic time delay for turning "off" the corona and exposure lamp after a length of copy paper has been severed from the copy paper supply.

Another object is to provide a cam driven by a gear means linked to the chain drive of the machine whereby said delay time is determined primarily by the rotational speed of the cam.

These and other objects and advantages will become apparent from the illustrations in the accompanying drawings and the following specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the drawings in which the same characters of reference are employed to indicate corresponding or similar parts throughout the several figures of the drawings.

FIG. **1** is a perspective view of the photocopy machine embodying the principles of the invention, and showing the machine when used as a book copier;

FIG. **2** is a perspective view of the photocopy machine of FIG. **1** when used as a sheet copier;

FIG. **3** is a side elevational view showing the mechanical drive means and the cam-switch control means gear-linked to the drive means;

FIG. **4** is a sectional mechanical schematic view showing the main component parts of the machine for reproducing an original document;

FIG. **5** is an enlarged view of the cam-switch control means;

FIG. **6** is a perspective view of a book copier attachment for use when the photocopy machine is used as a book copier;

FIG. **7** illustrates the pivot means when the movable section is in a closed-position;

FIG. **8** illustrates the pivot means when the movable section is pivoted from the closed toward an open-position;

FIG. **9** illustrates the movable section in the open-position;

FIG. **10** is a fragmentary perspective view of the pivot means when the movable section is in the open-position; and

FIG. **11** is an electrical schematic of the machine.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the several figures of the drawings, the reference numeral **10** indicates generally a combination sheet and book electrostatic photocopy machine embodying the principles of the invention. The outer structure of the machine **10** is substantially rectangular shaped and includes a front sidewall **13** opposed to back sidewall **14**, opposed end walls **15** and **16** and a top side **17** (FIGS. **1** and **2**). The machine **10** comprises an original document transport means **20** having a sheet copier position (FIG. **2**) and book copier position (FIG. **1**), a copy paper transport means **22**, a cameral means **23** and a developer means **24** (FIG. **4**).

The original document transport means includes a movable section **26** and a stationary section **28**. In the sheet copier position, the movable section **26** is in a closed-position in juxtaposition above the stationary section **28**. In the book copier position, the movable section **26** is in an open-position extending laterally outward from the stationary section **28**. Pivot means **30** (FIGS. **1** and **7** thru **10**) enable the movable section **26** to be pivoted from the closed-position (FIG. **2**) to the open-position (FIG. **1**). A book copier attachment means **31** having a movable book carrier **31'** (FIG. **6**), is manually secured to the machine when the original document means **20** is in the book copier position and manually removed prior to pivoting the movable section **26** into the closed-position.

The stationary section **28** includes drive rollers **32**, **33**, **34** and **36** rotatably mounted to sidewalls **13** and **14**. Idler rollers **38**, **39**, **40** and **42** are similarly rotatably mounted to the movable section **26**. In the closed-position, rollers **32** and **38**, **33** and **39**, **34** and **40** and **36** and **42** afford four (**4**) pairs of cooperating rollers. A transparent document-scanning window **43** is positioned between drive rollers **34** and **36**.

Turning now more specifically to FIG. **4**, the copy paper transport means **22** transports a length of copy paper through a copy paper pathway **44** from a copy paper input **46** to a copy paper output **48**. The copy paper may be stored in a roll **49** supported on a spindle **50**.

The copy paper transport means **22** includes an input pair of cooperating rollers **51** and **51'** and cooperating pairs of rollers indicated respectively by the numerals **52** and **52'**, **53** and **53'**, **54** and **54'**, and **55** and **55'** spaced apart within pathway **44** which convey the copy paper from the input **46** to the output **48**. An image-receiver section **56** is positioned in the copy paper pathway **44** between roller pair **53,53'** and roller pair **54,54'**. A back-up plate **57** is opposed to and spaced from the image-receiving section **56** to receive the copy paper therebetween.

A knife means **58** is positioned in the copy paper pathway between the input roller pair **51,51'** and roller pair **52,52'**. A corona section indicated generally by the reference numeral **60** is mounted between roller pairs **52,52'** and **53,53'**. Corona section **60** charges (negatively) the photosensitive copy paper prior to its passage across the image-receiving section **56**. The corona section receives its power from the high voltage power supply **60'** (FIG. **11**).

The camera means **23** comprises a mirror **62**, lens **63** and a high intensity exposure lamp **64**. The mirror **62** reflects the image of the original moving across the scanning window **43** through lens **63** and onto the sensitized copy paper passing across the image-receiving section **56**. The developer means **24** includes a receptacle **65** container toner solution **66**. The toner develops the exposed copy paper passing through receptacle **65** after the camera means **23** has transferred the image of the original thereon. The output rollers **55** and **55'** squeeze the toner back into the receptacle and transfer the copy paper onto an output conveyor means **67** leading to the copy paper output **48**.

Referring now particularly to FIG. **3**, the mechanical drive means for the original document transport system **20** and the copy paper transport means **22** will be described. A motor means **70** drives a main sprocket **71**, which in turn drives a continuous revolving drive chain **72**. The rollers **32**, **33**, **34** and **36** of the stationary section **28** are linked to the chain **72** respectively by sprockets **74**, **75**, **76** and **78**. The rollers **51' 52'**, **53**, **54** and **55** of the copy paper transport means **22** are similarly linked to the chain **72** respectively by sprockets **80**, **81**, **82**, **83** and **84**. The other roller of each corresponding pair is an idler roller. A copy paper clutch means indicated generally by the reference numeral **86** couples and decouples sprocket **80** from the shaft of the input drive roller **51'**. When the clutch means **86** energizes, the input rollers **51,51'** pull the copy paper from the roll **49** into the copy paper pathway **44**, past the knife means **58** and toward the roller pair **52,52'**.

A document-switch **90,SW1** is centrally positioned between sidewalls **13**, **14** adjacent to the input drive roller **32** (FIG. **1**). Referring now particularly to FIG. **11**, switch **90** includes a switching arm **91** and stationary terminals **93** and **94**. Arm **91** is depressed by the leading edge of an original document or the carrier **31'** from an original-position in contact with terminal **93** to a copy-position in contact with terminal **94**. When switch **90** initially switches into the copy-position, clutch means **86**, a knife relay **95** and a first solenoid stop means **96** energize.

The knife relay **95** comprises switches **97** and **98**. Switch **97** includes a switch arm **100** and contacts **102** and **104**; and switch **98** includes switch arm **106** and contacts **108** and **110**. Switch arm **100** is connected to terminal **112** of a knife solenoid **113**. The energizing or de-energizing of the solenoid **113** causes knife switch **114** to open and close. The other terminal **115** of knife solenoid **113** is connected to line **1** of the AC power. Contact **102** is connected to contact **93** of switch **90**, and contact **104** is unconnected. Switch arm **106** is connected to line **2** of the AC power. Contact **108** is connected to contact **94** of document-switch **90**, to input power terminal **116** of the first solenoid stop means **96** and a terminal **118** of knife switch **114**. The other input power terminal **119** of the stop means **96** is connected to AC line **1**. Contact **110** is connected to input power terminal **120** of a second solenoid stop means **122**. Input power terminal **124** of knife relay **95** is connected to AC line **1** and input terminal **126** is connected to switch arm **128** of knife switch **114** and terminal **129** of copy clutch means **86**.

A light relay **130** includes a switch member **132** having a switch arm **134** moving between contacts **135** and **136**. Switch arm **134** is connected to AC line **1**; contact **135** is connected to input power terminal **144** of the second solenoid stop means **122**, to the corona power supply **60'** and to the high intensity exposure **64**; and contact **136** is connected to heater means **146**. Input power **137** and **138** of relay **130** are connected respectively to AC line **2** and contact **140** of a copy-switch **142,SW2**.

Contact **148** of copy-switch **142,SW2** is connected to terminal **150** of clutch means **86**; and switch arm **152** of copy-switch **142** is connected to AC line **1**. The corona power supply **60'** and exposure lamp **64** are turned "on" when switch arm **152** connects with contact **140**.

A cam-switch control means indicated generally by the reference numeral **156** (FIGS. **3**, **5** and **11**) cooperates with the copy-switch **142** to primarily con-

trol the on-off of the corona and the exposure lamp. The switch control means **156** comprises a cam **158** comprising an outward extending neck portion **162** having an arcuate outer edge **162'**. The leading side edge **163** of the cam abutts fingers **164, 165** respectively of the first and second solenoid stop means **96** and **122** at different times of the copy cycle. The outer edge **166** of neck portion **162** depresses the switch arm **152** of the copy-switch **142**.

The fingers **164, 165** respectively solenoid stop means **96** and **122** block cam **158** when in a de-energized condition and release the cam in an energized condition. Fingers **164** and **165** are attached substantially perpendicular to the corresponding outer end of bar **166** which pivots around a centrally positioned pivot point **166'**. The inner end of bar **166** is attached to the corresponding solenoid piston **167**. In the energized condition, the piston **167** of the corresponding solenoid stop means is pulled inwardly against the resilient forces of a resilient member **167'**, and the finger **164** or **165** contacting the cam is moved away from the cam side edge **163**, by the bar **166** pivoting around pin **166'**.

A gear drive means indicated generally by reference numeral **168** links cam **158** with the chain drive **72** (FIG. 3). Gear means **168** comprises an input gear **170**, output gear **172** and intermediate gears **174** and **176**. Input gear **170** meshes with chain coupling gear **178** which is mounted on the shaft **180** of roller **53** (FIG. 3). Sprocket **82** linked with main chain **72** is also mounted on shaft **180**. Output gear **172** and cam **158** are mounted on stub shaft **182** (FIG. 5). Intermediate gear **176** is linked with intermediate gear **174** and the output gear **172**. Input gear **170** and intermediate gear **174** are mounted on stub shaft **184**, and gear **176** is mounted on pin **185**.

The rotational speed of cam **158** is the same as the rotational speed of the output gear **172**. The speed of the output gear with respect to the speed of the chain **72** or a gear directly linked with the chain is determined by the size of the coupling gear **178**, the input gear **170**, the intermediate gear **174** and the output gear **172**. Gear **176** function primarily as a transmission gear.

Pivot means **30** is connected to the movable section **26** and sidewall **13**, and another pivot means **30** is connected to movable section **26** and sidewall **14**; and both pivot means are connected together by a bar **190**. A plate **192** is connected to the movable section **26** by a pivot pin **193** and to the stationary section **28** by pivot pin **194**. A bracket **196** is secured to the corresponding sidewall **13, 14** and includes an upper stop **198** and a lower stop **200**. In the closed-position for the movable section **26**, bar **190** abutts the lower stop **200**. When rotating the movable section **26** to the open-position, the plate **192** pivots around pivot pin **194** until bar **190** abutts the upper stop **198** (FIG. 8). The movable section **26** is then pivoted around pin **193** until reaching the open-position (FIGS. **9** and **10**). In moving the movable section **26** from the open-position to the closed-position, the plate **192** is pivoted around pin **194** until the bar **190** abutts stop **200**; then the movable section is pivoted around pin **193** until reaching the closed-position.

SYSTEM OPERATION

Referring particularly to FIGS. **2, 3, 5** and **11**, the operation of the sequential switching of the machine will be described. All switches in FIG. **11** are shown in their respective positions prior to inserting an original document into the machine for reproduction. When the original document is inserted, its leading edge switches the document-switch **90,SW1** from the original-position to the copy-position, causing the clutch means **86**, the knife relay **95** and the first solenoid stop means **96** to energize. The energized clutch means **86** enables input rollers **51,51'** to pull the copy paper into pathway **44**.

In the energized or "on" state for knife relay **95**, switch **97** provides a pathway from AC line **2** to terminal **112** of the knife solenoid **113**, which becomes the sole pathway to line **2** for the knife solenoid after the document-switch **90** is switched back to its original position; and switch **98** provides a pathway from AC line **2** to terminal **126** of the knife relay **95** via knife switch **114**, to maintain the knife relay **95** energized for the time interval after the document-switch **90** has returned to its original position and prior to the operation of the knife solenoid **113** of knife means **58**.

Prior to the release of the first solenoid stop means **96** from contact with the cam **158**, the outer edge **162'** of neck portion **162** of the cam maintains switch arm **152** in connection with contact **148** of the copy-switch **142**, which is its initial-position. When the first solenoid stop means **96** is energized, piston **167** is pulled inward causing bar **166** to pivot clockwise whereby finger **164** is moved out of contact with cam **158**. The cam now free of contact with finger **164** rotates clockwise in response to the gear drive means **68**, until the leading edge **163** of neck portion **162** abutts the second finger **165** of the second solenoid stop means **122** (FIG. **5**). During the cam movement between the first and second stop means **96** and **122**, the neck portion **162** moves out of contact with the copy-switch **142,SW2**. When this occurs, the copy-switch **142** switches into its operational-position, thereby severing the path between AC line **2** and clutch means **86** and energizing the light relay **130**. When the clutch means is de-energized, roller **51** is decoupled from chain **72** and the copy paper is primarily pulled into pathway **44** by drive roller **52**.

When light relay **130** is energized, relay switch **132** severs the path between the heater means **146** and AC line **2** nd connects AC line **2** with the corona high voltage power supply **60**, the exposure lamp **64**, and terminal **144** of the second solenoid stop means **122**.

When the trailing edge of the original document has moved past the document-switch **90,SW1**, switch **90** returns to its original position; thereby providing a current path between AC line **2** and terminal **112** of knife solenoid **113** via switch **97** of knife relay **95**. This energizes the knife solenoid **113**, causing a length of copy paper to be severed from the roll and the solenoid switch **114** to "break open."

When solenoid switch **114** is open, the path between terminal **126** of the knife relay **95** and AC line **2** is severed, causing the knife relay **95** to de-energize. Switch **98**, in its de-energized or "off" state, severs the AC link with the first solenoid stop means **96** and pro-

vides a link between AC line **2** and terminal **120** of the second solenoid stop means **122**, causing respectively the first stop means **96** to de-energize and the second stop means **122** to energize.

When the second stop means **22** is energized, piston **167** is pulled inward causing bar **166** to pivot clockwise whereby finger **164** is moved out of contact with cam **158**. The cam, now free of contact with finger **165**, responds to gear drive means **168** and continues its clockwise rotation until contacting finger **164** of the first stop means **96**. Prior to reaching finger **164**, the cam switches the copy-switch **142**,SW2 from the operational-position to the initial position.

When the copy-switch **142** switches back to the initial-position, light relay **130** is de-energized, thereby turning off the corona power supply **60'** and the exposure lamp **64**. Now the machine is in standby awaiting another original document.

The system operation was described when the machine **10** is in the sheet copier position. When the machine is in the book-copier position, the carrier **31'** controls the switching of the document-switch SW1,**90**.

The foregoing specification and description are intended as illustrative of the invention, the scope of which is defined in the following Claims.

We claim:

1. In a photocopy machine having a power source, a first transport system operated by said power source during each photo-copying cycle for moving an original document past a scanning zone, a second transport system operated by said power source for synchronized movement of photo-sensitive sheet material on which copies are to be made through a charging zone containing electrostatic facilities and an image receiving zone containing illuminating facilities, means for actuation of said electrostatic facilities and said illuminating facilities in coordination with the movement of said sheet material comprising the combination of:

a cam slippably driven by said power source;

switch means operated by said cam for actuating said electrostatic facilities and said illuminating facilities;

a first cam stopper adapted to engage said cam at the start of each photocopying cycle to prevent movement of said cam;

a second cam stopper spaced from said first cam stopper also adapted to engage said cam to prevent movement thereof;

a document sensor disposed adjacent said first transport system to sense a document moving past said sensor;

means responsive to said sensor for disengaging said first cam stopper from said cam during the time that said sensor senses a document moving therepast and for engaging said second cam stopper with said cam during the time that;

said sensor senses a document moving therepast and to disengage from said cam when the sensor senses that said document has moved past said sensor.

2. The actuating means of claim **1** wherein said cam is provided with a neck portion and a recessed portion, said neck portion being engageable sequentially by said cam stoppers and said switch means being biased toward said cam in a manner to bear thereagainst, said switch means being in the operative position when bearing against the recessed portion of said cam and in the inoperative position when bearing against the neck portion thereof.

3. The actuating means of claim **2** wherein said switch means is positioned so as to bear against said neck portion when the cam neck portion is engaged by said first cam stopper.

4. The actuating means of claim **3** wherein said neck portion is of sufficient length to retain said switch means in the inoperative position for a measured time after said cam neck portion is disengaged by said first cam stopper.

5. The actuating means of claim **4** wherein said switch means is disposed opposite the recessed portion of said cam when the cam neck portion is engaged by said second cam stopper.

6. The actuating means of claim **5** wherein said recessed portion is of sufficient length to cause said switch means to remain in the operative position for a measured time after said cam neck portion is disengaged by said second cam stopper.

7. The actuating means of claim **6** wherein the document sensor is a yieldable switch interposed in the path of movement of a document moved by said first transport system and adapted to yield upon contact with such document to thereby actuate solenoid means for operating said cam stoppers and to be released when no longer in contact with such document.

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