

[54] **DESK-TOP ELECTROSTATIC COPYING MACHINE**

[75] Inventors: **Giovanni Ravera**, Turin; **Nicola Cosmo**, Ivrea, Turin; **Giorgio Siletto**, Turin, all of Italy

[73] Assignee: **Ing. C. Olivetti & C. S.p.A.**, Torino, Italy

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[51] Int. Cl. .... **G03g 15/00**

[58] Field of Search ..... **355/3, 8, 10, 11, 355/14, 51, 66, 67, 71, 16**

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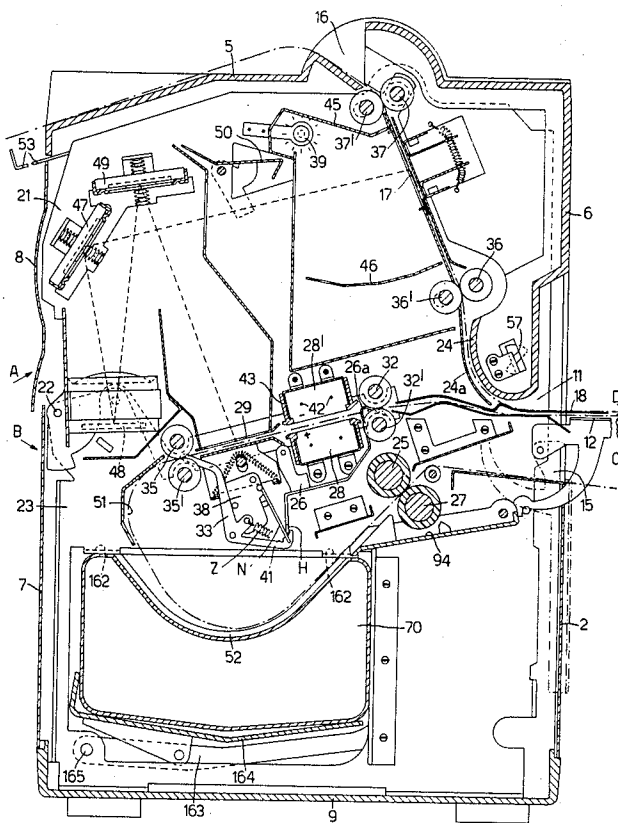
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*Primary Examiner*—Robert P. Grenier  
*Attorney*—Harold J. Birch et al.

[57] **ABSTRACT**

A desk-top electrostatic copying machine comprising a lower section, an upper section pivotally attached to the lower section, and a front section pivotally attached to the upper section. The lower section contains a copy paper charging station, a copy paper exposure station, and a copy paper developing station, all disposed along a copy paper flow path. The copy paper flow path is defined by bottom elements carried by the lower section and top elements carried by the upper section, so that when the upper section is opened the flow path of the copy paper is exposed. The upper section contains an original paper illuminating station and an optical system for projecting the image of the original paper from the illuminating station to the copy paper exposure station. An original paper flow path is defined by bottom elements carried by the upper section and top elements carried by the front section so that when the front section is pivoted to the open position the flow path of the original paper is exposed.

**7 Claims, 5 Drawing Figures**



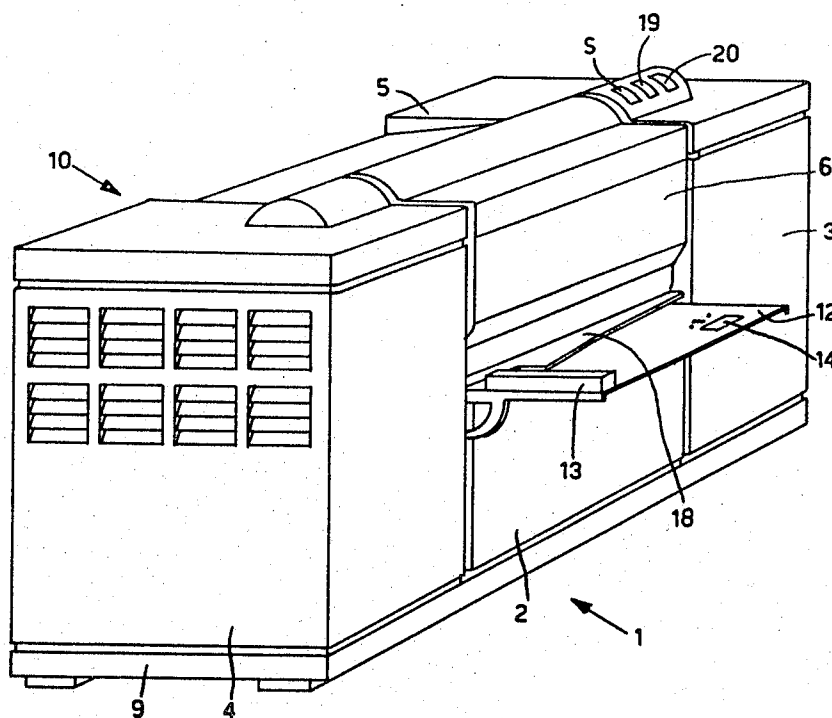


Fig. 1

INVENTOR  
GIOVANNI RAVERA-NICOLA COSMO  
GIORGIO SILETTO

BY

ATTORNEYS

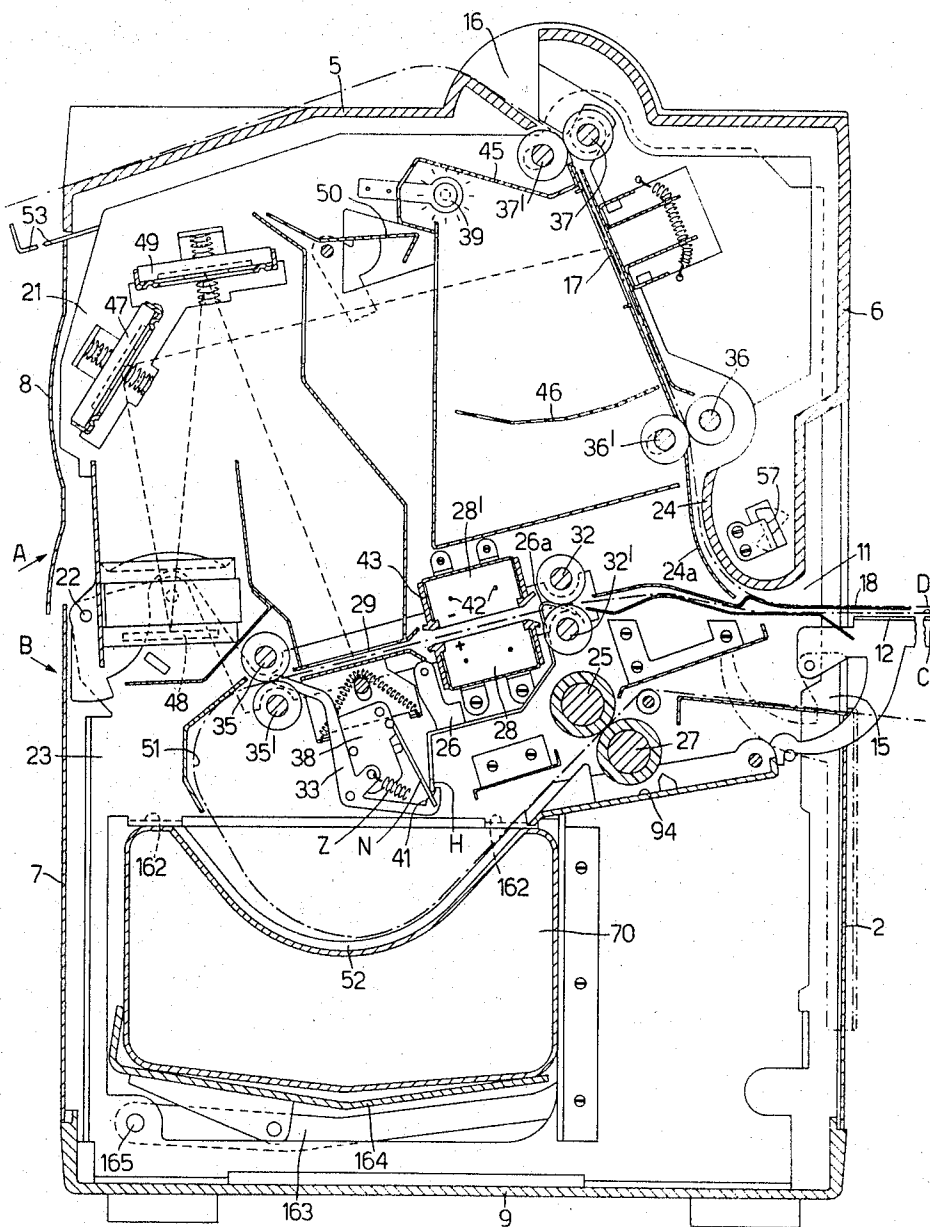


Fig. 2

INVENTOR  
GIOVANNI RAVERA - NICOLA COSMO  
GIORGIO SILETTO

BY

ATTORNEYS

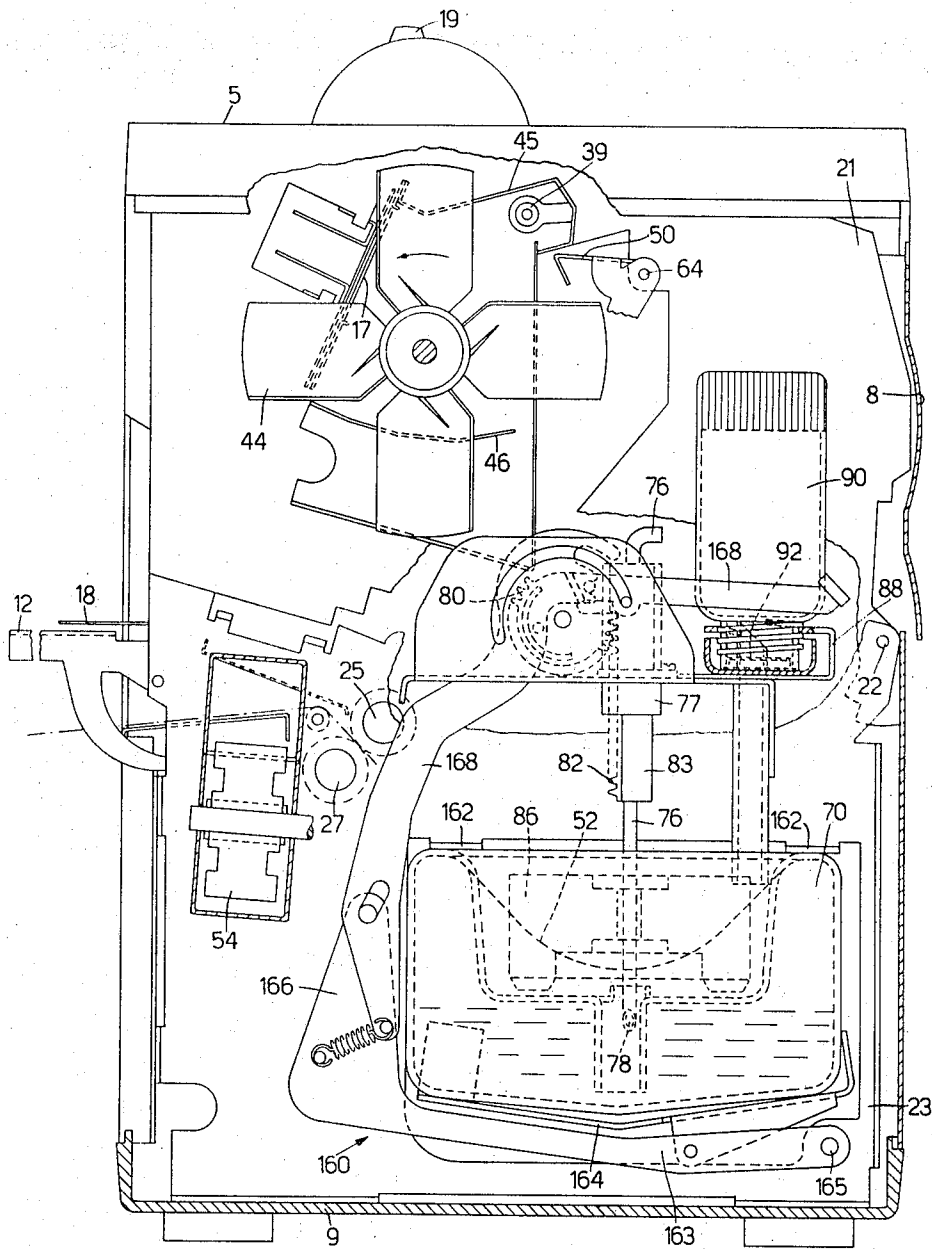
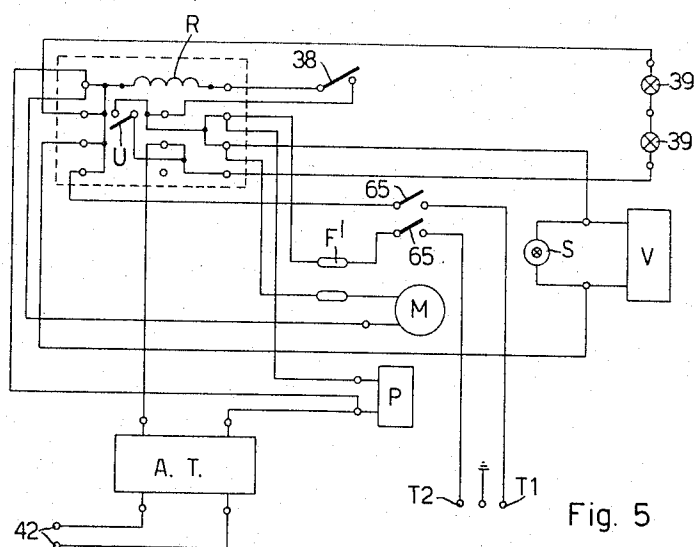
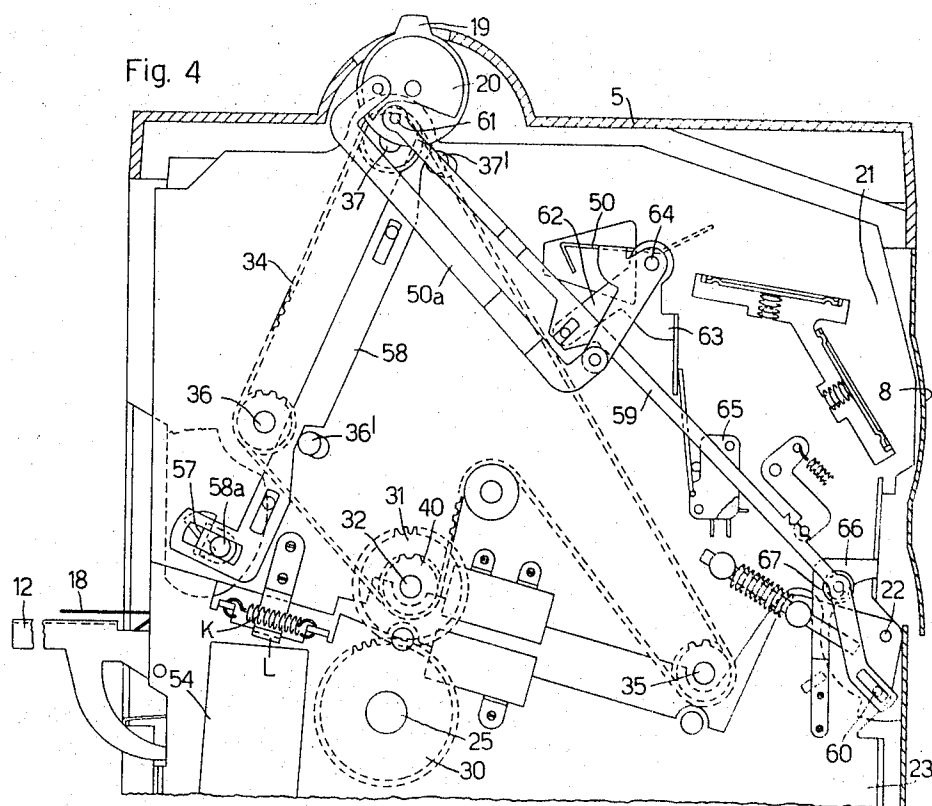


Fig. 3

INVENTOR  
GIOVANNI RAVERA-NICOLA COSMO  
GIORGIO SILETTO

BY

ATTORNEYS



INVENTOR  
GIOVANNI RAVERA-NICOLA COSMO  
GIORGIO SILETTO  
BY

ATTORNEYS

## DESK-TOP ELECTROSTATIC COPYING MACHINE

The present invention relates to a desk-top electrostatic copying machine which, although it has an extremely simple and compact structure and is light in weight, is furthermore improved in performance. A desk top machine is small enough to stand on a desk, in contrast to floor standing machines.

The object of this invention is to provide a machine in which the paths of the original and copy sheet are properly accessible for clearing paper jams.

According to the invention there is provided a desk top electrostatic copying machine comprising a lower part containing a developing station and an upper part hinged thereto, the upper and lower parts being provided with means for driving a copy sheet through a path lying between the said two parts and passing through a charging station having means for charging the copy sheet, and then through an exposing station, whereby, when the upper part is hinged open, the said path is opened out, the charging and exposing stations lying above the developing station and a deflector being provided for causing the exposed copy sheet to double back through the developing station after leaving the exposing station, the upper part having a third part hinged thereto, the upper and third parts being provided with means for driving an original through a second path lying between these two parts and passing through an illuminating station, whereby, when the third part is hinged open, the said second path is opened out, the upper part further comprising an optical system for illuminating the original at the illuminating station and projecting an image thereof on to the copy sheet at the exposing station as the original and copy sheet are driven simultaneously through the illuminating and exposing stations.

The preferred embodiment incorporates safety interlocks which ensure that the power is off when the machine is opened.

A preferred embodiment will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a front perspective view from the left of a copying machine;

FIG. 2 is a median sectional view of the machine;

FIG. 3 is a side view of the machine from the right with the cover removed;

FIG. 4 is a partial side view of the machine with the cover removed, likewise from the right; and

FIG. 5 is a circuit diagram illustrating the operation of the machine.

The machine embodying the invention constitutes an improvement in the electrostatic copying machine illustrated in U.S. Pat. No. 3,498,709 with a system for replenishing the developer which is a further improvement in the system illustrated in British Patent No. 1,194,847.

FIG. 1 shows a desk-top electrostatic copying machine 1 having a body 10. The body 10 is arranged in such manner as to ensure perfect light-tightness in the machine so as to avoid leakage of the charge from the copy sheet.

The body 10 is formed of upper and lower parts A and B (FIG. 2). The lower part B comprises end sections 3 and 4 (FIG. 1), central sections 2 and 7 therebetween (FIG. 2), all mounted on a base 9. The upper section A can be swung upwardly as a whole on pivots

22 at the back of the machine and comprises a cover 5, upper central section 8 and also an upper front section 6 which is hinged on the part A by hinges 57 allowing the section 6 to be swung forwardly through about 60° to open up the path of the original. Hinging up the part A (through about 35°) opens up the path of the copy sheet. The walls of the side sections 3 and 4 are removable for maintenance and interchanging the developer tank.

At the front of the machine there is a slot 15 for receiving the original D above a separator 18 and the copy sheet C below the separator. To assist collation and insertion, the separator 18 has an inclined leading edge (see FIG. 1) and lies just above a table 12 which is swung up to a horizontal position for use but which can be staved flat against the section 2. A side edge guide 13 on the table 12 is movable in a graduated slot 14 for adjusting to different paper widths.

The original, face downwards, is driven through an ascending path past an illumination station 17 and out through a slot 16 between the cover 5 and part 6. The copy paper, photoconductive side upwards (e.g., a zinc oxide coating) is driven towards the back of the machine through a charging station 28 and exposure station 29, following a path inclined downwardly and which then turns sharply downwards, doubles back through a developing station 52, the copy finally emerging through a slot 15 below the table 12. The original drops on to the cover 5 which can be extended rearwardly by retractable arms 53.

The copier is actuated by a small electric motor not shown in the drawing and a starting and stopping knob 19 is mounted on the cover 5 of the body for supplying the motor which transmits the motion to the feed system for the copy and the original. At the side of the knob 19 a warning light S indicates that the machine is in operation. On the other side of the knob 19 there is arranged a second knob 20 by means of which the operator adjusts the exposure to suit for the original to be copied.

The upper part A of the machine houses all the optical parts, these being mounted between side plates 21 which are hinged by the afore-mentioned hinges 22 to lower side plates 23.

At the point of entry of the documents the separator 18 curves upwardly to deflect the original up between a guide plate 24a integral with the plates 23 and a guide plate 24 which is formed by an inwardly curved portion of the cover of the upper, front central portion 6. The original is engaged by rubber rollers on shafts 36 and 36' driven up through the illuminating station 17, and engaged by further rollers on shafts 37 and 37' which eject the original through the slot 16. The shafts 36 and 37 are mounted in the portion 6. The shafts 36' and 37' on the other hand are mounted in the part A, being spring biased (by springs not shown) towards the shafts 36 and 37.

It will therefore be seen that, when the part 6 is swung open, the path followed by the original D is completely opened up so that any paper jam in this path can be easily rectified. When the part 6 is swung open, pins 58a (FIG. 4) push up two sliders 58 with cam tracks 58b which cam the shafts 36' and 37' away from the shafts 36 and 37.

The operator pushed the original and copy paper into the mouth 11 with their leading edges in registration. As soon as the rollers on the shaft 36 and 36' pick up

the original, the rollers on two shafts 32 and 32' pick up the copy paper and drive it with the same speed as the original, firstly through the charging station 28 and then through the exposure station 29 to rollers on shafts 35 and 35'. The latter rollers drive the exposed copy paper down through a guide 51 which doubles the paper back through the developing station 52, thence to squeegee rollers 25 and 27 which eject the copy through the outlet 15.

The shafts 32 and 35 are journaled in the top part A. The shafts 32' and 35' are journaled in the lower part B and spring-biased towards the shafts 32 and 35. At the charging station, upper and lower charger housings 28' and 28 are fixed to parts A and B respectively and house corona discharge wires 42. The housings are tilted so that the paper follows a downwardly inclined path towards the back of the machine. Each housing has insulating sides 43 which have bevelled edges adjacent the path of the paper. Thin threads of nylon for example are stretched between the walls 43 of each housing, across the mouth of the housing facing the paper, to prevent paper feeding into either housing. In operation the wires 42 in the upper and lower housings 28' and 28 are supplied with negative and positive voltages respectively.

At the exposure station the paper passes between upper and lower guide plates fixed to parts A and B respectively, the upper plate being transparent.

It can now be seen that, when the top part is hinged open the parts fixed thereto separate from the parts fixed to the lower part B and the whole path of the copy paper as far as the deflector 51 is opened out for clearing paper jams. The parts A and B are normally held closed by arms L which engage springs K (FIG. 4).

The motor (not shown) drives the roller 25 via a worm gear. The roller 25 carries a gear 30 (FIG. 4) which meshes with a gear 31 on the shaft 32 when the part A is closed on to the part B. A toothed pulley 40 on the shaft 32 drives the shafts 36, 37 and 35 via corresponding pulleys and a toothed belt 34. The optical system is wholly mounted in the part A and comprises two lamps 39 with reflectors 45 and 46 (FIG. 2) which illuminate the original through a transparent plate at the station 17. The image of a strip of the moving original is reflected by a front-silvered mirror 47 to a reflecting objective 48 with a nominal focal length of 135 mm and an aperture of 4.5 mm, thence to another front silvered mirror 49, and thence to the moving copy paper at the exposure station. The light path lengths are such that the image is reproduced at the exposure station with a reproduction ratio of 1:1. A fan 44 (FIG. 3) cools the lamps. The reflecting surfaces of the mirrors are coated with a layer of silicon monoxide. The illustrated folded, crossing light path makes for compactness.

The exposure control knob 20 (FIG. 4) controls a vane 50 via a lever 50a and the vane partially obscures the ray paths from the original to the mirror 47 and can thus be used to adjust the light flux passing to the copy paper.

The background areas of the original to be copied may have various reflection characteristics and it is therefore necessary to provide means for varying the amount of light to be used in the exposure station. With experience, the operator will be able to gauge the adjustment required according to the types of surfaces of the originals and to achieve the optimum conditions of

exposure of the original on the copy sheet. The control 20 is designed so as to provide five different levels of intensity of illumination.

After exposure, the copy sheet is conveyed by the rear semi-circular guide or deflector 51 to the developing station 52, while at the same time the original is ejected through the slot 16.

At the developing station 52 there is a platform unit 160 for supporting the developer container 70 and comprising a platform 164 pivoted on an arm 163 fulcrumed on a shaft 165 and movable between a lower loading and unloading position and an upper working position. A connecting extension 166 of one of the arms 163 is connected at its upper end to a lever 168, which can be raised and lowered manually by means of a crank. The removable and disposable developer container 70 is positioned in the platform unit 160. The container is made of plastics material and is shaped in such manner as to constitute a developing tank 52 which is concave at its upward-facing surface and is thus adapted to receive the copy sheet coming from the exposure station 29. The developer container 70 is sealed when it is initially inserted in the machine in order to prevent upsetting both during the period of storage and during the operation of insertion. During this introduction, the platform 164 is in its lower position, thus allowing the container to be slipped easily into place. This having been done, by raising the lever 168, the platform 164 swings upward and forces the developer container to make contact with stop tongues 162, which hold it clamped in the working position. In this position, the container is ready for supplying the developer to the tank 52.

In the lower part B of the copier are mounted an air pump, which is not shown in the drawing, and a pipe 76 leading from the pump to the container. A portion of the pipe passes through a guide column 77 and a slide 83 telescoping within the column 77 and its end 78, which is inserted in the container, is formed of rigid material and had a chamfered cutting edge for perforating the sealed opening of the container. Moreover, a second perforating element (not shown) descends together with a pipe 76 to make a second opening in the developer container, so that the developer can pass into the developing tank 52. The pump supplies air to the container 70 through the pipe 76, forcing the developer into the tank through the opening punched by the second perforating element. The crank which operates the lever 168, in addition to positioning the platform 164, also controls the position of the slide 83 for moving the cutting-edge end 78 of the pipe 76 and the second perforating element downwardly. Thus the crank has a toothed sector 80 adapted to mesh with a rack 82 on the slide 83. At the same time as the developer container is raised into position, the toothed sector 80 operates the rack 82, compelling the pipe 76, its chamfered end 78 and the second perforating element to move downwardly, thus cutting openings in the developer container. On the other hand, when the container must be replaced, the crank and lever 168 lower the platform 164 to its lower position, through the connection 166, thus releasing the container and also raise the slide 83 and withdraw the pipe 76 and the second perforating element from the container.

A float 86 mounted slidably on the pipe 76 within the developing tank controls the level of the developer in the tank. When the developer has reached its working

level, the float compels the air to divert from the container, interrupting any flow into the tank. When the level of the developer falls, the float 86 again directs the flow of air through the pipe into the container, filling the developing tank. By disconnecting the supply from the copier, the developer in the tank flows back into the container. For a more complete description of the construction and the mode of operation of the developer container, reference should be made to the aforesaid British Patent No. 1,194,847.

Above the upper right-hand part of the container and separated from it, there is fixed a holder 88 for a bottle 90 for replenishment with concentrated developer. The bottle is screwed into the holder, which is provided with a perforating tube 92 communicating with the subjacent tank 52. The screwing action causes the perforation of the sealed diaphragm of the bottle and the flow of the concentrate into the tank, whence it is mixed with the developing liquid exhausted by the execution of an operative cycle of the machine.

Disposed a little above the developing station and in front thereof is the pair of squeegee rollers 25, 27 for receiving the copy sheet after its passage through the developing tank 52 and ejecting it through the exit 15. The outer surface of the rollers is made of rubber or similar material for removing the surplus developing liquid from the copy sheet. A drip plate 94 is pivoted on the side walls 23, for returning the developing liquid from the rollers 25 and 27 to the tank.

Positioned on the right side of the machine, close to the front, there is a centrifugal blower 54 (FIG. 3) which distributes air over the copy sheet while it passes from the rollers 25, 27 towards the exit 15. Towards the rear part of the right side of the copier is located the aforesaid motor, which is connected by means of a worm gear to the gear 30 mounted on the end of the roller 25. The motor also drives the blower 54.

The machine is powered via a two-pole microswitch 65 (FIG. 4). The switch knob 19 moves an eccentric pin 61 linked to one end of a lever 59. This lever in turn is linked via levers 62 and 63 on a shaft 64 to the microswitch. The lower end of the lever 59 engages over a pin 60 fixed to the lower part B and, when the upper part A is hinged open, the pin pulls down the lever 59 and switches the power off. This mechanical interlock assures complete safety in clearing jams of the copy paper.

Another interlock prevents the machine being switched on when the side cover 3 is removed for changing the developer tank. Thus a leaf spring 66 engages a roller 67 on the lever 59. The leaf spring 66 is moved clear of the roller by a projection (not shown) on the cover 3.

Referring to FIG. 5, when the switch 65 is on, one supply terminal T<sub>1</sub> is connected to linked terminals of a relay 9 and thence to the motor M, pump P, warming lamp S and a fan circuit V which drives the fan in a modification in which this has a separate motor. The live terminal T<sub>2</sub> is connected through a fuse F' and further linked terminals for energising the aforementioned items.

The lamps 39 and a high voltage circuit A<sub>r</sub> for supplying the corona wires 42 are only energised when a copy sheet is actually passing through the machine. To this end, the end 26a of a lever 26 (FIG. 2) projects into the path of the copy paper just past the first rollers, whereby a microswitch 38 is closed via a projection H

of the lever 26 and an arm N of the microswitch. When the switch is closed and the relay R energised, contacts U connect the live terminal to the lamps 39 and circuit A<sub>r</sub>. The lever 26 is latched in the "on" position by a lug 41 of another lever 33 which lever extends into the path of the copy paper adjacent the second set of rollers. The lever 33 is rotated anti-clockwise by the copy paper against the action of a spring Z. When the trailing edge of the copy paper passes through the second rollers, and is thus fully clear of the exposure station 29, the spring Z restores the lever 33, whereby the lever 26 is unlatched, the switch 38 goes off, and the relay R is de-energised. If discharge lamps with heated filaments are used it can be arranged that these are energised all the time the switch 65 is closed to keep the lamps warm and ready to strike as soon as the relay R operates.

What we claim is:

1. A desk top electrostatic copying machine comprising a lower part containing a developing station and an upper part hinged thereto, the upper and lower parts being provided with means for driving a copy sheet through a path lying between the said two parts and passing through a charging station having means for charging the copy sheet, and then through an exposing station, whereby, when the upper part is hinged open, the said path is opened out, the charging and exposing stations lying above the developing station and a deflector being provided for causing the exposed copy sheet to double back through the developing station after leaving the exposing station, the upper part having a third part hinged thereto, the upper and third parts being provided with means for driving an original through a second path lying between these two parts and passing through an illuminating station, whereby, when the third part is hinged open, the said second path is opened out, the upper part further comprising an optical system for illuminating the original at the illuminating station and projecting an image thereof on to the copy sheet at the exposing station as the original and copy sheet are driven simultaneously through the illuminating and exposing stations.

2. A copying machine according to claim 1, wherein the said means for driving the original and copy sheet comprise pairs of rollers, the two rollers of each pair being mounted respectively on the upper and lower parts or respectively on the upper and third parts and including a driven roller provided with a pulley, the pulleys being coupled by a belt.

3. A copying machine according to claim 2, wherein the pulleys and belt are toothed.

4. A copying machine according to claim 2, wherein one driven roller is mounted on the upper part and coupled to a motor via gears which engage when the upper part is closed down on to the lower part.

5. A copying machine according to claim 1, wherein the optical path from the illuminating station to the exposing station is a folded, crossing path via a plurality of mirrors.

6. A copying machine according to claim 1, wherein the optical system comprises a vane adjustably positionable under manual control in the light path from the illuminating station to the exposing station for controlling the exposure of the copy sheet.

7. A desk-top electrostatic copying machine comprising:

a lower section,

a copy paper developing station in said lower section,

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means defining the bottom of a copy paper flow path  
from a copy paper inlet to said developing station  
mounted in said lower section,  
a copy paper charging station disposed along said  
copy paper flow path between said copy paper inlet 5  
and said developing station,  
a copy paper exposure station interposed along said  
copy paper flow path between said charging station  
and said developing station,  
an upper section pivotally attached to said lower sec- 10  
tion and movable between an open position and a  
closed position,  
means defining the top of said copy paper flow path  
carried by said upper section and movable there- 15  
with between said closed position wherein said  
means defining the top of said copy paper flow path  
and said means defining the bottom of said copy  
paper flow path cooperate to provide a flow path  
through which copy paper can move and said open 20  
position wherein said means defining the top of  
said copy paper flow path is spaced from said  
means defining the bottom of said copy paper flow  
path to allow access thereto,  
copy paper drive means for moving said copy paper 25  
along said copy paper flow path,  
a front section pivotally attached to said top section

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and movable with respect thereto between an oper-  
ating position and an access position,  
an original paper illuminating station is said upper  
section,  
optical means in said upper section for projecting an  
image of the original paper at said illuminating sec-  
tion upon said exposure station,  
means defining the bottom of an original paper flow  
path from an original paper inlet to an original  
paper outlet mounted in said upper section,  
means defining the top of said original paper flow  
path carried by said front section and movable  
therewith between said operating position wherein  
said means defining the bottom of said original  
paper flow path and said means defining the top of  
said original paper flow path cooperate to provide  
a flow path through which the original paper can  
move and said access position wherein said means  
defining the top of said original paper flow path is  
spaced from said means defining the bottom of said  
original paper flow path to allow access thereto,  
and  
original paper drive means for moving said original  
paper along said original paper flow path.  
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