March 31, 1970 TADAMITSU UCHIYAMA 3,503,677

ELECTROPHOTOGRAPHIC COPYING MACHINE

Filed May 17, 1967 3 Sheets-Sheet 1

FIG.1

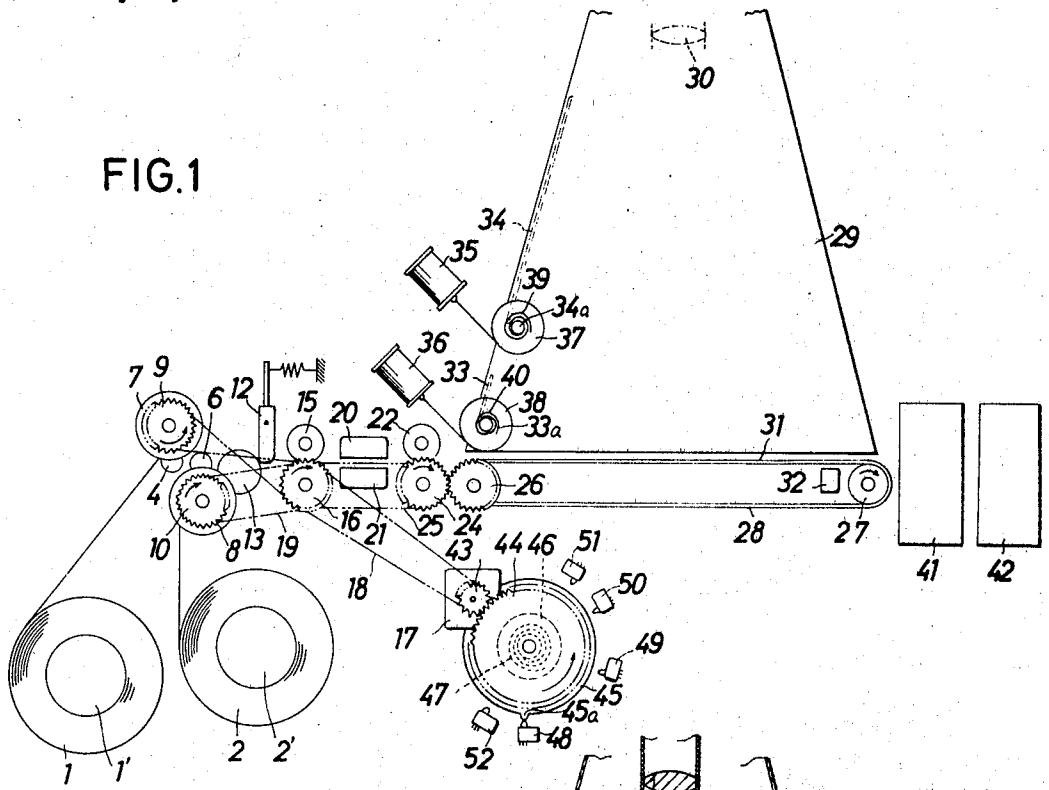
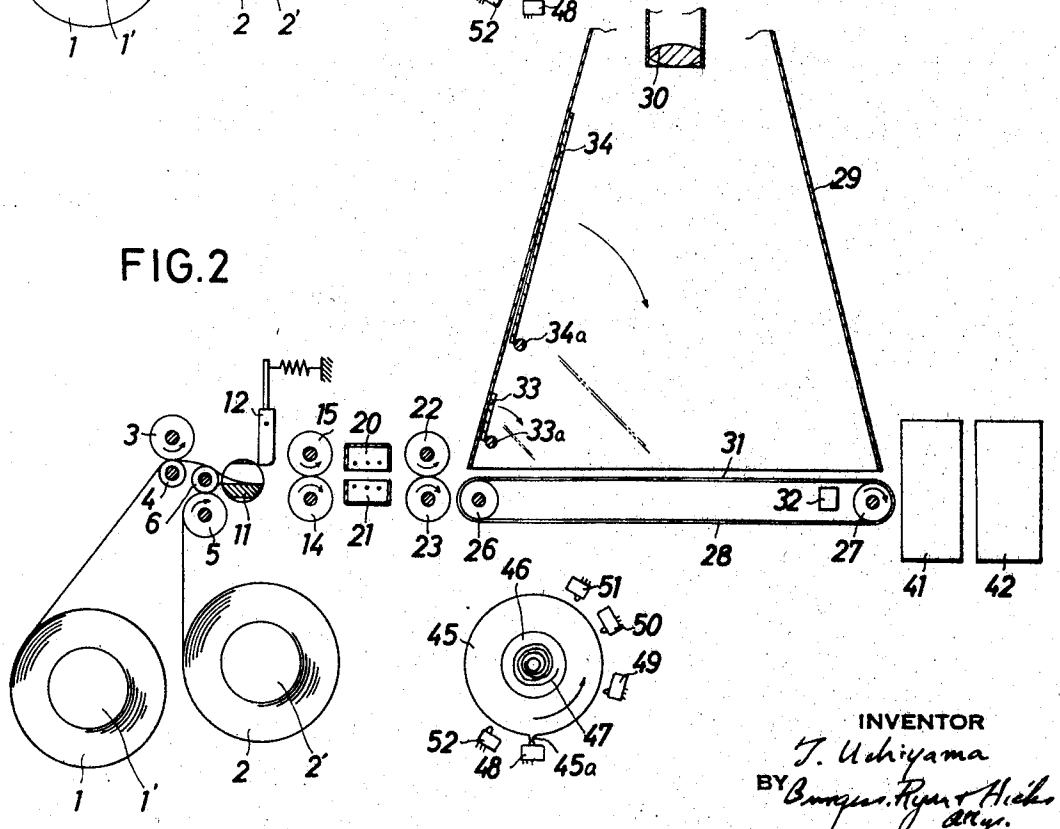


FIG.2



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March 31, 1970 TADAMITSU UCHIYAMA 3,503,677

ELECTROPHOTOGRAPHIC COPYING MACHINE

Filed May 17, 1967 3 Sheets-Sheet 2

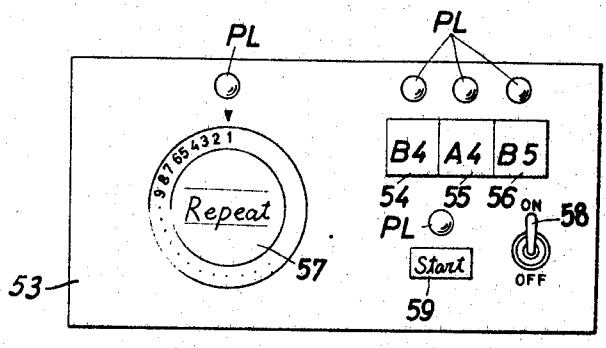


FIG. 3

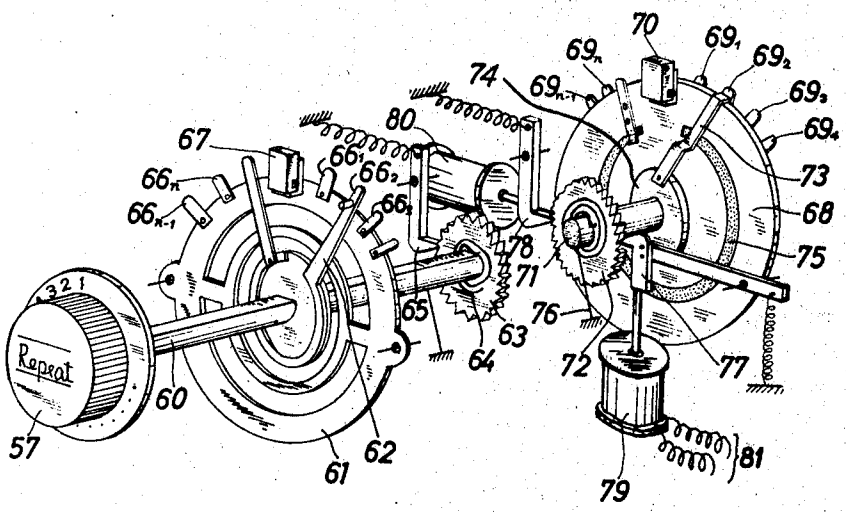


FIG. 4

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March 31, 1970 TADAMITSU UCHIYAMA 3,503,677

ELECTROPHOTOGRAPHIC COPYING MACHINE

Filed May 17, 1967 3 Sheets-Sheet 3

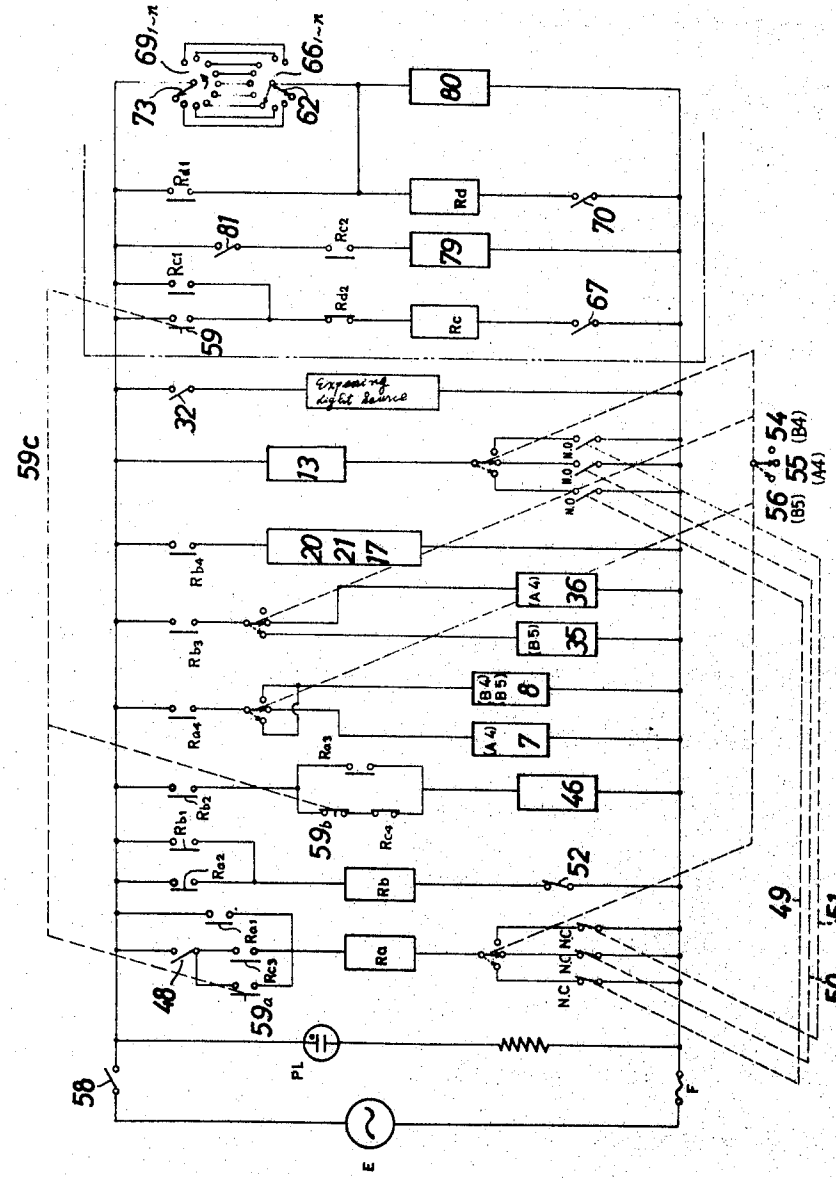


FIG.5

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United States Patent Office 3,503,677
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3,503,677

ELECTROPHOTOGRAPHIC COPYING MACHINE

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Int. Cl. G03g *13/00, 15/00;* G03b *19/04*
U.S. Cl. 355—13
4 Claims

ABSTRACT OF THE DISCLOSURE

An electrophotographic machine having a plurality of rolls of photosensitive paper each roll being of a different width than the others to provide sheets of a different width. Paper feed rollers are provided for feeding a predetermined length of paper from a preselected one of the rolls and a cutter mechanism for cutting an appropriate length of paper from the preselected roll. After the paper is cut into its appropriate length, it is moved past suitable electrodes to be changed and then moved into a dark box where it is exposed to the object to be copied. Within the dark box is a belt conveyor for conveying the paper across one end of the box and a pivoted plate masking device adapted to cover one end of the box for masking part of the exposure area not occupied by paper when a smaller than the maximum size is being exposed.

BACKGROUND OF THE INVENTION

This invention relates to an electrophotographic copying machine with stored-in rolled sensitive papers.

Electrophotographic copying machines have hitherto been known in which a roll of photosensitive paper stored in the machine is cut to a desired length by a cutting knife and then sent to the electrifying, exposing, developing and fixing zones in turn to obtain copies.

It has also been known that when a plurality of copies are to be taken from the same original, the original copy is cyclically moved so as to actuate microswitches by the motion of the original whereby to cut the paper and send it automatically to the various devices mentioned above. However, these known machines with the paper cutting and feeding mechanism or with the repetition mechanism for multiple copying from one original have been adapted to cut from a rolled paper having a fixed width and therefore it is not possible to choose sizes of paper. Therefore, replacement of rolls of different width is required to get a copy in a paper of a desired size, what makes the machine very inconvenient.

SUMMARY

Therefore, an object of the invention is to improve the prior art electrophotographic copying machine, i.e., the copying machine which contains therein a roll of sensitive paper and performs automatic cutting, electrification, exposure, development and fixing, the improvement being the incorporation in a cooperative relation of a mechanism for selecting sizes of paper to be cut and a mechanism for masking a part of the exposure surface of the selected size, so that free choice of any desired size of copy paper is possible.

In addition to the selection of paper size, the invention has for its object to change the number of copies per unit time to improve the efficiency of the machine, as, for example, 6 papers per minute for B4 size and 11 papers per minute for B5 size.

BRIEF DESCRIPTION OF THE DRAWINGS

The details of the invention will be apparent from the description with reference to the drawings, in which:

FIG. 1 is a side view of an embodiment of the invention;

FIG. 2 is a longitudinal cross-section of the apparatus shown in FIG. 1;

FIG. 3 is a front view of an operation panel for selecting paper size and the number of printed papers;

FIG. 4 is a perspective view of an example of a repetitive mechanism for relation of the number of printed copy papers; and

FIG. 5 is a diagram of the electrical circuit used in the machine of the invention.

FIGS. 1 and 2 show the arrangement of various sections and driving mechanisms therefor in the machine of the invention, wherein a roll **1** of sensitive paper having a width corresponding to the shorter side (210 mm.) of a paper of A4 size is mounted on a spindle **1'**, the leading end of the paper being supported between rollers **3** and **4**. On a spindle **2'** disposed parallel to spindle **1'** is mounted a roll **2** of sensitive paper having a width of the shorter side of B4 paper (257 mm.), whose trailing end is supported between rollers **5** and **6**. These rollers **3**, **4** and **5**, **6** constitute pairs of feed rollers for feeding papers **1** and **2**, respectively. Secured to the ends of the shafts of rollers **3** and **5** are gears **9** and **10** with electromagnetic clutches **7** and **8** for driving these rollers intermittently. Near the feed rollers is a conventional cutter mechanism comprising a movable knife **11** and a fixed knife **12** and a solenoid **13** (FIG. 1) as shown in FIG. 2. Operation of the knife takes place after the feeding of the paper stops. The sensitive paper **1** or **2** cut by this cutter is fed to the electrifying section by a pair of guide rollers **14** and **15**. As shown in FIGS. 1 and 2, these guide rollers **14** and **15** are rotated in the direction of the arrow by chains **18**, **19** passed around gear **16** fixed on the shaft of guide roller **14**. The output shaft of a motor **17** and gears **9**, **10** drive said feed rollers. The electrifying unit comprises a pair of oppositely polarized needle electrodes **20**, **21** where the sensitive paper **1** or **2** is charged electrically for advance into the exposing section through a pair of guide rollers **22**, **23**. The roller **23** has secured on its shaft end a gear **24** which is driven by a chain **25** running around the gear **16**. The exposing unit comprises a paper feeding belt **28** passed between two rollers **26**, **27**, a dark box **29** located above said belt, a source of light for flash exposure, a lens **30**, and mask plates **33**, **34** mounted in said dark box. Inside the loop of the belt **28** is provided a suction device using a vacuum action for keeping the photosensitive paper in contact with the belt **28** as it is moving past the exposing area **31**. Also at a proper location inside the loop of the belt is positioned a microswitch **32** which, when its probe is pushed by the paper being fed, turns on said flash lamp so that an original or microfilm text is imaged through lens **30** on to the sensitive paper on said belt **28** for exposure. The dark box **29** is so designed as to make exposure of a paper of B4 size.

If an image of A4 or B5 size are to be projected, the mask **33** and **34** operates to mask a part of exposure area **31** so as to adjust the exposure area to the A4 or B5 size. As shown in FIG. 2, these mask plates **33** and **34** are secured to shafts **33***a* and **34***a*, respectively, which extend horizontally along the side wall of dark box **29**. The ends of shafts **33***a*, **34***a* project externally through the wall of the dark box and carry pulleys **37** and **38** adapted for rotation by the action of solenoids **35** and **36**. The mask plates **33** and **34** are normally positioned against the inner side wall of the dark box by return springs **39** and **40** (FIG. 1). The sensitive paper, after exposure, passes into a developing apparatus **41** of known type and thence to fixing section **42** (shown as blocks in FIGS. 1 and 2).

A motor **17**, shown located at the lower center of FIG. 1, has secured on its output shaft a gear **43** engaging a larger gear **44** which has on its shaft a control disk **45** with a projection **45***a*. This disk is arranged for rotation upon the action of a magnetic clutch **46**, while normally it rests in the starting position shown in FIGS. 1 and 2 by a return spring **47**. Arranged around the disk **45** are microswitches **48** for starting, **49** for B5 size, **50** and **51** for A4 size, and **52** for stopping, each being operative when its tripping member is pushed by the projection **45***a* of the disk **45**. The period required for the projection **45***a* of disk **45** to turn anticlockwise from the starting position at microswitch **48** up to the stopping position at microswitch **52** is set to be equal to the period required for the sensitive paper **1** or **2** to travel, from the feed rollers **3**, **4** or **5**, **6**, through the complete process of electrification, exposure, development and fixing. The microswitches **49**, **50** and **51**, each of which has two contacts, one normally open and the other normally closed, are arranged at such distances from the projection **45***a* at rest as correspond to the lengths to which papers of A4 size and B4 size are to be cut, respectively. These microswitches **49**, **50** and **51** are connected to a four-circuit, three-contact selector switch and control the actions of the aforementioned movable knife **11**, the feed rollers **3** and **5** and the magnetic clutches **7** and **8**.

A control panel **53**, shown in FIG. 3, is provided at a suitable location in the machine. The control panel includes switches **54**, **55** and **56**, only one of which is operable at a time, for selecting copy papers of B4, A4, B5 sizes, a setting knob **57** for actuating the repetition mechanism used for multiple copying, a main switch **58**, a starting switch button **59**, and pilot lamps PL indicating conditions of the individual switches.

Referring to FIG. 4, there is shown an example of the repetition mechanism used to take, multiple copies. A movable contact **62** of rotary switch **61** and a ratchet wheel **63** are bodily fixed on the shaft **60** of the repetition setting knob **57**. This ratchet wheel **63** is biased by a return coil spring **64** and is engaged by a non-return pawl **65**. The movable contact **62** is adapted to contact one of a set of stationary contacts 66_1 to 66_3 rigidly mounted on the periphery of a disk made of a synthetic resin. At a position on the synthetic resin disk adjacent the fixed contact 66_1, there is mounted a microswitch **67**, whose contact is opened by the movable contact **62** when it is in the starting position and closed when the movable contact is on the fixed contact 66_2 or other higher positions.

A stationary disk **68**, also made of synthetic resin, is provided, on its periphery, with a set of fixed contacts 69_{n-1} to 69_4, corresponding to the above mentioned fixed contacts 66_{n-1} to 66_3, and a microswitch **70**. A shaft **71** extends for free rotation through the center hole of said disk **68** and carries a ratchet wheel **72** and a disk **74** having a movable contact **73**. This movable contact **73** slides on a conductive segment **75** on the disk **68** and, on the other hand, contacts one of said fixed contacts 69_1 to 69_4, to count the number of copied papers. The ratchet wheel **72** is loaded with a return coil spring **76**, while it is engaged by a non-return pawl **78** and an indexing pawl **77**, both of which are operable with solenoids **80** and **79**, respectively.

The various switches and solenoids described so far are wired as shown by the circuit diagram in FIG. 5. Thus, connected to the power supply E, via main switch **58** and fuse F, are the selector switch four circuits and three contacts **54**, **55**, **56** for selecting paper sizes, microswitches **49**, **50**, **51** each having normally closed and normally open contacts arranged around said disk **45** with projection **45***a*, a start push-button switch **59** with normally open contacts **59***a*, **59***c* and a normally closed contact **59***b*, magnetic clutches **46**, **7**, **8**, solenoids **13**, **35**, **36**, **79**, **80**, and motor **17**, charging electrodes **20**, **21**, heater, exposing light source, etc., for operation in suitable timings through relays R*a*, R*b* having normally open contacts Ra_1, Ra_2, Ra_3, Ra_4 and Rb_1, Rb_2, Rb_3, Rb_4, a relay Rc having normally open contacts Rc_1, Rc_2, Rc_3 and a normally closed contact Rc_4, and a relay R*d* having a normally open contact Rd_1 and a normally closed contact Rd_2, respectively. The section shown to the right of the broken line on the right-hand side of FIG. 5 shows the circuit for the repetition mechanism, wherein switch **81** connected in series with solenoid **79** is operatively related to the movable knife **11** of the cutter unit so that, at each operation of the cutter, it is closed to excite said solenoid **79**, which in turn indexes the ratchet wheel **72** stepwise until the movable contact **73** comes to a position on disk **68** corresponding to a desired number of prints.

The operation of the machine will now be described below. Let it be first assumed that only one copy is to be taken with a sensitive paper of B5 size. The main switch **58** on the control panel **53** (FIG. 3) is closed. Among the paper size selecting switches **54**, **55** and **56**, the switch **56** is pressed to close its contact. This means selection of paper size B5 and the selector switches in the circuit of FIG. 5 assume their contact positions as shown by the dotted lines. Then, start button **59** is pushed to close contacts **59***a* and **59***c* and open the contact **59***b*. Closing of contact **59***a* causes a current flow from the power supply E through a circuit—power supply E, main switch **58**, microswitch **48** (this switch **48** is of normally open type but is now closed by projection **45***a* of the control disk **45**), contact **59***a*, relay R*a*, contact of **56**, normally closed contact of microswitch **49**, fuse F, power supply E, thereby exciting the relay R*a*. Excitation of this relay R*a* closes its self-hold contact Ra_1, contact Ra_2 for relay R*b*, and contacts Ra_3, Ra_4, so that contact Ra_1 holds current flow in its own relay and contact Ra_2 operates relay R*b*. When this relay R*b* is operated, its contacts Rb_1–Rb_4 are closed. By closing of Rb_4, motor **17** is started, a high voltage is applied to electrifying electrodes **20**, **21** and a heater for fixing (not shown) energized. Closure of Rb_3 actuates solenoid **35** which in turn lays the mask plate **34** in the dark box **29** down to the position shown by the broken line in FIG. 2. On the other hand, closure of contact Rb_4 causes operation of magnetic clutch **8** for the feed rollers **5** and **6** holding the leading end of the rolled sensitive paper **2**, in order to begin to feed the sensitive paper, while at the same time the control disk **45** begins its rotation in the direction of arrow (FIG. 1 and 2) due to closure of contacts Rb_2 and Rb_3. As a result of the starting of disk **45**, the normally open type microswitch **48**, which has been closed by the projection **45***a* of disk **45**, is opened. Relieving the start push-button switch **59** after excitation of relay R*a* will leave relays R*a* and R*b* kept energized because the contact Ra_1 continues to hold its circuit. As the disk **45** rotates, its projection **45***a* comes to push the probe of microswitch **49**, closing one of its normally open contacts which then feeds the cutter solenoid **13** to actuate movable knife **11** to cut the sensitive paper **2**. This results in cutting the paper to B5 size. On the other hand, the normally closed contact of said microswitch **49** is opened by said projection **45***a* to deenergize relay R*a*. This causes its contacts Ra_1–Ra_4 to return their normal open position. Opening of Ra_4 disconnects the magnetic clutch **48** and thus the feed rollers **5** and **6** stop. Despite the opening of contacts Ra_2 and Ra_3, the relay R*b* continues on because its contacts Rb_1, Rb_2 are closed and therefore the disk **45** goes in rotation. The resulting sensitive paper, cut to B5 size, is then electrically charged by the electrifying electrodes **20**, **21** and sent under the action of feed rollers **22**, **23** to the exposure area **31** on the conveyor belt **28**. This exposure area **31** is defined by the mask plate **34** to the B4 size of paper.

A flashed exposure is then effected by a lamp which is turned on when said sensitive paper trips a microswitch **32** at the exposure area. It then proceeds to the development and the fixing sections **41** and **42** to complete a copy. Meanwhile, the control disk **45** continues its rotation and, when the cut paper has passed through the fixing section,

the projection 45*a* of the disk 45 opens microswitch 52, disconnecting the relay R*b* to open its contacts Rb_1–Rb_4. Thus, current from the power supply E is now all cut off. The mask plate 34 then returns to its initial position in the dark box 29, motor 17 stops and the control disk 45 is brought to its initial position by return spring 47, to complete the whole cycle.

The above description has been made in connection with the copying operation using B5 size of paper. If it is preferred to select the paper size A4 or B4, a switch for A4 or B4 size on the control panel 53 (FIG. 3) is operated, closing contact 55 or 54 of the selector switch in FIG. 5, which energises a corresponding magnetic clutch 7 or 8 for feed rollers 3, 4 or 5, 6 and the solenoid 36 for mask plate 33 (not operative for B4 size). Microswitch 50 or 51 operates and the cutter solenoid 13 functions for cutting the sensitive paper to A4 or B4 size. Other operations are the same as those described for B5 size and therefore will not detailed here.

Description will now be made of the operation where a repetition mechanism according to the invention is used for obtaining multiple copies. It should be noted that the operation in this case is such that the operation of the repetition mechanism is added to the operation of the machine, so far described for obtaining a single copy, and therefore such part of description that may overlap will be omitted here. Further, it will be assumed for convenience of description that the B5 size of papers be chosen and three copies be taken.

The selector switch 56 on the control panel 53 (FIG. 3) is now pushed and the repetition setting knob 57 is set to the position shown by index "3." The result is that the movable contact 62 fixed to shaft 60 of rotary switch 61 (FIG. 4) is positioned in contact with a contact 66_3 among fixed contacts 66_{1-n}, and at the same time the ratchet wheel 63 integral with said shaft 60 is turned clockwise against the action of return spring 64 for engagement with non-return pawl 65. The turning of said movable contact 62 also closes microswitch 67 (FIG. 5). When start button 59 is pushed, the relays R*a*, R*b*, magnetic clutches 46 and 8, and solenoid 35 is supplied with current, as described before, and the control disk 45 begins to rotate in the direction of arrow (FIGS. 1 and 2).

As a result of closure of contact 59*c* of start switch 59, the relay R*c* is excited, opening its contact Rc_4 and closing its contacts Rc_1, Rc_2, Rc_3. This contact Rc_1 holds the circuit for relay R*c*, whereas contact Rc_2 gives current to the solenoid 79 for operating the indexing pawl 77 for the counting ratchet wheel 72. When the microswitch 49 for B4 size is operated by the projection 45*a* of the rotating disk 45, its normally open contact gets closed (FIG. 5) to actuate cutter solenoid 13 to cut the sensitive paper 2. On the other hand, the normally closed contact of microswitch 49 is opened to deenergize relay R*a* to open its contacts Ra_1, Ra_2, Ra_3 and Ra_4. This opening of contact Ra_4 deenergizes the magnetic clutch 8 to stop feed rollers 5 and 6 so that the feed of paper is interrupted for some time. Due to the opening of contact Ra_3, the magnetic clutch 46 for the control disk 45 is deenergized and therefore the disk 45 is brought back by the return spring 47 to its initial position (FIGS. 1 and 2). When control disk 45 comes back to its initial position, its projection 45*a* closes again microswitch 48 which in turn energizes relay R*a* via contact Ra_3 to close its contacts Ra_1, Ra_2, Ra_3 and Ra_4. This results in actuation of magnetic clutches 46 and 8, which then start feeding of sensitive paper 2 and rotating of disk 45. On the other hand, when the movable knife 11 of the cutter operates, the switch 81 connected therewith is closed to feed the solenoid 79 via contact Rc_2 (FIG. 5). This solenoid 79 will then act on the pawl 77 to index the ratchet wheel 72 one step, so that the movable contact 73 fixed on shaft 71 of said ratchet wheel 72 is moved clockwise onto fixed contact 69_2.

The operation mentioned above is repeated until the cutting of sensitive paper takes place. The movable contact 73 moves to the fixed contact 69_3. Since this fixed contact 69_3 is connected to the fixed contact 66_3 of the rotary swith 61, current from power source E flows, in FIG. 5, through such two circuits as movable contact 73, fixed contact 69_3, fixed contact 66_3, movable contact 62, solenoid 80, power source E, and, movable contact 73, fixed contact 69_3, fixed contact 66_3, movable contact 62, relay R*d*, microswitch 70, power source E. The solenoid 80 is therefore excited and removes the engagement between ratchet wheel 72 and non-return pawl 78, so that the ratchet wheel 72 is turned anti-clockwise by return spring 76 to bring the movable contact 73 back to its original position. However, if during this period the movable contact 73 would get slightly away from the fixed contact 69, it would be a difficulty since the solenoid 80 would then be deenergized. To avoid this, relay R*d* is inserted in the machine, whose energization closes its contact Rd_1 and opens Rd_2. Through Rd_1, current through solenoid 80 is maintained until the movable contact 73 takes its initial position. When movable contact 73 returns to the initial position, microswitch 70 is opened and relay R*d* is deenergized to open its contact Rd_1 and close Rd_2. Energization of relay R*d* also opens contact Rd_2 and therefore deenergized relay Rc_1 opening its contacts Rc_1, Rc_2, Rc_3 and closing Rc_4. Opening of contact Rc_3 disconnected relay R*a* to open its contact Ra_1–Ra_4. This opened contact Ra_4 disconnects the magnetic clutch 48 whereby stopping the feed rollers 5, 6. However, despite the opening of contact Ra_3 the magnetic clutch 46 for the control disk 45 is held excited by recovery of contact Rc_4 and so the disk 45 continues its rotation while the sensitive papers cut to B5 size pass through the electrifying, exposing, developing and fixing section successively. When the last paper completes its fixing process, the projection 45*a* of control disk 45 disconnects microswitch 52 whereby all currents in the machine cease and the machine stops its working.

As seen from above, this invention provides a machine which permits cutting of a sensitive paper from a roll to a desired size, and is therefore very convenient compared with the conventional machines which require replacement rolled papers to change the paper size. The feature of the invention consists in eliminating such replacement of paper and making more use of it. For this purpose, in accordance with the invention, means are provided for reducing the exposure area, and such means are interlocked with means for selecting the size of the sensitive paper, whereby the number of copies produced per unit time may be increased for papers smaller than the exposure area. This arrangement makes it possible, without necessitating any improvement in mechanical performance itself, to increase the number of copies per unit time and therefore this is a great advantage of the machine of the invention.

In the case where copies smaller than the maximum exposure area are taken one sensitive paper is being exposed with the exposure area partially covered by the mask plate, when another paper has been placed under the masking plate. This minimizes loss of time and if, for example, a maximum of 6 copies per minute is available using B4 size, it can produce 8 copies per minute for A4, and 11 copies per minute for B5.

What is claimed is:

1. An electrophotographic copying machine comprising, a plurality of rolls of photosensitive paper each being of a different width than the others to provide paper sheets of a different width, paper feeding rollers for feeding a predetermined length of said photosensitive paper from any preselected one of said rolls of paper, a cutter mechanism for cutting the photosensitive paper after a predetermined length has been fed, said cutting mechanism being operable when the feeding of the paper stops, means for preselecting a roll of photosensitive paper to give a sheet of a desired width, means for pre-selecting a length of photosensitive paper to give a sheet of a desired length, means for pre-selecting the number of copies to be automatically made before the machine discontinues copy-

ing, means for moving said photosensitive sheet past suitable electrodes to charge said sheet, means for moving said sheet into a dark box where it is exposed to the object to be copied, and belt means for conveying said sheet across one end of said box and masking means comprising a pivoted plate within said dark box adapted to cover part of one end of said box adjacent to the belt means for masking off areas not occupied by said sheet when a sheet smaller than the maximum size is being exposed.

2. An electrophotographic copying machine, according to claim 1, wherein said masking means is moved about its pivot support by electric power means.

3. An electrophotographic copying machine according to claim 1, wherein said masking means comprises a plurality of movable plates adapted to mask part of the exposure area when a sheet less than the maximum size is being exposed.

4. A copying machine according to claim 1, wherein

each of said rolls of photosensitive paper has one set of feeding rollers to feed the paper on said roll to other parts to said machine.

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U.S. Cl. X.R.

95—31; 355—7