June 13, 1972 A. M. HYOSAKA ET AL 3,669,535

PHOTOCOPY MACHINE

Filed Jan. 21, 1970 2 Sheets-Sheet 1

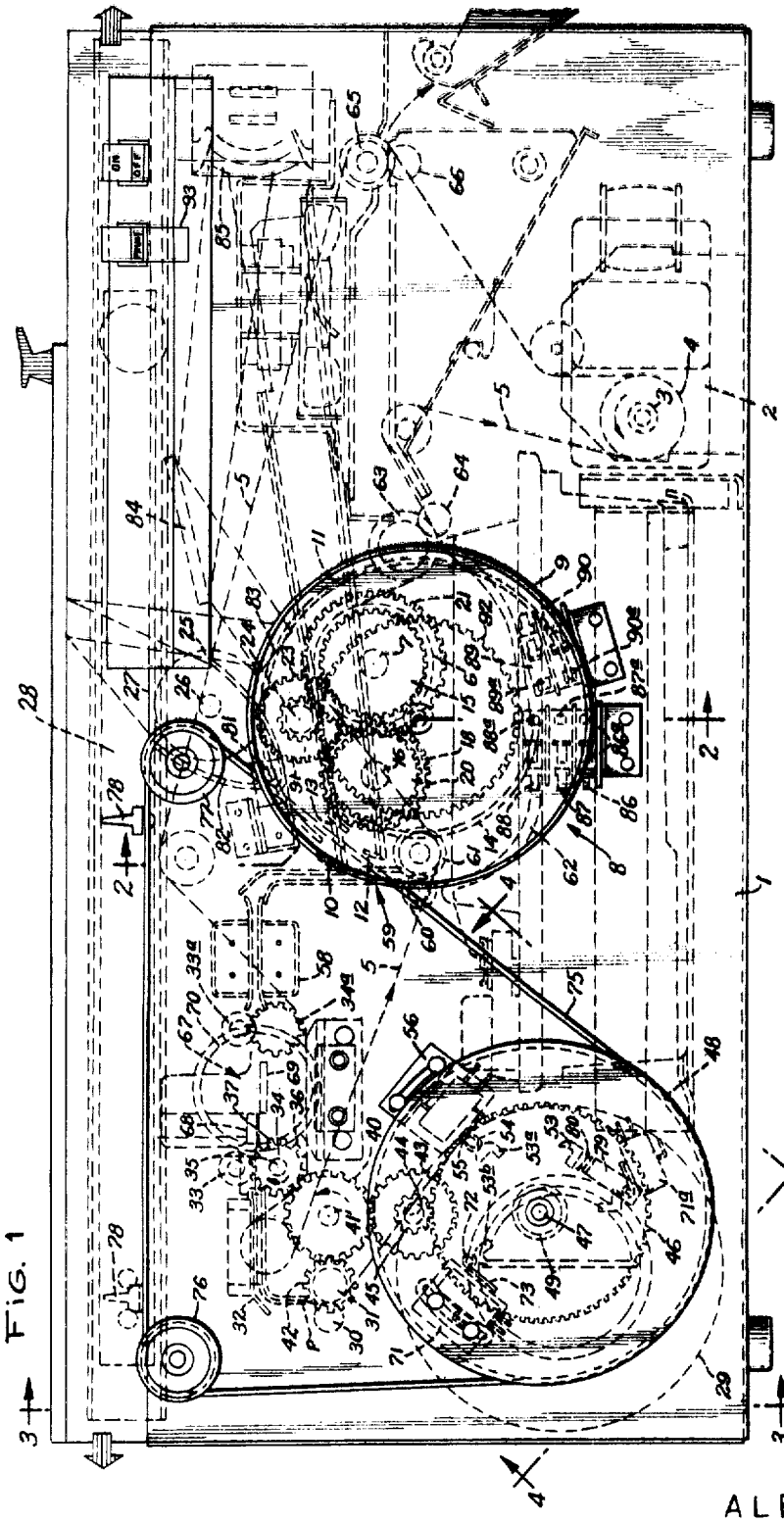


Fig. 1

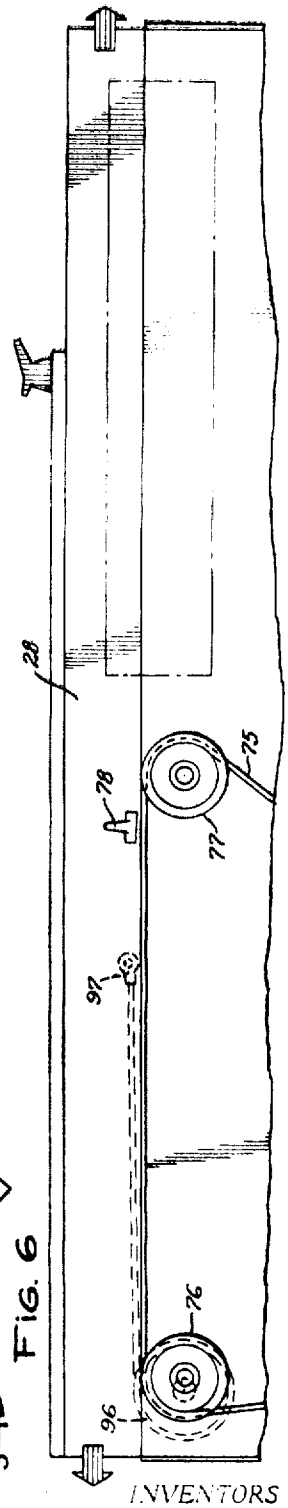


Fig. 6

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FIG. 2

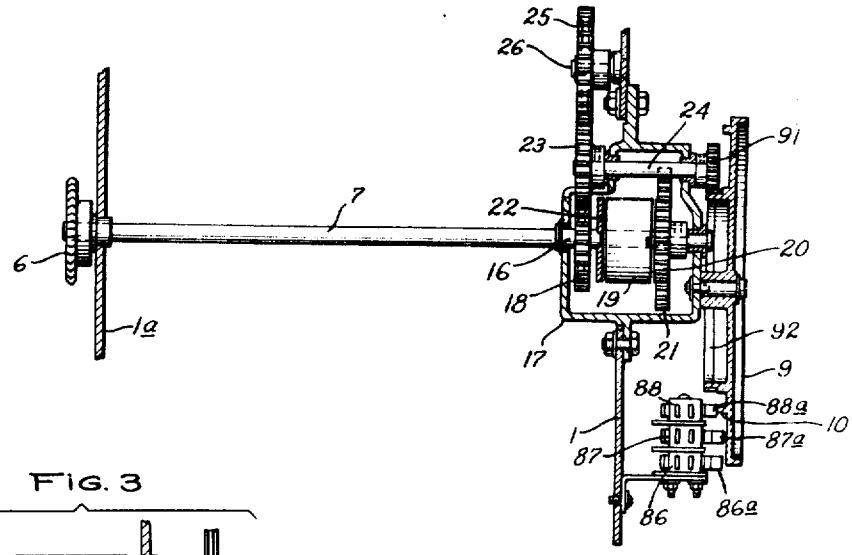


FIG. 3

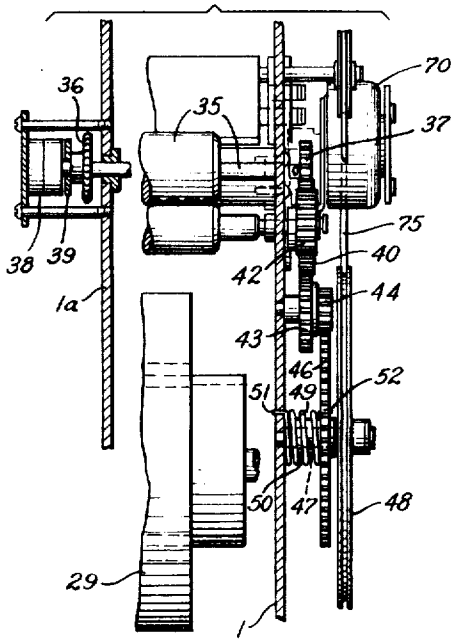


FIG. 5

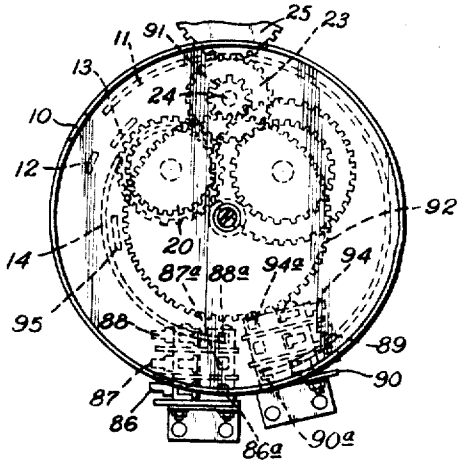
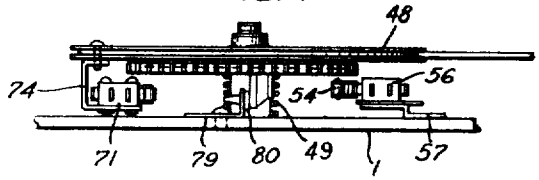


FIG. 4



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United States Patent Office 3,669,535 Patented June 13, 1972

3,669,535

PHOTOCOPY MACHINE

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Filed Jan. 21, 1970, Ser. No. 4,534
Int. Cl. G03g 15/00, 15/04
U.S. Cl. 355—8 8 Claims

ABSTRACT OF THE DISCLOSURE

An electrostatic photocopy machine moves a graphic original on a carriage from an intermediate normal or "home" position first in one direction, to a position at or beyond the position which it is to occupy at the beginning of the copy stroke, then in a second or opposite direction for the copy stroke, and finally in the first direction again back to the home position. A control circuit controlled by cam actuated switches controls the movement of the original in synchronization with movement of the copy material. A cam actuated switch is provided which is operable before the machine can be cycled to move the carriage to the home position when the machine is turned on in the event the carriage has been stopped in a position other than the home position. A time relay is provided which is activated simultaneously with a cam actuated knife switch. When the relay cuts out the direction of movement of the carriage is reversed.

BRIEF SUMMARY OF THE INVENTION

The invention relates in general to photocopy machines of the electrostatic type wherein a reciprocating carriage carries a graphic original and reciprocates it in a rectilinear path past an illuminating station. Copy material is transported through charging, exposing and developing stations. At the charging station an electrostatic charge is placed on the copy material, and at the exposing station it is exposed to the illuminated image on the graphic original which is projected thereon by means of a lens system. The original and copy material move at the same rate of speed, and at the end of the copy stroke the copy material passes through the developing station where the latent electrostatic image thereon is developed.

Photocopy machines have heretofore been known wherein the graphic original is positioned on a reciprocating carriage, however, such machines have been large and rather complicated operating mechanisms and therefore expensive. In one known device, the reciprocating carriage is normally positioned at a considerable distance beyond the machine housing and moves at a relatively slow rate of speed toward its displaced position while the leading edge of the copy material is moving toward the exposure station. When the copy material reaches the exposure station, the leading edge of the original will have reached the illuminating station and the carriage then moves more rapidly. This action is time consuming as well as necessitating more space.

The present invention is designed to overcome many of the disadvantages of similar devices heretofore known, and it is therefore a principal object of the invention to provide an eletcrostatic photocopy machine which is compact and economical to manufacture.

A further object of the invention is to provide mechanism for moving the carriage on which the graphic original is mounted, from an intermediate normal or home position first in one direction to a position at or beyond that at which the copy stroke begins, then in a second direction for the copy stroke and finally in the first direction again back to the intermediate home position.

A further and more specific object of the invention is to provide a novel arrangement of cam actuated switches for controlling movement of the carriage and synchronized movement of the copy material.

A still further object is to provide an arrangement which may be applicable to either a sheet feed, or a roll feed machine.

Other objects and advantages of the invention will become apparent upon reading the following description taken in conjunction with the accompanying drawings, in which

FIG. 1 is a front elevational view of a photocopy machine embodying the present invention with the housing removed therefrom and illustrating one of the side frame members upon which certain mechanism is mounted;

FIG. 2 is a sectional view partly in elevation of the drive cam assembly taken substantially along the plane of line 2—2 of FIG. 1;

FIG. 3 is a sectional view partly in elevation taken substantially along the plane of line 3—3 of FIG. 1;

FIG. 4 is a fragmentary elevational view along the plane of line 4—4 of FIG. 1;

FIG. 5 is a fragmentary elevational view of the drive cam assembly but showing a modification thereof, and

FIG. 6 is a fragmentary front elevational view of the upper part of the machine shown in FIG. 1, but illustrating a modified form of mechanism for returning the carriage to its normal or home position.

DETAILED DESCRIPTION

The concept of the present invention embraces a plurality of modes of operation particularly with respect to the timing and synchronization between the movements of the original and copy material and with respect to the stroke of the carriage which supports the original. In the illustrated form of the invention it is contemplated that the initial movement of the carriage carrying the original from its intermediate home position in the first direction, which is toward the left as viewed in FIG. 1, the extreme left position will be that at which the graphic original have its leading edge adjacent the illuminating station so that as soon as it begins movement toward the right it will begin to copy.

Also as shown, the apparatus is designed so that the carriage will move to the far left and will then wait until the leading edge of the copy material reaches the exposure window at which time the carriage will then begin moving toward the right for the copy stroke.

An alternative or second mode is contemplated wherein the copy paper feed mechanism begins operation simultaneously with the initial movement of the carriage toward the left, so that when the carriage reaches its extreme left position, with the leading edge of the original at the illuminating station, the leading edge of the copy sheet will have reached the exposure station and the carriage will immediately reverse its direction of movement without delay.

It is further contemplated that as a third mode the carriage could move toward the left and stop at a predetermined distance beyond the point where the leading edge of the original would be adjacent the illuminating station, and then begin to reverse movement in which case the leading edge of the original would arrive at the illuminating station at some short time after the carriage has begun its movement toward the right. In this situation, the copy material would begin its movement toward the various stations at a predetermined suitable point in time after the carriage has started its initial movement. The timing would be such that when the carriage has reversed its direction, the leading edge of the original would arrive at the illuminating station simultaneously with the arrival

of the leading edge of the copy material at the exposure station.

In the illustrated embodiment of the invention, there is a main drive motor and two clutches, one for driving the carriage in the first direction and the other for driving the carriage in the opposite direction. There is also illustrated a modified or alternative form wherein a spring return means may be used, to return the carriage from its position at the end of the copy stroke either to the intermediate home position, or to a far left position instead of utilizing the clutch means.

Referring now more particularly to the drawings, and especially to FIGS. 1 and 2, there is illustrated a framework, one side panel of which is indicated by the numeral **1** and all of which is intended to be located within a housing. Some of the mechanism illustrated is mounted on the near panel **1** of the frame and other elements are intended to be mounted on the far side of the frame, as will be more particularly pointed out hereinafter. The rear panel on the far side of the frame is indicated by the numeral **1***a* in FIG. 2.

A drive motor **2** has a shaft **3** on which is mounted a drive sprocket **4**. A sprocket chain **5** is driven by the motor and this chain passes around various idler and drive sprockets for the purpose of operating various parts of the apparatus. This chain is located on the panel **1***a* of the frame at the far side or rear as viewed in FIG. 1, and it drives a sprocket **6** keyed to the main drive shaft **7** (FIGS. 1 and 2) which drive a cam assembly generally indicated by the numeral **8**, which is mounted on the near or front panel **1**.

This drive cam assembly includes a cam disc **9** which has a plurality of arcuate raised portions or lobes which are caused to actuate switches when the disc **9** is rotated. These rises or lobes are identified in FIG. 1 by the numerals **10**, **11**, **12**, **13** and **14**. The function and manner of operation of each of these cam rises will be explained in greater detail hereinafter.

The main drive shaft **7** has a gear **15** rotatable thereon, and the motor, through the drive sprocket **4** and chain **5** will drive the shaft **7** in a clockwise direction as viewed in FIG. 1. A relatively short shaft **16** mounted in suitable bearings in a mounting bracket **17** (see FIG. 2) supports a first gear **18** at one side of a solenoid actuated drive clutch **19**, and a second gear **20** at the opposite side of the clutch **19**.

Gear **20** on shaft **16** meshes with a larger gear **21** keyed to the main drive shaft **7**. Thus, when the machine is turned on to drive the shaft **7** and gear **21** thereon in a clockwise direction, shaft **16** and the gear **20** thereon will be driven in a counter-clockwise direction by reason of the gear **20** being in mesh with gear **21**. Normally the aforesaid shafts **7** and **16** and the gears **20** and **21** will rotate freely and neither of the gears **15** or **18** will rotate until one or the other of the clutches associated therewith is engaged. The clutch **19** on shaft **16** is positioned between the two gears **18** and **20**. A duplicate arrangement is provided on the shaft **7** immediately behind the clutch **19**, as viewed in FIG. 2. That is, a similar clutch is provided between the gears **15** and **21**, but since the operation of the two clutches will be identical, a description of one will be sufficient.

When the solenoid clutch **19** is energized, it causes the armature plate **22** to move into engagement with the rotating clutch which, thereupon causes gear **18** to rotate in a counter-clockwise direction. This gear **18** meshes with an intermediate gear **23** keyed to the shaft **24** thereby driving it in a clockwise direction, as viewed in FIG. 1. Gear **23** meshes with carriage drive gear **25** on stub shaft **26**. The gear **25** meshes with a rack **27** on the underside of the carriage **28**. Gear **25** will then rotate in a counter-clockwise direction thereby moving the carriage from its intermediate home position, shown in FIG. 1, in a first direction toward the left.

When it is desired to move the carriage in the opposite direction, toward the right as viewed in FIG. 1, the clutch **19** will be disengaged and the similar clutch on shaft **7** will engage a similar armature plate thereby causing rotation of the gear **15**. This gear is also in mesh with gear **23** which will thereupon be rotated in a counter-clockwise direction, thereby rotating gear **25** in a clockwise direction to drive the carriage toward the right through the rack **27**.

The paper drive assembly and the carriage start apparatus are illustrated at the left hand side of FIG. 1. As mentioned above, the basic concept of the apparatus may be adapted for use either with pre-cut paper sheets or with a roll feed mechanism where a continuous web of copy material is cut to the desired length. The apparatus is illustrated here for use with a roll feed deivce wherein the roll of copy material is identified by the numeral **29** and the paper P is drawn from the roll and is caused to be fed by a pair of feed rollers **30** and **31**.

The leading edge of the copy material passes upwardly through a guideway **32** and thence between a pair of feed rollers **33** and **34**. The roller **34** is mounted on shaft **35** which extends from front to rear of the machine and is mounted in suitable bearings in the frame members **1** and **1***a*.

At the far side of the frame the shaft **35** has loosely mounted thereon a sprocket **36** which engages the sprocket chain **5** and is driven thereby. Also mounted on the shaft **35** is a gear **37**, but this gear is mounted at the front of the machine or the right hand side thereof, as shown in FIG. 3.

A clutch **38** is also mounted on shaft **35** adjacent the sprocket **36** which has an armature plate **39** thereon. This rotates with the sprocket and when the clutch is energized, the rotating plate **39** will then contact and carry with it the rotating part of the clutch, in the same manner as heretofore described more specifically with respect to the clutch **19**. In other words, when the clutch **38** is energized it will draw the armature plate **39** into engagement therewith thereupon causing the shaft **35** and the gear **37** thereon to rotate in a clockwise direction, as viewed in FIG. 1.

The gear **37** is in mesh with a gear **40** mounted on the shaft **41**. This gear **40** also meshes with a gear **42** for driving the rollers **30** and **31** and with a gear **43** on shaft **44**. This gear **43** is integral with a smaller gear **45** which meshes with a larger gear **46** on shaft **47**. When clutch **38** is energized and engaged to drive the aforesaid gear train it will commence feeding the copy material from the roll thereof toward the right, as viewed in FIG. 1. It will also rotate the gear **46** in a counter-clockwise direction.

A pulley **48** is also mounted on shaft **47** for free rotation with respect thereto, for a purpose which will appear more fully hereinafter. A torsion spring **49** is wound around a core **50** and one end **51** thereof is attached to the frame member **1**, as may be seen in FIG. 3. The opposite end **52** of the torsion spring is secured to the gear **46**. As will presently be seen, when this latter gear has been rotated through a predetermined arc the clutch **38** will be disengaged and the torsion spring will return the gear **46** and the elements mounted thereon back to the normal position thereof, as shown in FIG. 1.

In the embodiment illustrated the face of the gear **46** has mounted thereon a switch actuator **53**. When the gear **46** is caused to rotate in a counter-clockwise direction, upon energizing the clutch **38**, the switch actuator **53** will be carried therewith and will eventually come into contact with a roller **54** on an arm **55** for closing the switch **56**. This latter switch is mounted on the inner face of the side frame member **1** by means of a bracket **57**. The switch **56** is the one which starts the carriage **28** in its movement toward the right. In the embodiment shown, the switch arm **55** is spaced a distance from the initial position of the actuator **53** so that by the time the actuator closes the switch **56**, the leading edge of the copy material will have arrived at the exposure station.

Thus, from that point on, the copy material and the original on the carriage will move together in synchronism for the copying portion of the cycle.

The corona charging device is indicated by the numeral **58** and is of the usual and customary construction whereby, as the copy material passes therethrough, it will apply an electrostatic charge onto a surface of such material.

The exposure station is indicated generally by the numeral **59** and includes an opening past which the copy material moves and through which the image on the original is projected in the usual way. Below the exposure station there is provided a pair of feed rollers **60** and **61** to which the leading edge of the copy material is fed to the trough **62** in which is located the developer solution. The copy material passes through the developer station, and the feed rollers **63** and **64** adjacent the trough and the rollers **65** and **66** continue to move the developed copy material outwardly through an appropriate exit slot in a wall of the machine.

When a roll feed is used for the copy material it is necessary to have a cut-off knife arrangement and this is generally indicated in FIG. 1 by the numeral **67**. Such knife may be of any well-known and suitable construction which includes a stationary portion **68** and a rotary movable portion **69**. A rotary solenoid **70** is actuated at the appropriate time to cut the web of copy material, depending upon the length of the copy desired.

As may be seen in FIG. 1, there is provided a knife actuating switch **71** and a roller **72** mounted on the end of a contact arm **73**. This switch **71** is adjustably mounted on one face of the pully **48** by means of a bracket **74**, as may be seen in FIG. 4.

The switch actuator **53** is shown in its normal position in FIG. 1, but the numeral **53***a* shows the position of the actuator as it actuates switch **56** to start the carriage moving toward the right through the copy portion of the cycle. The position of the actuator shown at **53***b* is the position at which it actuates switch **71** to energize the solenoid **70** for operating the knife assembly to cut the web of copy material at the appropriate length. As stated above, the switch **71** is adjustably mounted on the pulley **49**, but the pulley itself may be rotated to different positions for the purpose of varying the length of the copy sheet.

To this end, there is provided a cord **75** which passes around the pulley **48** and around two other pulleys **76** and **77**, so that when the cord is moved it will rotate the pulley and position the switch **71** at different locations with respect to the actuator **53**. To facilitate such adjustment there may be provided a finger **78** fixed to the cord **48**, as shown in FIG. 1, whereby movement of this finger and the cord attached thereto, in a direction toward the left, will rotate the pulley **48** and carry with it the switch **71** to a position wherein it takes longer for the actuator **53** to reach it thereupon actuating the knife to cut a longer sheet. As shown in FIG. 1, with the finger **78** to the far right, this is intended to be the shortest sheet, about 8½ inches. As the finger and the cord attached thereto are moved toward the left, to the dotted line position, it will move the switch **71** to the position at **71***a* for the maximum length of sheet to be cut.

As will presently be seen, when the actuator **53** reaches the switch **71** to actuate the knife solenoid **70**, it will simultaneously disengage the clutch **38** to stop all further feeding of the copy material. At the same time, since the gear train will have been disengaged from the clutch the torsion spring **49** will return the gear **46** and the switch actuator **53** thereon back to its starting position. To prevent the actuator **53** from returning to a point beyond its initial position, there is provided a stop bracket **79** having a bumper portion **80** thereon against which the actuator will be moved in its return travel.

As an alternative, clutch **38** may be a single rotation clutch operated to move the leading edge of the copy material to the continuously rotating feed rollers **33***a* and **34***a*. Upon completion of its one rotation, clutch **38** no longer drives the paper. However, rollers **33***a* and **34***a* pull the paper and all mating rollers and gears in the train down to the gear **46** will continue to rotate and will move actuator **53** in the manner described above. Upon reaching switch lever **73** on switch **71**, knife solenoid **70** is actuated to sever the copy material P. Accordingly, rollers **33** and **34** and their corresponding gear train will no longer be caused to rotate by the moving copy material P and will allow torsion spring **49** to return the actuator to its initial position.

There is also illustrated the lamp **81** which is utilized to illuminate the original as it is being moved past the illuminating station for the copying portion of the cycle. This lamp is located within a reflector **82** which directs the illumination upwardly through a suitable opening onto the graphic original. The image is projected onto the copy material at the exposure station by a suitable lens system. In the embodiment shown, the image is reflected from the original to a mirror **83**, where it is reflected to a second mirror **84** and from there to a mirrored lens mounting **85**. The image is then projected from the lens directly through the window at the exposure station onto the copy material.

As may be noted in FIG. 1, there is provided, for this particular embodiment, a plurality of microswitches identified by the numerals **86**, **87**, **88**, **89** and **90**. The only ones of these which may be seen in FIG. 2 are those indicated at **86**, **87** and **88**. Switch **86** may be actuated by a cam rise or lobe on the disc **9** by contacting a roller **86***a* mounted on the switch arm. Switch **87** has a similar roller and switch arm **87***a* and switch **88** likewise is provided with a roller and arm or blade **88***a*. There is a roller and blade **90***a* for switch **90** and a similar roller and blade **89***a* for switch **89**.

The switches **88** and **90** operate only when the carriage is either to the left of home position or to the right of home position when the machine is initially turned on. For example, if for some reason, during a previous operation of the machine, the power was cut off to prevent the carriage from returning to its home position it must be returned to that position before the machine can begin its cycle. If the machine should stop to the left of home position, then the cam lobe **14** will have been rotated in a counter-clockwise direction from the position shown in FIG. 1, thereby closing the contacts of switch **88**. When the machine is initially turned on, if the carriage is either left or right of home position the appropriate switch **88** or **90** will be closed and, then the appropriate clutch will be actuated to drive the carriage to the right or left to its home position at which time the cam lobe **14** or **11** will be out of contact with the roll **88***a* or **90***a* to thereby open the switch. At this point the switch **88** or **90** will be cut out of the control circuit and the normal operation may begin.

In the operation of the machine with the parts in their position, as shown in FIG. 1, the "on/off" button will be depressed to set up the circuit in readiness for a print cycle. With an original in place on the carriage and with the leading edge of the copy material at the knife, the print button may be depressed which thereupon will energize the left drive clutch **19** and begin movement of the carriage toward the left as previously described. During this movement, the shaft **24** and the gear **91**, on the right end thereof shown in FIG. 2, will rotate clockwise. Gear **91** meshes with the large gear **92** formed as a part of cam disc **9** and drives the gear and the cam disc in a counterclockwise direction. When the cam lobe **10** thereon closes switch **86** by contacting the roller **86***a*, this will disengage the clutch **19** and stop further movement of the carriage. As shown, this movement of the carriage will bring the leading edge of the original to the illuminating station so that when the carriage begins its movement toward the right, the copy cycle will begin.

The closing of switch **86** will simultaneously energize clutch **38** which initiates the feeding of the copy material. Switch **56** is so positioned relative to the actuator **53** that when the actuator reaches its position **53***a* the leading edge of the copy material will have moved past the charging station and will have arrived at the exposure station. This actuation of switch **56** will energize the right drive clutch positioned on shaft **7** and immediately behind clutch **19** in FIG. 2 to initiate movement of the carriage toward the right.

The copy cycle is thus commenced and will continue until the actuator **53** closes switch **71**. As mentioned above, the position of switch **71** may be varied, depending upon the length of the original and the length of copy material desired. Upon the closing of switch **71** the rotary knife solenoid will be energized to cut the copy material, the clutch **38** will be deenergized to stop feeding the paper and a time-delay or hold-on relay will begin its countdown.

The time-delay or hold-on relay is indicated in FIG. 1 by the numeral **93**. The details of this relay are not shown inasmuch as it is a device which is well-known and may be purchased on the open market. This relay is suitably connected in the control circuit for the machine and will begin its countdown simultaneously with the operation of the solenoid actuated cutter. When the solenoid for the cutter is actuated to cut the copy material the relay begins its countdown and, as stated above, feeding of the copy material will be stopped.

The relay is set so that the sheet of copy material which has been cut from the roll will continue to be fed past the exposure station until the trailing edge thereof has passed such station and the copying portion of the cycle has been completed. When the relay cuts out, several things will occur. The right hand drive clutch on shaft **7** will be de-energized and disengaged and the clutch **19** on shaft **16** will be engaged to drive the carriage in its original direction toward the left and back to its home position. If a single copy is to be made, the clutch **19** will then be disengaged and nothing further will occur until the print button is again depressed.

When the relay cuts out both the lamp **81** and the corona discharged device **58** will go off, but the drive rollers **61** and **62**, **63** and **64** as well as the rollers **65** and **66** will continue to operate to move the developed sheet out of the machine.

In the event that multiple copies are to be made, a counter will be included in the control circuit and this may be of any well-known construction. The cam lobe **12** on the cam disc **9** is the counter cam and will count the number of copies by contacting the roller **87***a* and close the contacts on the switch **87**. The counter will be set for a predetermined number of copies and the cooperation between cam **12** and switch **87** will merely act to count the number of copies made. After the predetermined number has been copied the carriage will then be caused to stop at its home position. During the making of the multiple copies the carriage will travel from its right hand position at the completion of the copy stroke all of the way to the left without stopping at the home position.

In the third mode of operation, as has been mentioned previously, the carriage can be caused to move toward the left to a position beyond that at which the leading edge of the original is at the illuminating station. In this event, the carriage will be moved to this far left position and immediately caused to reverse itself and will move a relatively short distance before the leading edge of the original reaches the illuminating station and the copy stroke begins. In this mode the copy material will begin to be fed at some suitable point in time after the carriage begins its initial movement in the first direction toward the left, but before it reaches the full left position thereof.

In order to accomplish this result the switch **56** may be eliminated and a further microswitch **94** may be added to the circuit, as shown in FIG. 5. This switch **94** has a switch arm and roller **94***a* adapted to be actuated or depressed by an additional cam lobe **95** on the cam disc **9**.

In this mode, depressing the print button will begin the initial movement of the carriage in its first direction, as mentioned above. Actuation of switch **94** by cam lobe **95** will energize and engage the clutch **38** to begin driving the copy material feed rollers. A short time thereafter the cam lobe **10** will close switch **86** which will thereupon disengage the clutch **19** on shaft **16** and immediately engage the clutch on shaft **7** for driving the carriage in the opposite direction toward the right. The timing of the carriage and of the copy material is such that the leading edge of the original will reach the illuminating station at the same time the leading edge of the copy material reaches the exposure station, whereupon continued movement of both will cause a copy to be made, as above described. From this point on the operation will be as explained above and the original will be returned to its home position, unless multiple copies are to be produced.

In all modes of operation provision must be made for a possible mulfunction of the apparatus. That is to say, if a paper jam occurs or if for some reason the hold-on relay does not begin its countdown, safety means must be provided to prevent the carriage from moving too far beyond a predetermined distance at the end of the copy stroke. To this end the cam lobe **13** is provided which actuates the switch **89** by depressing the switch arm on which the roller **89***a* is mounted.

In the normal operation of the machine the lobe **13** will never reach roller **89***a* on the switch **89**. If, however, there is a mulfunction which causes the carriage to continue movement beyond the end of the copy stroke, then lobe **13** will actuate switch **89** in the control circuit which will thereupon turn off all power and stop operation of the machine.

In the form of the invention described above, there have been two clutches provided, one for driving the carriage in its initial and final direction and the other for driving the carriage in the opposite direction for the copy stroke. FIG. 6 of the drawings illustrates a fourth mode which embodies a modification of the means for returning the carriage toward the home position after the copy stroke has been completed. For this purpose a coiled spring **96** is provided, one end **97** of which is adapted to be secured at some suitable point on the carriage. When this mechanism is utilized, at the time of the completion of the copy stroke and the cutout of the relay there will be only a de-energization and disengagement of the clutch on shaft **7** which will allow the spring **97** to pull the carriage back to home position instead of energizing the clutch **19**.

It is contemplated in this mode that the clutch **19** will drive the carriage in its initial movement from home position toward the left, but the return to home after completion of the copy stroke may be made by the spring. A further or fifth mode is also contemplated where the clutch **19** may be eliminated altogether. In this event the return spring **96** may be positioned such that, upon depressing the print button, suitable stop means will be actuated and withdrawn from the path of the carriage to allow the spring to move the carriage further toward the left from the home position to a suitable position where the right hand drive clutch may then take over and move the carriage through the copy stroke.

From the foregoing description it will be apparent that we have provided an electrostatic photocopy machine which is compact and which is so constructed as to produce copies in the shortest possible period of time.

Changes may be made in the form, construction and arrangement of parts from those disclosed herein without in any way departing from the spirit of the invention or sacrificing any of the attendant advantages thereof, provided, however, that such changes fall within the scope of the claims appended hereto.

It is contemplated in this mode that the clutch **19** will drive the carriage in its initial movement from home position toward the left, but the return to home after completion of the copy stroke may be made by the spring. A further mode is also contemplated where the clutch **19** may be eliminated altogether. In this event the return spring **96** may be positioned such that, upon depressing the print button, suitable stop means will be actuated and withdrawn from the path of the carriage to allow the spring to move the carriage further toward the left from the home position to a suitable position where the right hand drive clutch may then take over and move the carriage through the copy stroke.

From the foregoing description it will be apparent that we have provided an electrostatic photocopy machine which is compact and which is so constructed as to produce copies in the shortest possible period of time.

Changes may be made in the form, construction and arrangement of parts from those disclosed herein without in any way departing from the spirit of the invention or sacrificing any of the attendant advantages thereof, provided, however, that such changes fall within the scope of the claims appended hereto.

The invention is hereby claimed as follows:

1. In an electrostatic photocopy machine for making a copy of a graphic original on copy material wherein the copy material is transported past charging, exposing and developing stations, the combination of,

(a) transport means for transporting copy material from an initial position past the charging, exposing and developing stations,

(b) a reciprocable carriage adapted to support a graphic original to be copied, said carriage having a first position at the beginning of the copy cycle, a second position at the end of the copy cycle, and a home position intermediate said first and second positions,

(c) drive means for driving said carriage,

(d) an illuminating station for illuminating the original and projecting the image thereon to the copy material at the exposing station during movement of said carriage from said first position thereof to said second position thereof, and

(e) control means including

(1) switch means operable to cause said drive means to move said carriage from said home position thereof to said first position thereof,

(2) cam actuated switch means operable to actuate said drive means to move said carriage from said first position thereof to said second position thereof for the copy stroke,

(3) cam actuated switch means operable to initiate movement of the copy material from the said initial position thereof, and to move it past the charging, exposing and developing stations,

(4) cam actuated switch means operable to move said carriage from said second position in a reverse direction toward said home position after completion of the copy stroke, and

(5) cam actuated switch means operable before the machine can be cycled to drive said carriage to said home position when the machine is initially turned on in the event said carriage has been stopped in a position other than said home position.

2. The combination of elements defined in claim **1**, wherein said drive means includes a first clutch member for driving said carriage from said home position to said first position and for driving said carriage from said second position toward said home position, and a second clutch member for driving said carriage from said first position to said second position.

3. The combination of elements defined in claim **1**, wherein said drive means includes a coiled spring member for moving said carriage from said second position toward said home position.

4. The combination of elements defined in claim **1**, including a rotary cam disc having a plurality of cam lobes thereon, and a like plurality of switches in said control means, said switches adapted to be actuated by said cam lobes during rotation of said cam disc.

5. The combination of elements defined in claim **1**, wherein the copy material is fed from a roll of copy material, and including a knife assembly to cut the material a predetermined time before the completion of the copy stroke, and cam actuated switch means to actuate said knife assembly.

6. The combination of elements defined in claim **1**, including cam actuated safety switch means operable to turn off power to the machine when said carriage moves beyond said second position after completion of the copy stroke.

7. The combination of elements defined in claim **5**, wherein said last named cam actuated switch means includes a switch adjuatable to different positions for different lengths of copy material to be cut, a rotary member rotated by said transport means and having a switch actuator thereon adapted to actuate said last named switch means upon rotation through a predetermined arc.

8. In an electrostatic photocopy machine for making a copy of a graphic original on copy material fed from a roll of copy material, wherein the material is transported past charging, exposing and developing stations, the combination of

(a) transport means for transporting copy material past the charging, exposing and developing stations,

(b) a knife assembly for severing the copy material from the roll thereof,

(c) a reciprocable carriage adapted to support a graphic original thereon and move it past an illuminating station for a copying stroke from a first position to a second position thereof,

(d) drive means for reciprocating said carriage,

(e) first cam actuated switch means operable to actuate said drive means for initiating movement of said carriage and for moving it through the copy stroke,

(f) second cam actuated switch means operable to actuate said knife assembly at a predetermined time period prior to completion of the copy stroke,

(g) a time hold on relay actuated simultaneously with the operation of said second switch means to begin a time countdown, and

(h) means operable when said relay cuts out, to actuate said drive means and reverse its direction of movement.

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U.S. Cl. X.R.

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