United States Patent

Tanaka et al.

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[54] ELECTRONIC COPYING MACHINE

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[52] **U.S. Cl.**.....**355/13**, 355/28, 355/29
[51] **Int. Cl.**.....**G03b 29/00**
[58] **Field of Search**.....355/28, 29, 13; 83/203, 205; 200/166 BB

[56] **References Cited**

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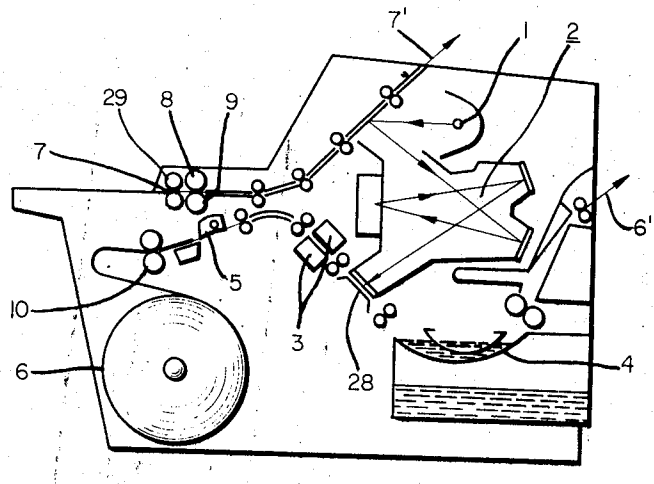
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Assistant Examiner—Michael Harris
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[57] **ABSTRACT**

An electronic copying machine having a cutter for photosensitive paper and a sensor for detecting front and rear edges of an original so as to ensure smooth movement of the original while eliminating the risk of erroneous operation. The photosensitive paper is fed continuously, and the cutting means cuts the photosensitive paper at a certain minimum length L when the original is not longer than L, while cutting the photosensitive paper at a length corresponding to the length of the original when the original is longer than L.

12 Claims, 7 Drawing Figures



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SHEET 1 OF 3

FIG. 1

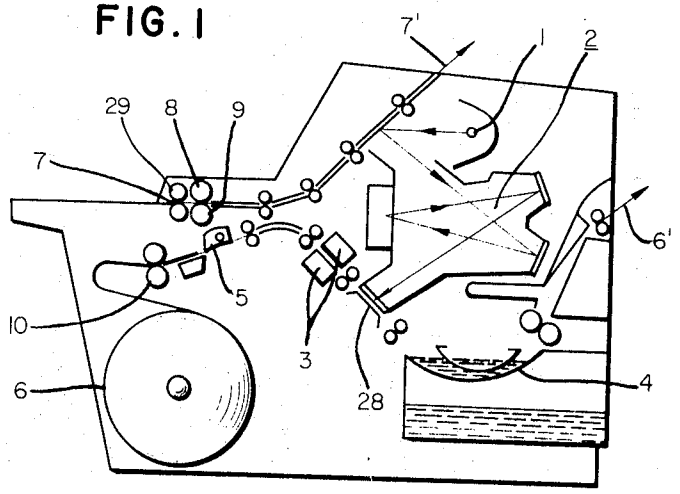
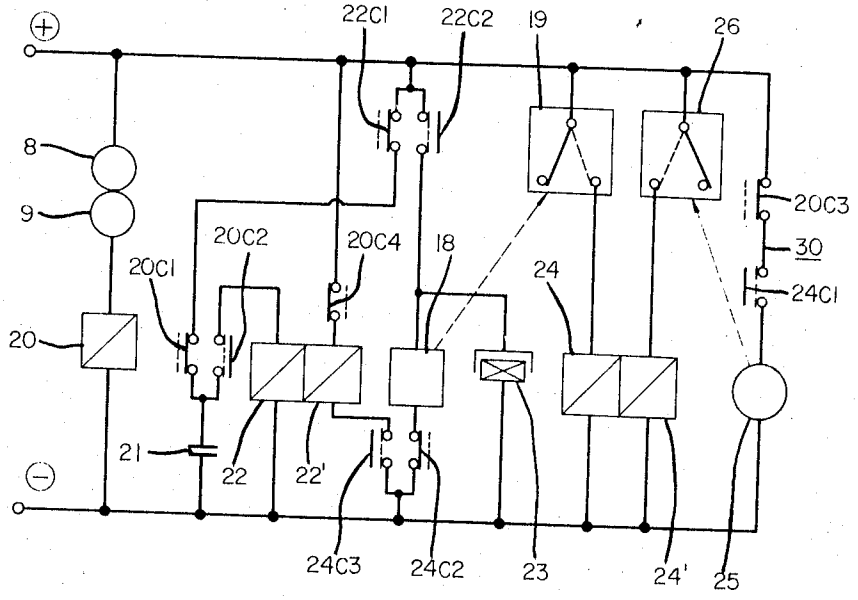


FIG. 2



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FIG. 3

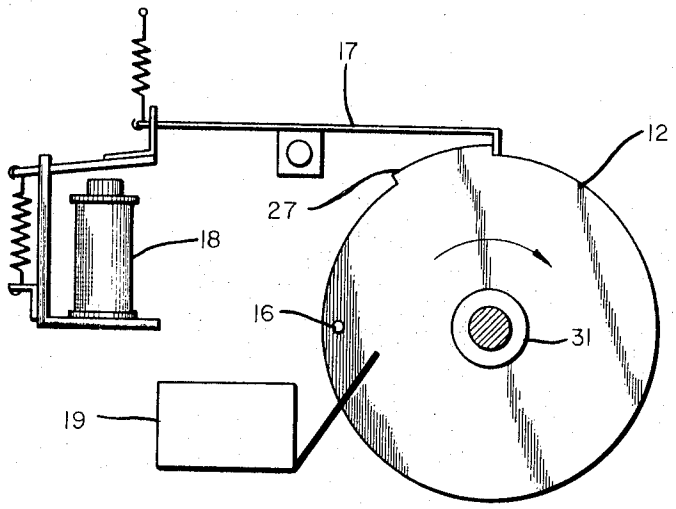
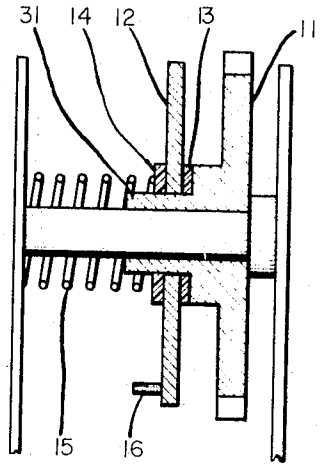


FIG. 4



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FIG. 5

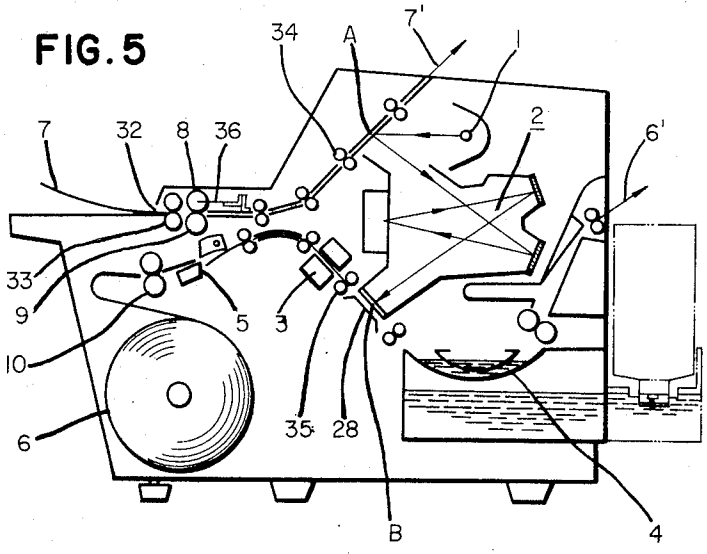


FIG. 6

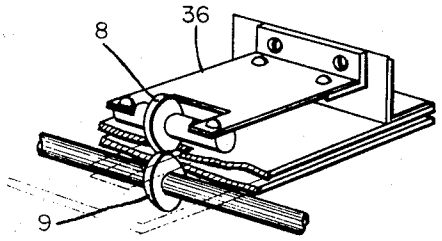
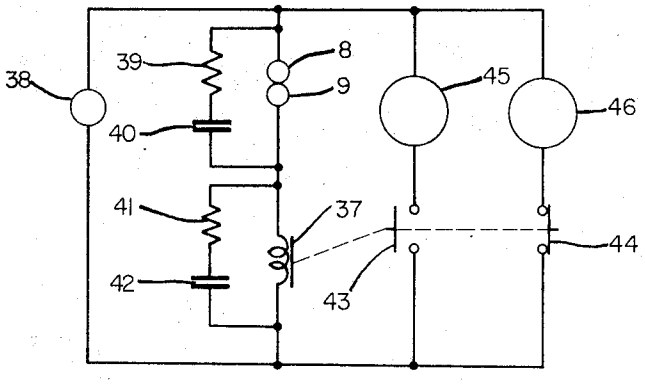


FIG. 7



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ELECTRONIC COPYING MACHINE

This invention relates to an electronic copying machine using a rolled photosensitive copying paper, and more particularly to an electronic copying machine which feeds photosensitive paper continuously while automatically cutting it at a length corresponding to the length of the original being copied.

In a conventional copying machine using a rolled photosensitive paper, a dial is provided for setting the length at which the photosensitive paper is cut, and the dial is manually set for each original to be copied so as to cut the photosensitive paper at a length corresponding to the length of the original being copied. Such manual setting is troublesome. Furthermore, if the paper dimension of the original is one of the standardized sizes, the setting of the aforesaid manual dial can be made comparatively easily by using standard scales. If the original is, however, of nonstandard size, the operator must take accurate measurement of it. Exact setting of the manual dial is not necessarily easy for such nonstandard size paper. In addition, should the photosensitive paper be cut too short, smooth feeding of the photosensitive paper is hampered to cause the copying machine to be clogged with the paper.

Therefore, an object of the present invention is to provide an electronic copying machine which obviates the aforesaid difficulties of the conventional copying machine. With the electronic copying machine according to the present invention, the photosensitive paper is automatically cut at a length corresponding to the length of each original being copies, so that there will be no waste of copying paper. In the electronic copying machine of the invention, troublesome manual setting is not necessary at all, and the risk of clogging with paper is completely eliminated, because smooth feeding of the photosensitive copying paper is ensured by cutting it at a length longer than a minimum length which is long enough for the smooth feeding even if the original being copied is extremely short.

Another object of the present invention is to provide an electronic copying machine which accurately detect front and rear edges of an original being copied for effecting automatic cutting of photosensitive copying paper at a length corresponding to the length of the original between the front and rear edges thus detected. For this end, a pair of electrically conductive sensing rolls are disposed in mutually engageable fashion, and a capacitor is connected in parallel with the sensing rolls in such manner that smooth feeding of the original through the copying machine is ensured while eliminating the risk of erroneous operation thereof.

Other objects and a fuller understanding of the present invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic sectional view of an electronic copying machine, according to the present invention;

FIG. 2 is a electric circuit diagram of the copying machine;

FIG. 3 is a schematic elevation of the actuating mechanism of a photosensitive copying paper cutter usable in the electronic copying machine, showing essential portions thereof;

FIG. 4 is a vertical sectional view thereof;

FIG. 5 is a view similar to FIG. 1, illustrating another embodiment of the present invention;

FIG. 6 is a schematic perspective view of a detector for sensing the front and rear edges of an original being copied, which is usable in the electronic copying machine according to the present invention; and

FIG. 7 is a circuit diagram of the detector.

Referring to FIG. 1, showing a schematic vertical sectional view of an electronic copying machine, according to the present invention, an original 7 being copied is fed by rollers 29 in a direction depicted by the arrow 7' toward the outside of the copying machine, Photosensitive copying paper is delivered from a copying paper roll 6 to feeding rolls 10, and fed through a charger 3, an image receiving section 28 and a developing tank 4 in a direction as shown by the arrow 6'. The original 7, of course, moves in synchronism with the copying paper. Light beams from a light source 1 become incident to the original 7 so as to be reflected by the original toward the image receiving section 28. An optical system 2 is provided in the passage of the reflected light beams in such manner that a well focused image of the original is formed at the image-receiving section 28. A cutter 5 located in the proximity of the feeding rolls 10 for cutting the photosensitive copying paper. A pair of electrically conductive sensing rolls 8, 9 are normally kept in contact with each other to carry an electric current through the contact between them. The electric current through the contact between the sensing rolls 8, 9 are interrupted upon entrance of the original 7 therebetween, so that the front and rear edges of the original can accurately be detected by checking the current through the rolls 8, 9.

In a control system of the electronic copying machine, of which circuit is shown in FIG. 2, relay contacts are designated by adding symbols C to numerals representing relays to which the relay contacts belong. Operative positions of the relay contacts, which are shown by solid lines in the FIGURE, represent their normal positions to be assumed before the control circuit detects the copying paper for starting operation. As can be seen from the solid line circuits, before an original 7 comes into contact with rolls 8, 9 and electric current flows through the rolls 8, 9 to actuate the relay 20, while a capacitor 21 is charged through relay contacts 22C1 and 20C1. Intrusion of the original 7 between the sensing rolls 8, 9 interrupts the current through the relay 20, to open the relay contact 20C1 while closing another relay contact 20C2. Accordingly, the capacitor 21 is discharged through a circuit consisting of the relay contact 20C2 and a holding relay 22. The holding relay 22 is energized to open the relay contact 22C1 while closing another relay contact 22C2. As a result of it, an electromagnet 18 is actuated, an a magnetic clutch 23 is engaged to drive a means for delivering the photosensitive copying paper for starting the feeding of the copying paper. The electromagnet 18 actuates a delay means, to be described hereinafter. A microswitch 19 turns its contact element to a dotted line position at the end of a certain predetermined delay time for energizing a holding delay 24. Being energized, the holding relay 24 closes its contacts 24C1, while opening another relay contact 24C2 for deenergizing the electromagnet 18.

An AND-circuit 30 is inserted, in series, between relay contacts 24C1 and 20C3. The relay contact 20C3 is kept open as long as the relay 20 is deenergized by the presence of the original 7 by the sensing rolls 8 and 9. Thus, the AND circuit closes only when the following two conditions are simultaneously established: namely, the elapse of the aforesaid delay time, and the resumption of electrical current through the relay 20 upon leaving of the original 7 from he sensing rolls 8, 9.

After the relay contact 24C1 closes the elapse of the delay time, when the relay 20 is reenergized to close the relay contact 20C3 in response to the passage of the original 7 from the sensing rolls 8, and 9, a rotary solenoid 25 is actuated. The rotary solenoid drives the cutter 5. At the same time, the rotary solenoid 25 turns the contact element of a microswitch 26 to its dotted line position, for energizing a holding relay 24', so as to return the holding relay 24 to is original position. Accordingly, the relay contact 24C1 opens to deenergize the rotary solenoid 25 for returning the microswitch 26 to its original position. Before the relay contact 24C3 opens, a holding relay 22' is energized through a contact 20C4 of the relay 20 which now carries an electric current, so as to return the holding relay 22 to its original position. As a result, the relay contact 22C2 opens, to interrupt the current through the magnetic clutch 23. Thus, the delivery of the photosensitive copying paper stops, and the charging of the capacitor 21 resumes. Thereby, the electronic copying machine returns to the original position ready for receiving a next original 7.

FIGS. 3 and 4 illustrate the time delay means. In the FIGURES, a cam disk 12 is driven at a reduced speed by a

prime mover of the copying machine. The cam disk 12 frictionally engages the boss 31 (FIG, 4) of a continuously rotating gear 11 in such manner that the cam disk 12 can frictionally slip relative to the boss 31. A lever 17 normally holds the cam disk 12 stationary be the engagement of the right-hand end of the lever 17 and a projection 27 of the cam disk 12, as shown in FIG. 3. Upon energization, the electromagnet 18 turns the lever 17 counterclockwise, as seen in figure so as to disengage the lever 17 from the projection 27 of the cam disk 12. Accordingly, the cam disk 12 starts rotating together with the gear 11 by being driven by the friction between the disk and the boss in a direction as shown by the arrow of FIG. 3. A pin 16 is secured to the cam disk 12, so that the pin 16 engages an actuator arm of the microswitch 19 in response to the rotation of the cam disk 12 by a certain predetermined angle. When he pin 16 engages the actuator arm, the contact element of the microswitch 19 moves from the solid line position to the dotted line position, as shown in FIG. 2. Then, the electromagnet 18 is deenergized to return the lever 17 to the position as illustrated in FIG. 3, where the lever engages the projection 27 of the cam disk 12 as the cam rotates.

The cam disk 12 is carried by a gear 11 between a pair of abrasion-resisting washers 13 and 14 mounted on the gear. The washers 13, 14 are made of nylon or other suitable resilient material. A spring 15 is so disposed as to cause the two washers 13, 14 to engage the opposing surface of the cam disk 12 while allowing the cam disk 12 to frictionally slip relative to the gear 11.

The delay time of the aforesaid delay means is so selected that the length of the photosensitive copying paper which is fed during the delay time becomes minimum length L, which ensures smooth feeding thereof through the electronic copying machine. As pointed out in the foregoing, the cutter 5 is actuate only when the two relay contacts 20C3 and 24C1 are simultaneously closed, thanks to the AND-circuit 30. Accordingly, if the length of the original 7 being copied is not longer than the minimum length L, which is required for smooth feeding of the copying paper, the two relay contacts close in the order of 20C3 and 24C1, as can easily be seen from he circuit diagram of FIG. 2. Thereby, the copying paper is cut at a length equivalent to the minimum length L.

On the other hand, when the original 7 is longer than the minimum length L, the two relay contacts are closed in the order to 24C1 and 20C3, and the copying paper is cut at a length corresponding to the length of the original 7, as can easily be seen from the circuit diagram of FIG. 2.

In the illustrated embodiment, the magnitude of the minimum length L can be adjusted by properly selecting or varying the reduction ratio between the gear 11 and the cam disk 12 and varying the angular position of the pin 16 on the cam disk 12.

In order to prevent overlapping of successive originals 7 in the electronic copying machine, it is possible to mount an indicating lamp (not shown) which is actuated by the rotary solenoid 25. With such indicating lamp, the operator can feed an original 7 into the copying machine only after completion of the copying operation of the preceding original 7 with the cutting of the copying paper by the cutter 5, so that no overlapping of the originals occur in the copying machine.

FIGS. 5 to 7 illustrate a second embodiment of the present invention, in which like parts are designated by like reference numerals as in the preceding embodiment, which is described by referring to FIGS. 1 to 4. In FIG. 5, an original 7 is fed through an inlet opening 32. Feeding rolls 33 and 34 transfer the original 7 thus fed in a direction as shown by the arrow 7'. At the same time, the original 7 passes between a pair of electrically conductive sensing rolls 8 and 9; so as to interrupt an electric current between the rolls 8 and 9 as long as the original 7 is between them. Accordingly, the front and rear edges of the original can be sensed by the interruption and resumption of the electric current through the two sensing rolls 8 and 9. Delivery rolls 10 deliver photosensitive copying paper from a rolled copying paper 6 and feeds the copying paper in a direction as shown by the arrow 6', so that the copying paper travels through a cutter 5, a charger 3, feeding rolls 35, an exposing portion 28, and a developing tank 4.

The delivery of the photosensitive copying paper is initiated by an electric signal which is generated in response to the detection of the front edge of the original 7 at the electrically conductive sensing rolls 8 and 9. The feeding speed of the copying paper is identical with that of the original 7. As soon as an end signal is generated in response of the detection of the rear edge of the original 7 by the rolls 8 and 9, the cutter 5 is actuated by the end signal to cut the copying paper. Accordingly, the copying paper is cut at a length corresponding to the length of the original, provided that the copying paper is not cut shorter than a certain minimum length L.

When he copying paper moves through the image receiving section 28 at the same speed with that of the original 7, in synchronism with the arrival of the original 7 at a scanning section A, beams from a light source 1 reflect at the original 7 and pass through an optical system 2, which produces a well focused image of the original 7 on the photosensitive paper at the image-receiving section 28.

The electrically conductive sensing rolls 8 and 9 need not be as wide as the feeding rolls 33 and 34 of the originals. For instance, the rolls 8 and 9 can be a pair of electrically conductive wheels disposed at about the lateral center of the original 7 with respect to the moving direction of the original, as depicted in FIG. 6. The sensing rolls 8 and 9 can be made of metallic material or can be provided with electrically conductive rubber rings mounted on the peripheries thereof. In a preferred embodiment of the invention, one of the sensing rolls, e.g., the roll 9, is driven together with the feeding rolls 33, while the other sensing rolls, e.g., roll 8, is resiliently urged by a leaf spring 36 toward the first sensing roll 9 so as to cooperate with the first sensing roll 9.

Referring to FIG. 7, illustrating a control circuit of the embodiment of FIG. 5, a relay 37 is connected to the sensing rolls 8 and 9, in series therewith. A direct current source 38 normally maintains an electric current through the relay 37 and the sensing rolls 8 and 9. A shunt circuit consisting of a capacitor 40 in series with a resistor 39 is connected across the pair of the sensing rolls 8 and 9. Another shunt circuit consisting of a capacitor 42 in series with a resistor 41 is connected across the relay 37. Upon insertion of the original 7 between the sensing rolls 8 and 9, the current through the relay 37 is interrupted to close a relay contact while opening another relay contact 44. Accordingly, a magnetic clutch 45 is actuated to start the delivery of the photosensitive copying paper. At the same time, a cutter driver electromagnet 46 is deenergized. Upon passage of the original 7 through the sensing rolls 8 and 9, the current is resumed through the rolls 8, 9 and the relay 37 to open the contact 43 while closing the contact 44. Accordingly, the clutch 45 is released and the cutter 5 is actuated.

The capacitor 40 in the aforesaid control circuit is to prevent erroneous operation of the electronic copying machine. When the current through the sensing rolls 8 and 9 is momentarily interrupted by some reasons, for instance, by vibration from the outside of the machine or momentary intrusion of foreign matters between the sensing rolls, the capacitor 40 is charged by the power source 38 through the relay 37, as can be seen from FIG. 7 and the charging current acts to hold the relay as energized. Thus, the electronic copying machine is not susceptible to erroneous operation due to momentary interruption of the electric current through the sensing rolls 8, 9.

The capacitor 42 in parallel with the relay 37 functions as follows. As explained in the above, immediately after the current through the sensing rolls 8 and 9 is interrupted, the capacitor 40 discharges through the relay 37 for holding the relay 37 for a certain period of time. In other words, the capacitor 40 provides a certain time lag from the interruption of the current through the sensing rolls to the deenergization of the relay 37. This time lag is selected to be at a certain value which is not too short for the purpose to be described

hereinafter. Referring to FIG. 5, in order to compensate for such time lag, the distance between the sensing rolls 8, 9 and the scanning section A along the travelling route of the original 7 is selected to be somewhat shorter than the distance from the cutter 5 to an image-receiving section B. The latter distance is taken along the travelling route of the copying paper. It is, however, usually difficult to establish good matching between the aforesaid time lag and the route length difference, because of the manufacturing errors of various mechanical parts of the machine and the dispersion of electrical circuit constants. Accordingly, the aforesaid route length difference is selected to be somewhat longer than the value corresponding to the time lag due to the capacitor 40. By adjusting the magnitude of a time lag due to the capacitor 42 by varying the resistance value of the resistor 41, exact matching can be easily established between the total time lag, inclusive of those due to the capacitors 40 and 42, and the aforesaid route length difference.

In conventional copying machine with rolled copying paper, a microswitch with a low torque has been used, instead of the sensing rolls 8 and 9 of the aforesaid embodiments of the present invention. Such microswitch had various drawbacks, namely, thin originals were folded and wrinkled, considerable errors were caused by the difference in thickness of the original, etc. There has been proposed the use of a pair of electrically conductive sensing rolls. Conventional sensing rolls, however, were susceptible to erroneous operation due to vibration caused from the outside of the copying machine or intrusion of foreign matters between the sensing rolls.

According to a feature of the present invention, a shunt capacitor is provided in parallel with the sensing rolls, so that the erroneous operation due momentary separation of the cooperating sensing rolls is completely eliminated by the use of charging current of such shunt capacitor. With the copying machine of the present invention, the risk of wrinkling of thin originals is also completely eliminated by the use of the sensing rolls.

Furthermore, by mounting electrically conductive rubber ring on the peripheries of the sensing rolls 8, and 9, the operation of the copying machine is stabilized against vibration from he outside. By using a shunt capacitor with a series resistor whose resistance value is variable, in parallel with the relay 37, the mechanical compensation of the electrical time lag at the sensing means for detecting the front and rear edges of the original can be greatly simplified.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. An electronic copying machine comprising a sensing means for detecting front and rear edges of an original being copied and first and second signals in response to the passage of said front and rear edges respectively, a delaying means for generating a third signal a predetermined time after said first signal and corresponding to a minimum length of the copying paper, a photosensitive copying paper delivering means connected to said sensing means and actuated by said first signal, a paper cutter for automatically cutting the copying paper, and an AND circuit connected to said sensing means and said delaying means and actuated by the simultaneous existence of said second and third signals for stopping said copying paper delivering means and actuating the copying paper cutter.

2. An electronic copying machine according to claim 1, wherein said sensing means comprising a pair of electrically conductive sensing rolls which are in resilient contact with each other, so as to carry an electric current through the contact therebetween, an a capacitor connected across said pair of rolls.

3. An electronic copying machine according to claim 1, and further comprising a continuously rotating gear with a boss integrally formed therewith at the center thereof, wherein said delaying means consists of a cam disk having a peripheral projection and a pin integrally secured thereto, said cam disk being mounted on said boss of said gear by means of a spring and washers in such manner that the cam disk can frictionally slip relative to the gear, a control lever engageable with said projection, an electromagnet adapted to disengage said control lever from said projection upon actuation thereof, and a microswitch cooperating with said pin.

4. An electronic copying machine according to claim 1 and further comprising a relay connected in series with said sensing rolls and a capacitor with a series resistor connected across said relay, resistance of said resistor being adjustable, whereby a time lag inherent to said sensing means can finely be adjusted to facilitate mechanical compensation of the time lag.

5. An electronic copying machine according to claim 2, wherein said pair of sensing rolls are made of electrically conductive rubber, whereby operation of the copying machine is stabilized against vibration from the outside of the machine.

6. An electronic copying machine according to claim 3, wherein said cutter is so actuated that the copying paper is automatically cut by the cutter at a length longer than a certain minimum length which is adjustable by varying speed change ratio between said gear and said cam disk and angular position of said pin relative to said cam disk.

7. An electronic copying machine, comprising a means for sensing a leading edge and a trailing edge of an original said means having a control means for compensating the time lag of said sensing means at detecting the leading edge and trailing edge of the original, a means for delivering a copy paper from a copy paper roll, said delivering means connected to said reversing means and being actuated on receiving a first signal generated by said sensing means when the latter senses the leading edge of the original, a cutting means for the copy paper, an electromechanical means having a delaying means for controlling the operation of said cutting means so as to cut the copy paper to a predetermined minimum length, said electromechanical means connected to said sensing means and being actuated upon receiving said first signal, and an AND circuit connected to said sensing means and said delay means having a first switch which is closed by said delaying means at the expiration of the predetermined delay time by said delaying means, and a second switch which is closed upon receiving a second signal generated by said sensing means when the latter senses the trailing edge of the original said AND circuit cooperating mechanically and electrically with said delivering means and cutting means so that upon completion of said AND circuit, said delivering means and cutting means are stopped and actuated respectively, said AND circuit being completed when said first and second switches are closed, to stop the delivering means and to actuate the cutting means,

8. An electronic copying machine as claimed in claim 7, wherein said sensing means comprises a pair of electrically conductive sensing rolls which are in resilient contact with each other so as to carry an electric current therethrough, said sensing means being connected thereacross to a capacitor for compensating said time lag, and also connected thereacross to a relay which is actuated to actuate said delivering means upon receiving said first signal, and to stop and actuate said delivering means and cutting means respectively upon receiving said second signal.

9. An electronic copying machine as claimed in claim 7, wherein said electromechanical means includes an electromagnetic means and the delaying means, said electromagnetic means being actuated upon receiving said first signal to start the delaying means which compensates the predetermined minimum length of the copy paper to be delivered from the copy paper roll.

10. An electronic copying machine as claimed in claim 7, wherein said delaying means comprises a cam disk having a

peripheral projection and a pin integrally secured thereto, said cam disk being mounted on a base of a gear, which is continuously driven by a prime mover through a gearbox, by means of a spring and washers in such manner that the cam disk can frictionally slip relative to said gear, said peripheral projection being interlocked with the electromagnetic means by means of a lever which is normally engaged with said projection, the engagement between the lever and projection being disengaged together with to initiate the rotation of said cam disk when said electromagnetic means is energized upon receiving said first signal, said pin actuating a microswitch which closes the switch (24C1) after the cam disk is revolved at a predetermined angle.

11. An electronic copying machine as claimed in claim 10, including means for varying the velocity ratio between said prime mover and cam disk, and for varying the angular position of said pin relative to said cam disk.

12. An electronic copying machine as claimed in claim 8, wherein a capacitor and a resistor connected in series therewith are connected in parallel with the relay, the resistance of said resistor being adjusted to facilitate mechanical compensation of the time lag.

* * * * *