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[54] MULTIPLE-COPY ELECTROSTATIC MACHINE
CONTROL
3 Claims, 5 Drawing Figs.

[52] U.S. Cl. 355/14,
355/10
[51] Int. Cl. G03g 15/22
[50] Field of Search 355/14

ABSTRACT: An electrostatic copier to feed sheet by sheet piled electrophotographic paper and transfer the image of the original sheet onto the paper, including a microswitch disposed at the entrance of an exposure station which is actuated and switches circuits for a charging device and a lamp when the electrophotographic paper charged on the switching on of a copying start switch enters the exposure station. A second microswitch disposed at the exit of the exposure station stops supplying electricity to the charging device, the lamp and two preset switches for copying a plurality of sheets when the tail end of the electrophotographic paper leaves an actuating member.

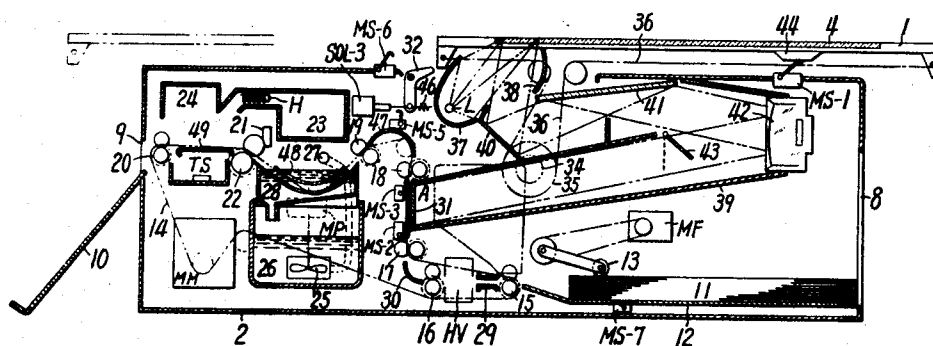


FIG. 1

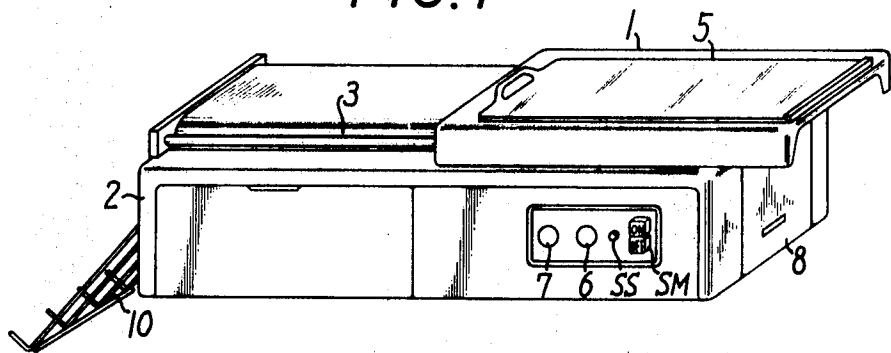
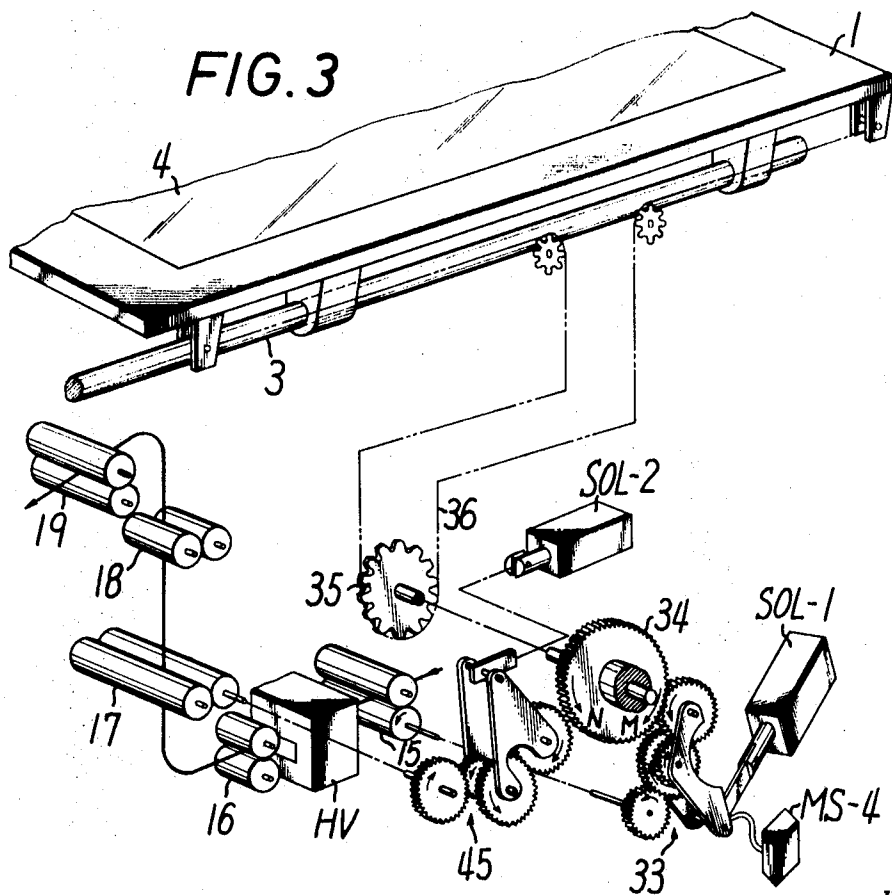


FIG. 3

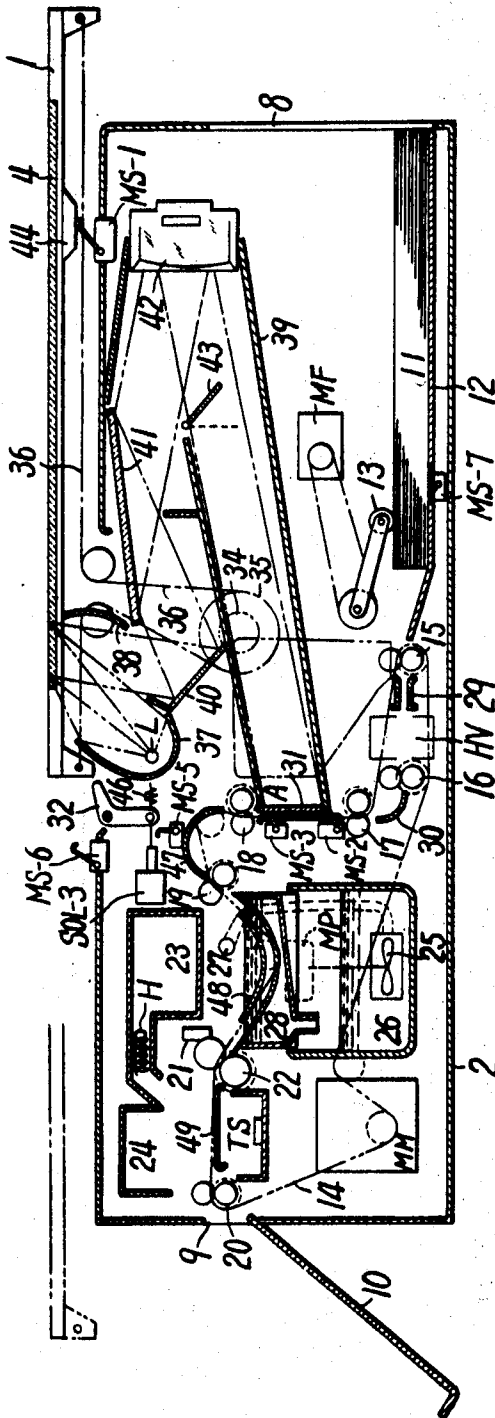


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FIG. 2



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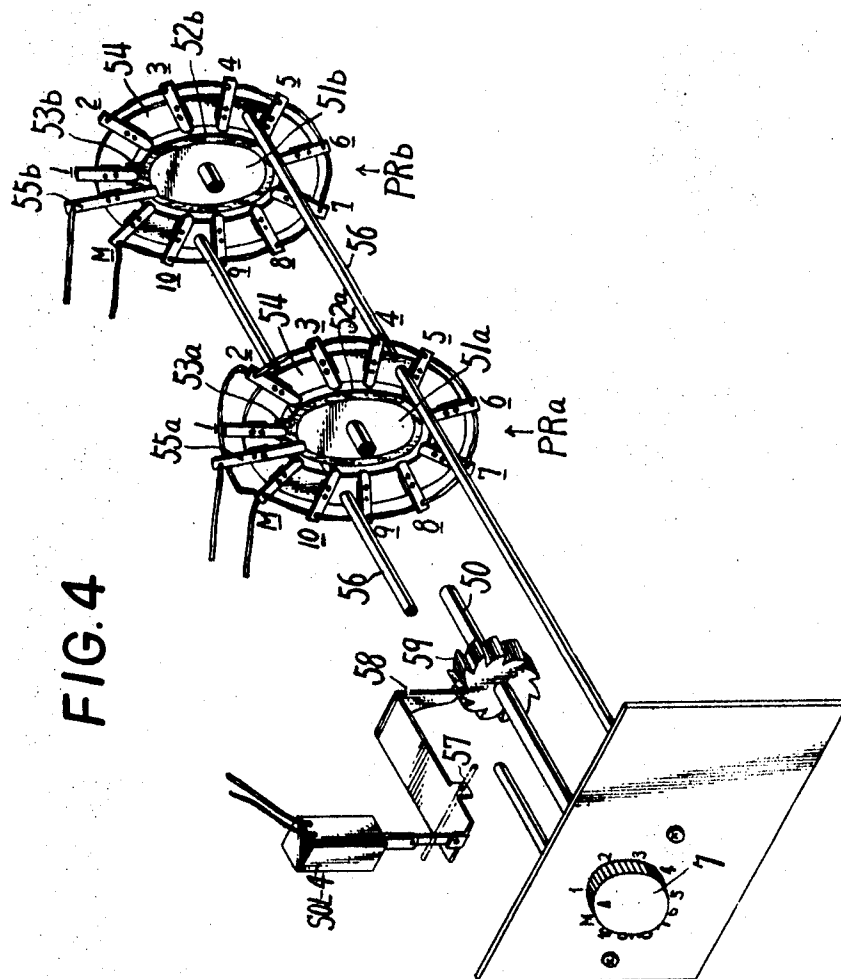


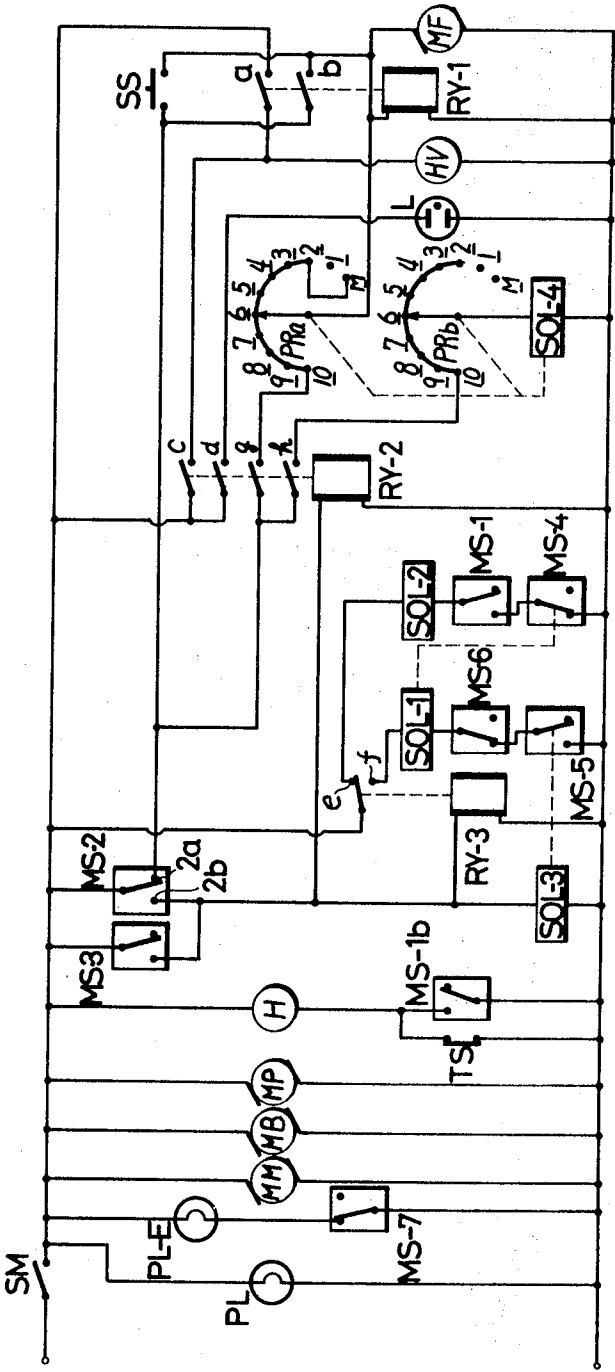
FIG. 4

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FIG. 5



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MULTIPLE-COPY ELECTROSTATIC MACHINE CONTROL

The present invention relates to an improvement in an electrostatic copier and more particularly to an electrostatic copier for automatically making a number of copies from one original sheet.

Conventionally, in case a number of copies were to be made by an electrostatic copier from the same original sheet, inconveniences encountered were that the start switch had to be depressed every time a copy was made and that the number of the copies had to be counted. An object of the present invention is to provide an apparatus for full-automatically making a desired number of copies with high efficiency.

In accordance with the present invention, two preset switches are provided in an electrical circuit for controlling the operations of feeding electrophotographic paper and of copying the original sheet, the contacting member of each of the preset switches being adapted to be set to a desired contact among a plurality of the contacts of the switch. On the other hand, a preset switch is associated with the electrical circuits of a feed motor for driving a feed roller upon being actuated by a start switch and of a relay which closes the self-maintaining contact upon being actuated by a start switch, the preset switch being disposed so as to be in parallel with the start switch. In the circuit of the other preset switch, there is provided a presetting solenoid, and a drive means such as a ratchet mechanism to be driven by the solenoid is associated with the preset dial shaft so that the contacting members of the respective preset switches may be rotated into contact with the contacts of the switches.

The circuit of the start switch and the circuits of the respective preset switches are connected to the main switch in the circuit of the copier through the contact of a microswitch which is adapted to open this contact and close the other contact when the electrophotographic paper reaches the entrance of an exposure station and which is adapted to close the former contact and open the latter contact when the paper leaves the actuating member of the contacts. In the respective circuits of the preset switches are provided two contacts to be opened and closed by means of a relay, and the current is supplied to the relay to close the contacts through the latter contact of the above-mentioned microswitch and another microswitch which is disposed in parallel with the contact of the microswitch and which is adapted to open a contact when the tail end of the electrophotographic paper has passed the exposure station and to keep the contact closed while the electrophotographic paper is passing through the exposure station.

With the structure described above, the object of the present invention can be accomplished. The practical features of the present invention will become apparent from the following description of the embodiment and accompanying drawings, in which:

FIG. 1 is a perspective view of an electrostatic copier embodying the present invention;

FIG. 2 is a front view in vertical section;

FIG. 3 is a schematic perspective view showing the clutch mechanism;

FIG. 4 is a schematic perspective view showing a mechanism for driving a preset dial; and

FIG. 5 is a connection diagram of the electrical control circuit.

Referring to the drawings, the numeral 1 designates a document station to be guided on a main frame 2 along a guide rail 3 and adapted for a reciprocating movement toward the right and left. As already known, the document station 1 includes a glass plate 4 for inspecting the original sheet and a document cover 5. The front face of the main frame 2 is provided with a main switch SM, start switch SS, exposure-adjusting dial 6, preset dial 7, etc. The right side surface is formed with an inlet 8 for feeding electrophotographic paper and the left side surface is provided with an outlet 9 for discharging processed copies and a copy receiver 10.

When a pile of electrophotographic paper is placed through the inlet 8 on a paper table 12 within the main frame 2, a microswitch MS-7 inserted in the circuit of a pilot lamp PL-E shown in FIG. 3 is opened. On the top surface of the pile of electrophotographic paper 11 at the left end is disposed a feed roller 13 to be driven by a feed motor MF.

When the main switch SM is turned on (see FIGS. 2 and 5), a pilot lamp PL is lighted, and a main motor MM is actuated to drive a chain mechanism 14, which further drives paper-driving rollers 15, 16, 17, 18, 19 and 20 and squeeze rollers 22 which are always kept clean by means of a cleaner 21. Furthermore, a fan motor MB is rotated to drive a fan (not shown) and send a blast through a duct 23 into a heat-fusing portion 24. A pump motor MP is also rotated to drive a pump 25 and supply the developer within a tank 26 into a developing device 28 through a conduit 27 and further back into the tank 26. A heater H whose circuit is opened or closed by a thermostat TS is charged to heat the blast supplied to the heat-fusing portion 24 through a duct 23. When the temperature of the heated blast exceeds a certain level, the thermostat is actuated to open the circuit of the heater H, while in case the temperature lowers below a certain level, the circuit is closed.

At the entrance of a path 31 provided in the exposure station A, there is disposed a microswitch MS-2 which is so adapted that, when no electrophotographic paper 11 is in transit, it keeps the contact 2a closed which is connected to the start switch SS while leaving the other contact 2b open and when the electrophotographic paper 11 passes, it opens the contact 2a and closes the contact 2b.

When the start switch SS is turned on, the circuit of the feed motor MF is closed to drive the feed roller 13, whereupon an uppermost sheet in the pile of electrophotographic paper 11 is fed onto the driving rollers 15 driven by the main motor MM and at the same time a relay RY-1 which is connected in parallel with the feed motor MF is energized to close the contacts a and b and generate a high voltage in a charging device HV through the contact a. Through the contact b and microswitch MS-2, the circuits involving the feed motor MF and relay RY-1 are closed, and even when the start switch SS is turned off, the current continuously flows through the feed motor MF, relay RY-1 and charging device HV. The electrophotographic paper 11 fed onto the driving rollers 15 is driven by the rollers 15 and delivered from a guide 29 to the charging device HV where it is sensitized. Further driven along the driving rollers 16, guide 30 and driving rollers 17, the sheet reaches the entrance of the path 31 in the exposure station A.

At the entrance of the path 31 of the exposure station A, there is provided the microswitch MS-2 as aforementioned. When the electrophotographic paper 11 approaching the path 31 comes into contact with the contacting member of the microswitch MS-2, the switch MS-2 opens its contact 2a and closes the contact 2b, thus serving as a changeover switch.

When the contact 2a of the microswitch MS-2 is opened, the circuits including the relay RY-1 and feed motor MF are opened thereby deenergizing the feed motor MF, and the feed roller 13 is therefore halted on the next sheet of the electrophotographic paper 11. Since the relay also gets deenergized, the contacts a and b are opened. Although the supply of current to the charging device HV is consequently interrupted for a moment, the microswitch MS-2 which closes contact 2b permits the relay RY-2 to be energized to close the contacts c and d, so that the current supply to the charging device HV is resumed through the contact c to get the electrophotographic paper 11 sensitized. The lamp L is also turned on through the contact d.

When the contact 2b of the microswitch MS-2 is closed, a stopper release solenoid SOL-3 and relay RY-3 are energized. The stopper release solenoid SOL-3 turns the stopper 32 positioned at the left end of the document station 1 clockwise in FIG. 2 to thereby enable the document station 1 to move leftward while associating the tail end of the stopper 32 with a microswitch MS-5 to get its contact closed.

Upon being energized as above described, the relay RY-3 opens the contact *e* and closes the contact *f*. Thus, when the contact *f* is closed and the contact of the microswitch MS-5 is closed, an actuating solenoid SOL-1 is brought into energization through a microswitch MS-6. (This microswitch is a safety switch which is adapted to be opened only when the document station 1 overruns leftward in FIG. 2 and which otherwise keeps the contact always closed.) The actuating solenoid SOL-1, when energized (see FIG. 3), brings a group of feed gears 33 meshing with a gear at one end of the driving roller 15 into meshing engagement with a clutch gear 34 and rotates the clutch gear 34 in the direction of an arrow M to thereby drive the document station 1 leftward in FIG. 2 by means of a chain sprocket 35 and chain 36 for driving the document station. Furthermore, simultaneously with the meshing engagement of the above-mentioned feed gear group 33, the contact of a microswitch MS-4 inserted in the circuit of the return solenoid SOL-2 to be described later is opened.

The lamp L has already been turned on upon this operation of the aforementioned relay RY-2 and as shown in FIG. 2 the lamp illuminates the original sheet from under the document station 1 by means of light reflectors 37 and 38, the light being adapted to strike the exposure station A by means of reflecting mirrors 40 and 41, a mirror lens 42 and exposure control plate 43 which are disposed in a dark box 39 of the optical system to form the image of the original sheet on the electrophotographic paper 11 passing through the path 31 in the exposure station A and effect exposure.

The undersurface of the document station 1 is provided with an actuating member 44 for the contacting member of a microswitch MS-1. While the actuating member 44 is in contact with the microswitch MS-1, namely only while the document station 1 stays at the right end in FIG. 2, the contact of the microswitch MS-1 is kept open, and upon the document station 1 being initiated into leftward travel, the contact is closed, while when the document station is completely returned, the contact is brought into an open position again. The gear ratio of the group of feed gears 33 is so determined that the speed of feeding the electrophotographic paper 11 may be synchronized with that of the leftward travel of the document station 1.

At the terminal end of the path 31 in the exposure station A there is disposed another microswitch MS-3 which is so adapted that, when the forward end of the electrophotographic paper 11 which has been exposed to the light as aforementioned is brought into contact with the contacting member of the microswitch MS-3, the contact of the switch may be thereby closed. As shown in FIG. 5, the microswitch MS-3 is arranged in parallel with the microswitch MS-2. By the contact being closed, current is supplied to the relays RY-2, RY-3, and stopper release solenoid SOL-3 to actuate respective mechanisms described above.

When the electrophotographic paper 11 has been exposed and the rear end thereof has left the contacting member of the microswitch MS-3 after passing through the exposure station A, the contact of the microswitch MS-3 is opened to terminate the supply of current to the relays RY-2, RY-3 and stopper release solenoid SOL-3. Accordingly, the relay RY-2 opens its contacts *c* and *d* to stop supply of current to the charging device HV and turn off the lamp L. The relay RY-3 gets deenergized to open the contact *f* and close the contact *e* and the current supply to the actuating solenoid SOL-1 is thereby terminated, while the stopper release solenoid opens the contact of the microswitch MS-5 by means of the stopper 32.

The actuating solenoid SOL-1, upon being deenergized (see FIGS. 3 and 5), moves the feed gear group 33 out of the meshing engagement with the clutch gear 34 to thereby halt the leftward travel of the document station 1 and closes the contact of the microswitch MS-4. Since the contact of the microswitch MS-1 has been closed by the leftward travel of the document station 1 as aforementioned, the return solenoid SOL-2 is energized by the contact *e* of the relay RY-3 which

is brought into closed position. By bringing a group of return gears 45 meshing with a gear on one end of a driving roller 17 which is driven by the main motor MM into meshing engagement with a clutch gear 34, the clutch gear is rotated in the direction of an arrow N to drive the document station 1 rightward in FIG. 2 by means of a clutch sprocket 35 and chain 36 for driving the document station. Since there is no need to synchronize the returning movement of the document station 1 with the speed of feeding the electrophotographic paper 11, the gear ratio of the return gears 45 is suitably determined to effect rapid returning movement. When the document station 1 has been returned to the right end in FIG. 2, the actuating member under the document station 1 comes into contact with the contacting member of the microswitch MS-1 to open the contact of the microswitch MS-1, so that the circuit of the return solenoid SOL-2 is opened and the solenoid is deenergized. The return gear group 45 is consequently moved out of meshing engagement with the clutch gear 34, whereby the document station 1 is brought to a halt. Although the left end of the document station 1, during the returning movement of the station, contacts the stopper 32, trouble-free return is ensured since a spring 46 is acting on the stopper 32 as illustrated.

While the operations described are carried out, the electrophotographic paper, passing along the driving rollers 18, guide 47, driving rollers 19 and a guide 48 in the developing device, is brought into contact with the developer, which turns the sensitized image aforementioned into a visible image. With developer squeezed by squeeze rollers 22, it is sent into the heat-fusing portion 24 to be heat-fused with a blast which is supplied through the duct 23 and heated by the heater H. Guided by a guide 49 and driven by driving rollers 20, the sheet is delivered onto the copy receiver 10 through the discharge outlet 9.

It will be apparent from the above description that with the foregoing structure alone, every time the start switch SS is depressed, the electrostatic copier operates to make one copy. Accordingly, in case a number of copies are to be made from an original sheet, the start switch SS must be pushed down every time the document station 1 is completely returned.

In accordance with the present invention as shown in FIGS. 4 and 5, there are provided, in the electrical control circuit of the electrostatic copier, two switches PRa and PRb of rotary type which perform switching action at the contacts of a preset dial 7, each of the switches PRa and PRb being provided with a suitable number, corresponding to the number of the copies, of contacts, M, 1, 2, ..., 10 in circular arrangement. The contacts M, 2, 3, ..., 10 of the switch PRa are connected in series into one circuit, with the contact 1 left independent of the above circuit. As to the other switch PRb, the contacts 2, 3, ..., 10 are connected in series into one circuit and the contacts M and 1 are respectively left alone independently. The switch PRa is connected to the circuit of the start switch SS so as to be parallel therewith and the switch PRb is connected to the circuit including the start switch SS, feed motor MF, and relay RY-1 and to the circuit including the switch PRb, the feed motor MF and switch PRa respectively in parallel connection. In the circuit involving the switch PRb is inserted in series a presetting solenoid SOL-4 whereby a preset dial shaft 50 is driven by means of a ratchet mechanism for switching the preset contacts to be later described so that the contacts of the above-mentioned PRa and PRb may be switched every time a sheet of the electrophotographic paper 11 is subjected to copying operation. Furthermore, contacts *g* and *h* which are adapted to switch the circuits of PRa and PRb are provided in these circuits respectively in series in operative relationship with the relay RY-2 which effects switching action to the contacts *c* and *d* adapted to open and close the circuits of the charging device and lamp L respectively.

Each of the preset switches and the mechanism for operating the same are shown in FIG. 4. Around the insulating discs 51a and 51b fixedly mounted on the preset dial shaft 50 are provided electroconductive plates 52a and 52b of doughnut

shape, contacting members 53a and 53b projecting from a portion thereof serving as changeover switches. Around the electroconductive plates 52a and 52b are respectively disposed contacts M, 1, 2, 3, ... 10 in radial arrangement, the insulating plates being provided with connecting members 55a and 55b which are always kept in contact with the electroconductive plates 52a and 52b. Numeral 56 designates support members for fixedly supporting the insulating plates 54. The presetting solenoid SOL-4 drives a ratchet pawl 58 supported on a shaft 57 and moves a ratchet wheel 59 on the shaft 50 by one pitch at a time.

In accordance with the above structure, in case six copies are to be made from the same original sheet, the original sheet is first set on the document station 1 and the scale of the preset dial 7 is set at 6 thereby bringing connecting members 55a and 55b into contact with the contacts 6 of the switches PRa and PRb.

When the main switch SM and start switch SS are turned on, the electrostatic copier is initiated into copying operation to carry out the same operation as the foregoing until the electrophotographic paper 11 closes the contact of the microswitch MS-3. When the rear end of the electrophotographic paper 11 leaves the contacting member of the microswitch MS-2 to open the contact 2b of the microswitch MS-2 and close the contact 2a, the relays RY-2, RY-3, stopper release solenoid SOL-3 are being supplied with current through the microswitch MS-3. When the contact 2a of the microswitch MS-3 is closed, the relay RY-2 closes the contacts g and h in operative relationship with the contacts c and d, so that through the contact 6 of the preset switch PRa, the relay RY-1 and feed motor MF are supplied with current, the contacts a and b of the relay RY-1 are closed and the feed motor MF is initiated into operation. Thus, a sheet of electrophotographic paper 11 is initiated into feeding operation by the feed roller 13 with a predetermined space apart from a preceding sheet 11 which is being driven through the exposure station A.

On the other hand, the relay RY-2, closing the contact h energizes the presetting solenoid SOL-4, through the contact h and preset switch PRb and turns the ratchet mechanism illustrated in FIG. 4 by one tooth, thereby releasing the contacting members 53a and 53b of respective preset switches PRa and PRb from the contacts 6 onto the contacts 5.

When the rear end of the electrophotographic paper 11 passing through the exposure station A leaves the contact of the microswitch MS-3, the contact of the microswitch MS-3 is opened to deenergize the relays RY-2, RY-3 and stopper release solenoid SOL-3, so that the contacts c, d, and f of the relays RY-2 and RY-3 are opened and the contact e is closed, the return solenoid SOL-2 further being initiated into operation to return the document station 1 as already described. The lamp L is also turned off. Simultaneously with the opening of the contacts c and d of the relay RY-2, the contacts g and h are opened, and the presetting solenoid SOL-4 is deenergized, while through the preset switch PRa the circuit including the feed motor MF and relay RY-1 is opened. However, since the relay RY-1 keeps the contacts a and b closed and the circuit including the contact 2a of the microswitch MS-2 and the contact b of the relay RY-1 is closed, the relay RY-1 keeps the contacts a and b closed in self-maintaining state even when the contact g of the relay RY-2 is opened. The feed motor MF is therefore supplied with current continuously and the charging device HV is also charged through the contact a.

Following the first sheet of electrophotographic paper 11 which has passed through the exposure station A, the second sheet of electrophotographic paper is fed by means of the feed roller 13. The microswitch MS-3, when opened, effects rapid returning movement of the document station 1 while the above-mentioned operation is being carried out, and the contact of the microswitch MS-1, when brought into open position, halts the document station 1. When the forward end of the second sheet of electrophotographic paper 11 reaches the exposure station A and the microswitch MS-2 closes the con-

tact 2b while opening the contact 2a, the current supply to the feed motor MF and relay RY-1 is terminated as already mentioned, while on the other hand the document station 1 is initiated into leftward travel to repeat the foregoing operation. In this manner, each contacting member of the microswitches PRa and PRb is moved into contact with the contacts 5, 4, 3, and 2 in succession to produce the third, fourth, fifth copies. When the contacting members 53a and 53b come into contact with the contacts 1, the sixth sheet of the electrophotographic paper 11 is sent out, since the contacts 1 are independent of the circuits connecting the contacts 2, ... 10 and are not connected to the contacts g and h of the relay RY-2. The forward end of the electrophotographic paper 11, upon reaching the exposure station A, closes the contact 2b of the microswitch MS-2 while opening the contact 2a, with the result that the current supply to the feed motor MF and relay RY-1 is halted. The forward end of the sheet 11 further closes the contact of the microswitch MS-3 and the tail end of the sheet 11, thereafter leaving the contacting member of the microswitch MS-2, further closes the contact 2a of the microswitch MS-2 and opens the contact 2b. Even when the contacts g and h of the relay RY-2 are closed, the preset switches PRa and PRb are open because the contacts 1 are independent. Accordingly, the current is not supplied to the feed motor MF and relay RY-1, nor to the presetting solenoid SOL-4. Therefore, the feed roller 13 is not rotated, nor are the contacting member of the preset switches PRa and PRb rotated by the ratchet mechanism. That is to say, after the sixth (last) sheet of the electrophotographic paper 11 has been sent out, the feed motor MF is no longer driven with the contacts a and b of the relay RY-1 kept open. As a result, when the document station 1 is completely returned and the sixth sheet 11, after being subjected to development and heat fusing, is delivered onto the copy receiver 10, further operation is no longer carried out but respective motors and the like are all brought to a halt by opening the main switch SM.

It will be apparent from the above description that when only one copy is to be made from an original sheet, the main switch SM and start switch SS are turned on with the respective contacting members of the preset switch PRa and PRb brought into contact with the contacts 1 by manipulating the preset dial 7.

Next, in case an indefinite number of copies are to be made, the preset dial 7 is manipulated to bring the contacting members of the preset switches PRa and PRb into contact with the contacts M, and then the main switch SM and start switch SS are turned on. Since the contact M of the preset switch PRb, just as the contact 1, is independent of the other contacts 2, ... 10, the circuit of the presetting solenoid SOL-4 is formed into a closed circuit independently of the action of the other operating members by means of the preset switch PRb, so that the ratchet mechanism is entirely left out of operation. On the other hand, the contact M of the preset switch PRa is connected in series to the contacts 2, ... 10, and accordingly when the contact g is closed by the relay RY-2, the circuit parallel with the start switch SS, namely the circuit of the preset switch PRa is closed. At this time, in case the contact 2a of the microswitch MS-2 is closed and the contact g of the relay RY-2 is also closed, the contacts a and b are closed so as to supply current to the feed motor MF and to render the relay RY-1 self-maintaining.

That is to say, the preset switch PRa, when closed, permits the relay RY-1 to repeat the self-maintaining action every time the electrophotographic paper passes through the exposure station, and the feed roller 13 thereby sends out the electrophotographic paper one sheet after another with a suitable space between sheets, while the reciprocating movement of the document station 1 and repeated movements of other operating members are performed. On the other hand, since the presetting solenoid SOL-4 is left out of operation, the contacting members of the preset switches PRa and PRb are not rotated but remain in contact with the contacts M. That is, the copying operation can be indefinitely repeated.

Indicated as at MS-1b in the drawing is a microswitch adapted for switching action integrally with the microswitch MS-1. The microswitch MS-1b is inserted in the circuit of the heater H in parallel with the thermostat TS to prevent overheating of the device and improper heat-fusing operation and effect heat fusing within an extremely short period of time.

While the foregoing description has been made in respect to an embodiment of a copying machine of the type having a movable document station, the present invention can also be embodied in an electrostatic copier of a type in which exposure is effected by a moving illumination and lens.

What is claimed is:

1. An electrostatic copier with electric circuits comprising a feed motor to drive a paper feed roller by being actuated with a start switch; a relay to close a self-maintaining contact by being actuated with the start switch; a first preset switch having a plurality of contacts connected in parallel with the circuit of the start switch; a second preset switch having a plurality of contacts connected in parallel with the circuit of the relay; a presetting solenoid to switch the contacts of the preset

switches every time a sheet of electrophotographic copy is made; a first pair of switches disposed in the circuits of the preset switches; a second pair of switches disposed in the circuits of a charging device and a lamp; and a relay to actuate the first and second pair of switches.

2. An electrostatic copier as claimed in claim 1 in which the circuits of the start switch and the preset switches are connected with the circuit of a main switch through a first contact of a microswitch to open the first contact and close a second contact when the electrophotographic paper reaches an exposure station and to open the second contact and close the first contact when the electrophotographic paper leaves the actuating member of the first and second contacts.

3. An electrostatic copier as claimed in claim 2 in which a second microswitch is connected in parallel with the second contact of the first-mentioned microswitch to close a contact and supply electricity to the relay and close the first pair of switches when the tail end of the electrophotographic paper has passed the exposure station.

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