

[54] **CIRCUITRY FOR CONTROLLING AN ELECTROSTATIC COPIER**

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3,358,570 12/1967 Morrill et al.355/14
3,503,677 3/1970 Uchiyama355/14 UX
3,099,944 8/1963 Eichorn et al.355/14
3,397,627 8/1968 Bruning et al.355/14 X
3,266,366 8/1966 Hunt.....355/11 X

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[58] Field of Search355/3, 10, 11, 14

[56] **References Cited**

UNITED STATES PATENTS

3,424,526 1/1969 Sacre355/10
3,432,231 3/1969 Gardner.....355/11 X

[57] **ABSTRACT**

A safety relay is serially connected with a manual switch for initiating operation of an electrostatic copier. A first contact of the relay maintains current in the relay coil, a second contact interconnects the power source with a high voltage generating source, and a third contact interconnects the power source with a discharge circuit. A two-position switch has a first position for connecting a voltage storage device to a power source and a second position for actuating a flash circuit. Another relay releases the safety relay with the two-position switch in the second position.

6 Claims, 6 Drawing Figures

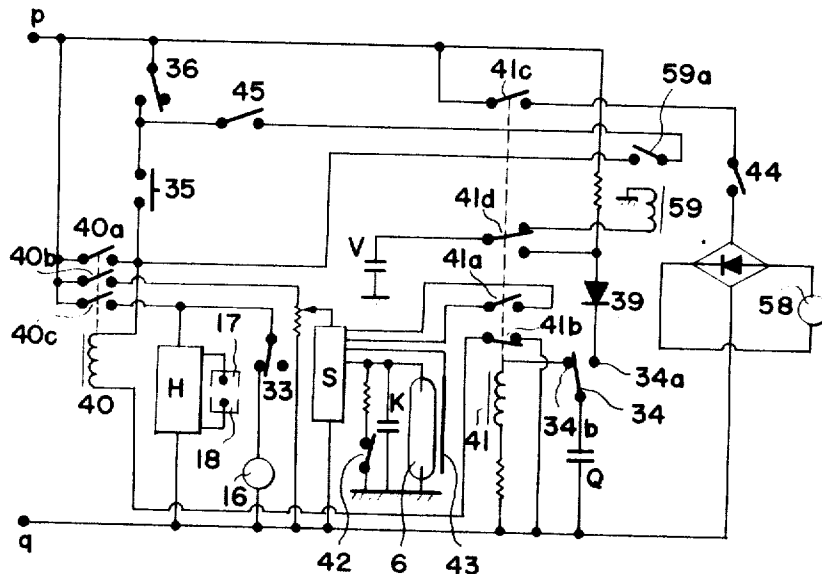


FIG. 1

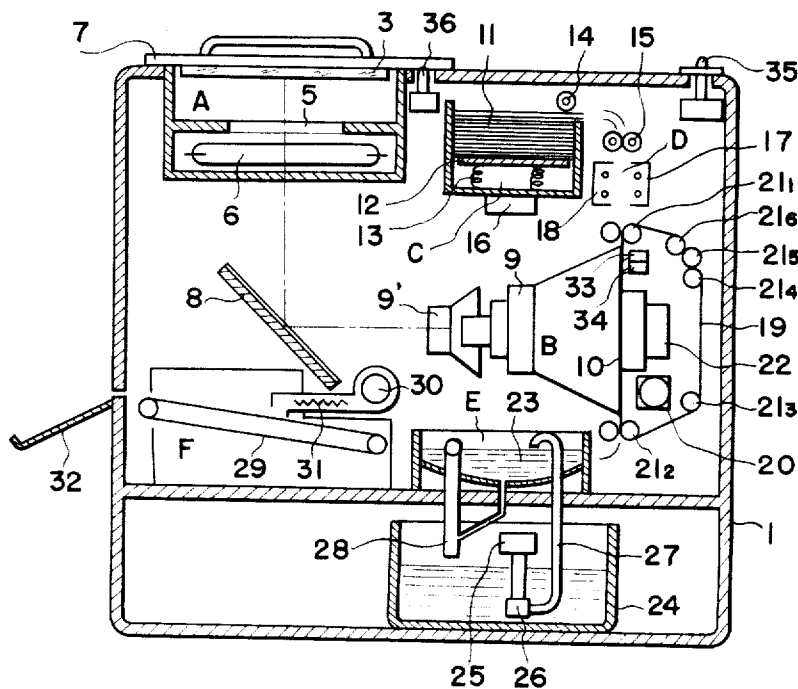
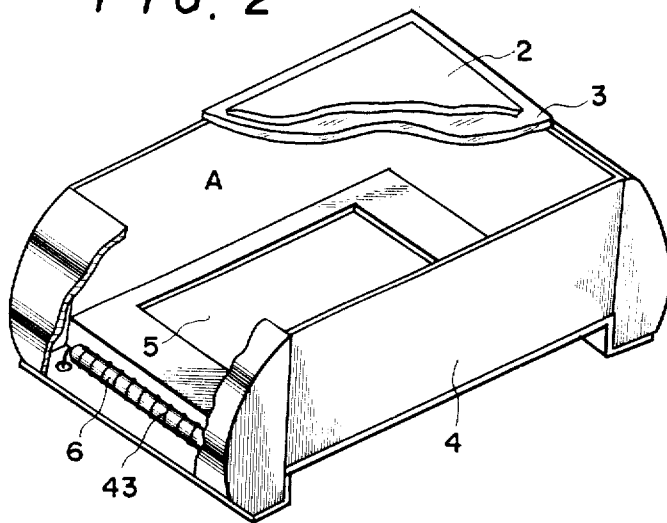


FIG. 2



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FIG. 3

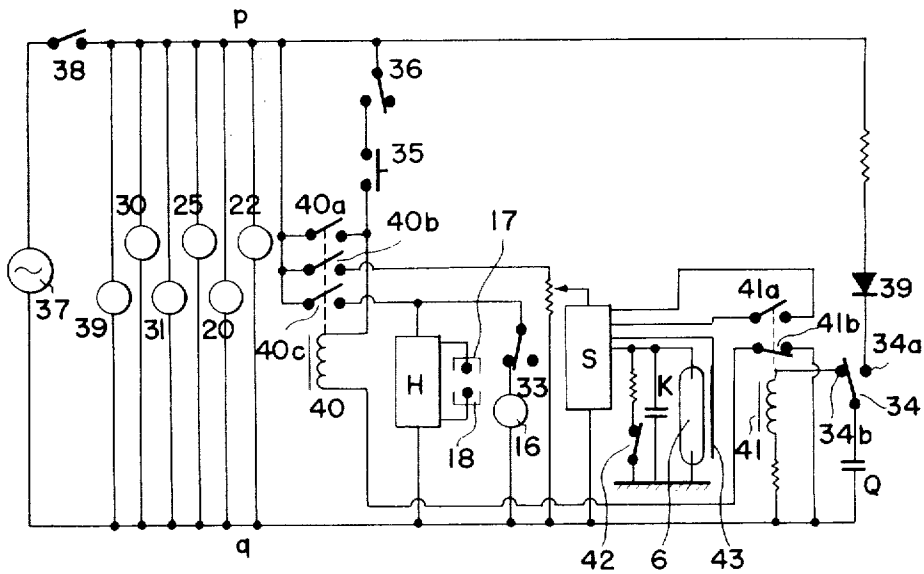
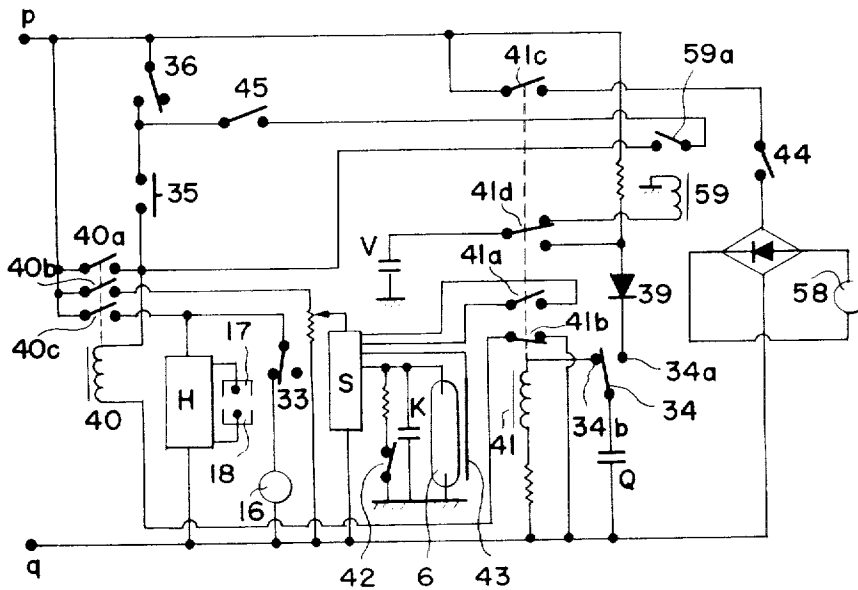


FIG. 4



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CIRCUITRY FOR CONTROLLING AN ELECTROSTATIC COPIER

BACKGROUND OF THE INVENTION

An electrostatic copier is provided with a charging device having a high voltage power source as high as several thousand volts, and makes use of a flash discharge tube requiring a high voltage electric circuit. Prior art electrostatic copier control circuits have not satisfactorily provided sufficient safety to avoid operational mishaps.

SUMMARY OF THE INVENTION

The present invention aims primarily to provide a safety switch circuit for an electrostatic copier control circuit, wherein a safety switch circuit opened in synchronism with the exposure is provided in series with a power switch.

The primary object of the present invention is to provide an electrostatic copier with a safety switch circuit opened in synchronism with the exposure of a given number of copying sheets in order to carry out successive copying.

Another object of the present invention is to provide a safety switch closed manually and opened in synchronism with the exposure of a copy, and a set switch for a number of copying sheets, so as to carry out successive copying from one to several sheets and to stop the operation of the high voltage power source generating circuit in synchronism with the exposure for the successive copying.

A further object of the present invention is to provide an electrostatic copier adapted to operate the driving circuit of a motor by means of the safety switch circuit so as to operate a delivery motor for delivering a photosensitive paper from a photosensitive paper stack in succession to the exposure station while the safety switch circuit is closing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view showing the essential parts of an electrostatic copier of an embodiment in accordance with the present invention.

FIG. 2 is an enlarged perspective view of the original irradiation portion of the electrostatic copier.

FIG. 3 is a circuit diagram of an embodiment in accordance with the present invention.

FIG. 4 is a circuit diagram of another embodiment of the present invention, which is provided with a safety switch circuit added with a switch for setting up number of copying sheets.

FIG. 5 is a perspective view of the switch for setting up the number of copying sheets in the embodiment of FIG. 4.

FIG. 6 is a circuit diagram of the safety switch circuit of another embodiment in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1, in copier case body 1 there are disposed original irradiation portion A, copying portion B, photosensitive paper stack C, charging portion D, developing portion E, and drying and fixing portion F.

Original irradiation portion A is provided in contact with the top surface of case body 1 as shown in FIG. 2 and composed of body 4 having flat glass 3, on the surface of which original 2 is placed. Body 4 is provided on its bottom surface with aperture 5 for emitting light rays of an image of original 2, however, except for aperture 5 body 4 is light tight to prevent the internal light rays from leaking and provided with two flash discharge tubes 6 on both sides inside thereof for illuminating the whole surface of the original instantaneously. The inside of body 4 is formed with irregular reflection surfaces so as to better reflect light rays. And, as shown in FIG. 1, on flat glass 3 there is provided cover 7 for holding down original 2 onto case body 1.

Right below aperture 5 there is provided reflector 8 disposed at an angle of 45 degrees so as to reflect light rays of

an image of original 2. On the optical axis of reflector 8 there is provided copying lens 9 in copying portion B to form an image of original 2 onto image forming surface 10.

Lens 9' is a copying lens for changing the magnification and interchangeable with copying lens 9 as occasion demands so as to form a different magnification in the same way as copying lens 9.

Photosensitive paper stack C is disposed on the upper portion of case body 1, and in the interior thereof a large number of photosensitive papers are piled up on loading plate 12 so that the photosensitive paper on the upmost position is always in contact with delivery roller 14 by being pressed upward by spring 13.

Reference numeral 15 denotes forwarding rollers which forward a photosensitive paper delivered to charging portion D, and roller 14 is driven by delivery motor 16.

Charging portion D is composed of two corona discharge devices 17, 18 facing each other, as well known in the prior art, to give a uniform charging to photosensitive papers delivered one after another.

Reference numeral 19 is a conveyor which transports the photosensitive paper to the copying portion and is driven by a number of carrier rollers 21₁, 21₂, 21₃, - 21_n driven by carrier motor 20. Rollers 21₁ and 21₂ are disposed vertically on the extension of image forming surface 10 of copying portion B. Facing image forming surface, and on the back of conveyor 9, there is disposed air suction mechanism 22 for holding photosensitive paper onto conveyor 9.

Developing portion E is composed of developing tank 23 for developing the photosensitive paper transported from carrier roller 21₂, developer reservoir 24 located under developing tank 23, pump 26 driven by motor 25, pipe 27 for drawing the developer through pump 26 to developing tank 23, and pipe 28 for returning the overflowing developer to reservoir 24, and arranged to develop the photosensitive paper by adsorbing wet toner onto the photosensitive paper on which an electrostatic latent image of original 2 is formed, as it passes through image forming surface 10.

The developed photosensitive paper is transported to drying and fixing portion F by belt 29 and applied to the drying air heated by fan 30 and heater 31 and discharged to tray 32.

On the entrance of the photosensitive paper on image forming surface 10 there are provided two switches 33, 34 in parallel. When the end of the photosensitive paper is sent in switch 33 is opened to shut off the circuit of delivery motor 16. Switch 34 is a charge and discharge change over switch to a condenser for operating a switch mechanism described hereinafter, which is changed over to the charge side when the end of the photosensitive paper is sent in and to the discharge side when the photosensitive paper is in position. Push button switch 35 projecting to the outside of case body 1 is a manual switch for a safety switch circuit described hereinafter and switch 36 is opened and closed by original hold down cover 7.

Next, as for motors 16, 20, 25, flash discharge tube 6, corona discharge devices 17, 18 for charging, air suction mechanism 22, fan 30, heater 31, and a safety switch circuit, referring to FIG. 3, to power source 37 through switch 38 there are connected in parallel with each other pilot lamp 60, fan 30, heater 31, motor 25 for developer circulating pump 26, motor 20 for carrying photosensitive papers, and air suction mechanism 22. In parallel with these parts, as a safety switch circuit for operating a high voltage generating circuit there are connected relay 40 and relay switch 41b—described hereinafter—in series with cover switch 36 closed by covering said original hold down cover 7 and said manual push button switch 35. Relay 40 having relay switches 40a, 40b, 40c are opened and closed thereby. Relay switch 40a is connected to relay 40 in parallel with cover switch 36 and manual push button switch 35, and forms a self-holding circuit for relay 40. And, relay switch 40b is connected to the high voltage power generating circuit S for lighting flash discharge tube 6, and relay switch 40c is connected to the high voltage power generating circuit H which high voltage is impressed on the

electrodes of corona discharge devices 17, 18 in charging portion D.

Usually closed relay switch 41b for the safety switch circuit is opened through the operation of relay 41. Power source 37 is connected to rectifier 39 via power switch 38 and to one terminal 34a of change over switch 34 connecting to condenser Q. The change over switch is operated by the photosensitive paper on the image forming surface 10, and is connected to the terminal 34a side while the photosensitive paper is transported therein, condenser Q is charged through the charge circuit closed by change over switch 34 connected to terminal 34a. Condenser Q is discharged through relay 41, simultaneously the change over switch is changed over to the other terminal 34b side by the passage of the photosensitive paper. In the high voltage power generating circuit for lighting flash discharge lamp 6 condenser K is provided and flash discharge tube 6 is connected in parallel therewith. Short circuit switch 42 in parallel with condenser K is interlocked with power switch 38 so as to be opened when power switch 38 is closed and closed when power switch 38 is opened.

Reference numeral 43 is a trigger electrode of flash discharge tube 6 which is connected to high voltage generating circuit S through relay switch 41a, and closed by relay 41 when change over switch 34 is changed over to the side of contact 34b by the photosensitive paper and triggers the discharge of flash discharge tube 6.

When power switch 38 is closed short-circuit switch 42 is opened and simultaneously pilot lamp 60 is lit, fan 30 starts, heater 31 is excited, motor 25 for developer circulating pump 26 is driven to pump the developer into developing tank 23, carrier motor 20 also starts to rotate to operate conveyor 19, and air suction mechanism 22 also starts to operate, however, change over switch 34 is still on the side of contact 34b and accordingly condenser Q is not charged, the high voltage generating portion is not conductive and delivery motor 16 also is not operated yet.

Thereupon, when original 2 is placed on glass plate 3 in original irradiation portion A and covered with cover 7, cover switch 36 is closed. Next, when manual switch 35 for the safety switch circuit is closed, relay 40 is operated and is self-held by relay switch 40a closed, and the high voltage generating circuit S for flash discharge tube 6 is closed by relay switch 40b, condenser K starts to be charged, the high voltage generating circuit S for corona discharge devices 17, 18 is closed by relay switch 40c, delivery motor 16 is driven through switch 33, photosensitive paper delivery roller 14 interlocked with delivery motor 16 sends out one sheet of photosensitive paper 11 from photosensitive paper stack C which is delivered to the charging portion by forwarding roller 15 to receive an uniform charge onto the whole surface thereof. The charged photosensitive paper charged is adsorbed onto conveyor 9 by air suction mechanism 22 to be delivered to image forming surface 10 by means of conveyor 9, and when the end of the photosensitive paper comes into contact with the actuator of switch 33, switch 33 is opened to stop the rotation of delivery motor 16. Further, when the end of the photosensitive paper operates change over switch 34, change over switch 34 is changed over from contact 34b to contact 34a to start to charge condenser Q. When the photosensitive paper passes through and is located just on image forming surface 10, change over switch 34 is changed over from contact 34a to contact 34b to allow the discharge current of condenser Q to operate relay 41. And accordingly, relay switch 41b is opened, relay 40 for the safety switch circuit is demagnetized to break its self-holding, and simultaneously relay switches 40b, 40c are opened, so that the safety switch circuit is not closed as long as push button switch 35 is not pushed down again and high voltage generating circuits S and H are shut off.

The aforesaid operation of relay 41 closes relay switch 41a at the same time to impress the trigger voltage onto trigger electrode 43 of flash discharge tube 6 and allow condenser K to discharge into flash discharge tube 6 to emit light. The lighting time of flash discharge tube 6 is very short, about 300

microseconds (μ Sec.) or so, so that even though conveyor 9 is not stopped and the light image of original 2 is irradiated and accordingly its latent image is formed on the photosensitive paper. In synchronism with the finishing of discharge of condenser Q relay 41 is demagnetized, and relay switch 41b is closed and relay switch 41a is opened to return to its original position.

In the embodiment shown in FIG. 4 a switch for setting up a number of copying sheets is added to the embodiment described above so as to open a safety switch circuit after copying for the desired number is carried out in succession.

In FIG. 5, index 51 on dial 50 faces scale plate 52 marked with M 1 2 3 ---, and onto dial axle 53 ratchet 54 and two cam plates 48, 49 are fixed rigidly, and on cam plates 48, 49 actuators 46, 47 of dial switches 44, 45 are arranged to come into contact therewith to operate dial switches 44, 45 respectively. Cam plate 48 is adapted to open dial switch 44 only when index 51 of the dial indicates scale 1 or M, and cam plate 49 is adapted to open dial switch 45 only when index 51 of the dial indicates scale 1.

Reference numeral 58 denotes a solenoid for turning lever 56 pivoted on pin 57 clockwise, and pawl 55 of lever 56 turns ratchet 54 by one tooth portion to turn the dial by one scale counter-clockwise.

Solenoid 58 is connected as shown in FIG. 4 in series with relay switch 41c, closed by relay 41, and dial switch 44.

To the power source through relay switch 41d of relay 41 there is connected condenser V which is charged through the operation of relay 41, and when relay 41 is demagnetized the charge current of condenser V is discharged through another relay 59 by relay switch 41d.

In parallel with manual push button switch 35 there is formed a circuit in which dial switch 45 and relay switch 59a, closed by relay 59 are connected in series.

Now, provided dial 50 is set up for two copies or more, after power switches 38 and cover switch 36 are closed, when manual push button switch 35 is pushed down, at the termination of the first copying relay 41, is operated by the discharge current of condenser Q to open relay switch 41b and release the self-hold of relay 40 for the safety switch circuit. However, at the same time relay switch 41d is changed over to the charge side to charge condenser V and in synchronization with demagnetization of relay 41 relay switch 41d is changed over to the discharge side to operate relay 59 to close relay switch 59a, so that manual push button switch 35 is short-circuited in parallel therewith through dial switch 45, and the safety switch circuit is closed in the same manner as push button 35, so as to operate relay 40.

Further, through the operation of relay 41 relay switch 41c is closed to operate solenoid 58 through dial switch 44, and accordingly by means of pawl 55 of lever 56 ratchet 54 is turned by one tooth portion to turn the dial to drop one step from the scale dial index. In this manner, when the scale of the dial reaches 1 dial switches 44, 45 are opened, so that the circuit in parallel with manual push button switch 35 as described above, is not closed through the operation of relay 41 and accordingly the self-hold for the safety switch circuit by relay 40 is broken, and the solenoid circuit is not closed and accordingly the high voltage power generating circuit is shut off.

Furthermore, when dial 50 is put together with scale M, dial switch 44 is opened, and the dial stops without turning for every copy. On the other hand, dial switch 45 is closing so that the circuit in parallel with push button switch 35 is closed for every copy to maintain the self-hold of relay 40 for the safety switch circuit, so as to do repeated copying continuously until power switch 38 or cover switch 36 is opened. In the embodiment shown in FIG. 6, condenser V, relay 59, and the circuit in parallel with manual push button switch 35 and having relay contact 59a in the embodiment shown in FIG. 4, there is provided a circuit in which dial switch 45 in parallel with relay switch 41b is opened through the operation of relay 41, and normally open relay switch 41d is closed through the opera-

tion of relay 41 are connected in series. As long as the dial is set up for scale M or over two the self-hold of relay 40 is continued and when the dial indicates scale I its self-hold is cut.

I claim:

1. A circuit for controlling an electrostatic copier having a corona flash discharge circuit, a flash circuit for irradiating original documents and a high voltage flash generating circuit and a power source, comprising:
 - a manually operated switch for initiating operation of said copier,
 - a safety relay including an operating coil serially connected to said manually operated switch, said safety relay including a first contact for maintaining current in said coil, a second contact interconnecting said power source with said high voltage generating source, and a third contact interconnecting said power source with said corona discharge circuit,
 - a first switch and a voltage storage means connected thereto, said first switch having a first position for connecting said voltage storage means to said power source and a second position for actuating said flash circuit,
 - a relay having an operating coil connected to said first switch in said second position, a first contact actuated by the operation of said operating coil for releasing said safety relay, a second contact closed by the operation of said coil for the actuation of said flash circuit.
 2. A circuit as in claim 1 wherein said relay includes third and fourth contacts, and further comprising a second relay including a second operating coil and a first contact, a dial switch serially connected to said first contact and said first contact of said safety relay, said dial switch and said first contact are in parallel with said manually operated switch for maintaining the operativeness of said circuit during multiple copying,
- second voltage storage means connected to said third con-

- tact whereby with said third contact in a first position said second voltage storage means is connected to said second operating coil with said third contact in said first position and said voltage storage means is connected to said power source with said third contact in said second position and said first contact is opened, and
- means for indicating the number of copies interconnected to said power source through said fourth switch contact.
3. A circuit as in claim 1, further comprising, a second switch serially connected with said manually operated switch and closed in response to the preparation of a document for copying at a copying station.
4. A circuit for controlling an electrostatic copier as set forth in claim 1 further comprising:
 - a photosensitive paper stack, a delivery roller for delivering a sheet of photosensitive paper from said photosensitive paper stack, a delivery motor driving said roller, and a circuit for actuating said delivery motor in response to the closing of said manually operated switch.
5. A circuit for controlling an electrostatic copier as set forth in claim 2 further comprising:
 - means for setting the number of sheets to be copied;
 - means for incrementally decreasing said number in response to the actuation of said flash circuit;
 - switching means in parallel with said manually operated switch, a third relay actuated by the closing of said second contact for closing said switching means to maintain current in the operating coil of said safety relay.
6. A circuit for controlling an electrostatic copier as set forth in claim 5 wherein said means for setting the number of sheets to be copied includes a numbered dial, a cam mounted to rotate with said dial and said switching means includes a third switch actuated by said cam with said dial set at 1.

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