United States Patent [19]

Takahashi et al.

[11] **3,883,242**

[45] **May 13, 1975**

[54] **ELECTRONIC PHOTOGRAPHIC COPYING MACHINE**

[75] Inventors: **Isao Takahashi**, Yokohama; **Motoharu Fujii**, Tokyo; **Kazuo Kawakubo**, Tokyo; **Masao Ariga**, Tokyo; **Susumu Sugiura**, Yamato, all of Japan

[73] Assignee: **Canon Kabushiki Kaisha**, Tokyo, Japan

[22] Filed: **July 23, 1973**

[21] Appl. No.: **381,399**

Related U.S. Application Data

[62] Division of Ser. No. 211,276, Dec. 23, 1971.

[30] **Foreign Application Priority Data**

Dec. 29, 1970 Japan 45-12721

[52] **U.S. Cl.** ..... **355/3 R**

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

[58] **Field of Search** 355/3, 16, 11, 14

[56] **References Cited**

UNITED STATES PATENTS

3,088,386	5/1963	Sugarman	355/11
3,490,842	1/1970	Reick et al.	355/10
3,575,506	4/1971	Knechtel	355/16
3,600,082	8/1971	Knechtel	355/8
3,604,797	9/1971	Szczesniak	355/16
3,770,345	11/1973	Kawakubo et al.	355/3 R

Primary Examiner—John M. Horan

Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] **ABSTRACT**

An electrophotographic copying machine including a repetitively usable photosensitive member removably mounted in the machine and having a plurality of image processing elements including an image transfer device disposed around the photosensitive member. The photosensitive member is mounted within a first body portion of the machine, while the transfer device is mounted in a removable second body portion of the machine, whereby the photosensitive member is accessible for removal when the two body portions are separated.

1 Claim, 25 Drawing Figures

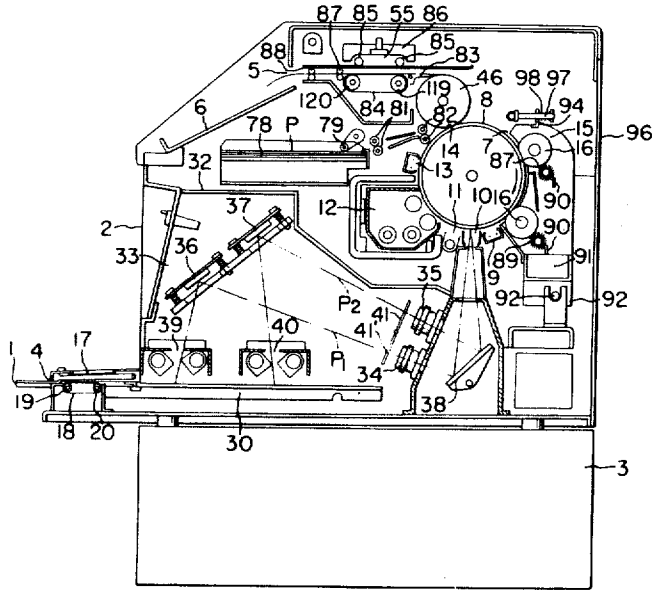


FIG. 1

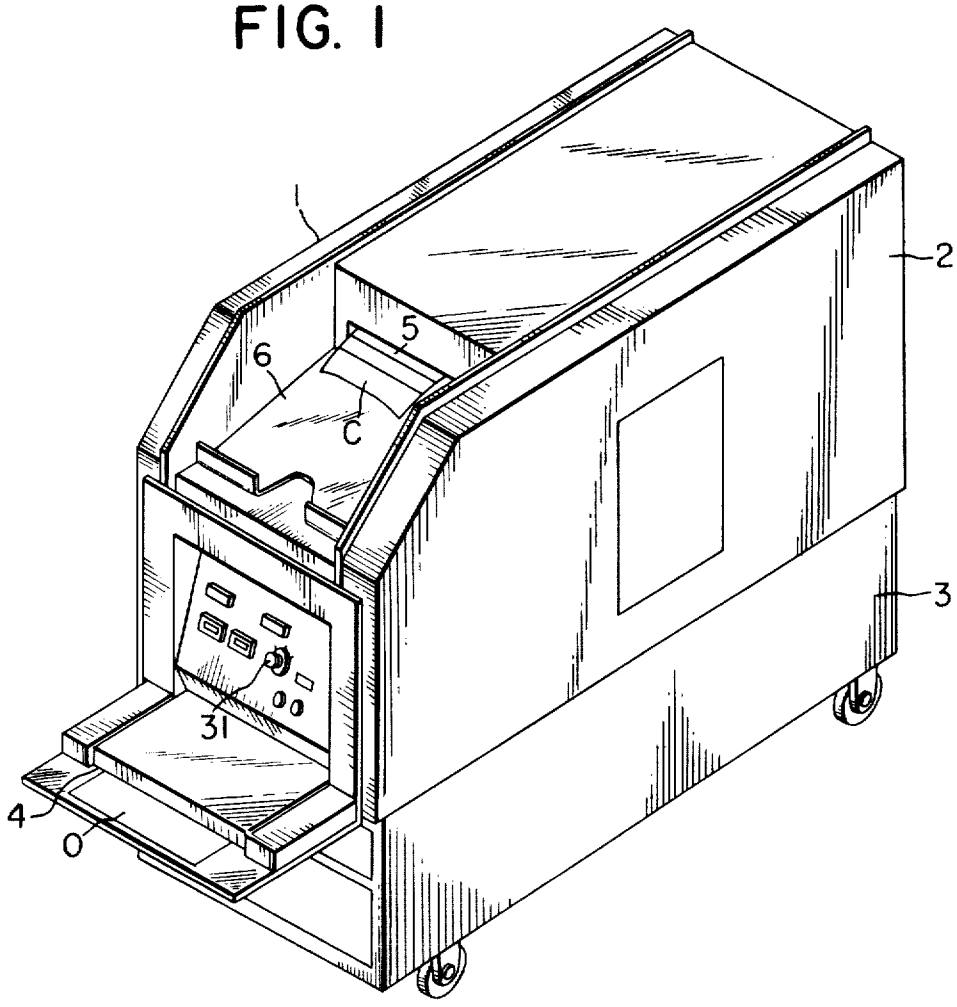


FIG. 2

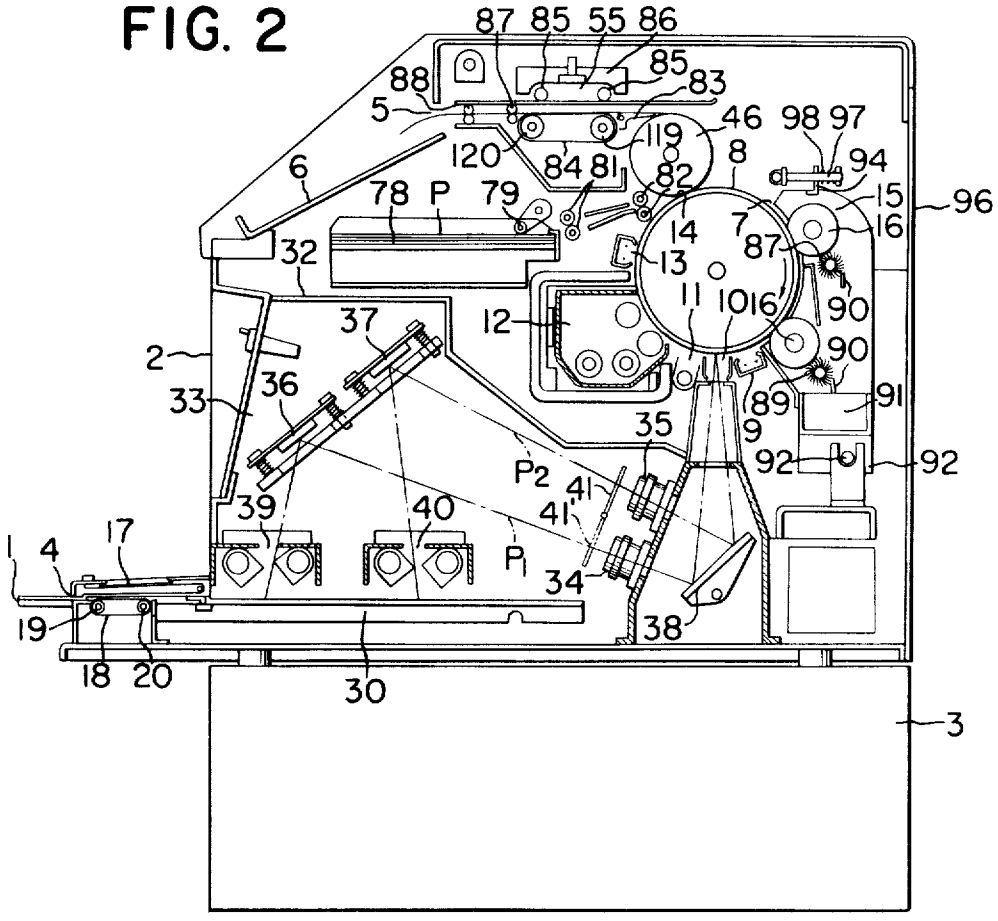

87 85 55 86
85
88
83
5
46 98 97
119
120
8
94
84 81
82
15
96
6
78 P 79
14
7
16
32
13
87
11
10
16'
90
37
12
90
2
36
33
89
91
9
35
92
92
P2
41
41'
39
40
17
1
4
P1
34
19
38
18
20
30
3

FIG. 3

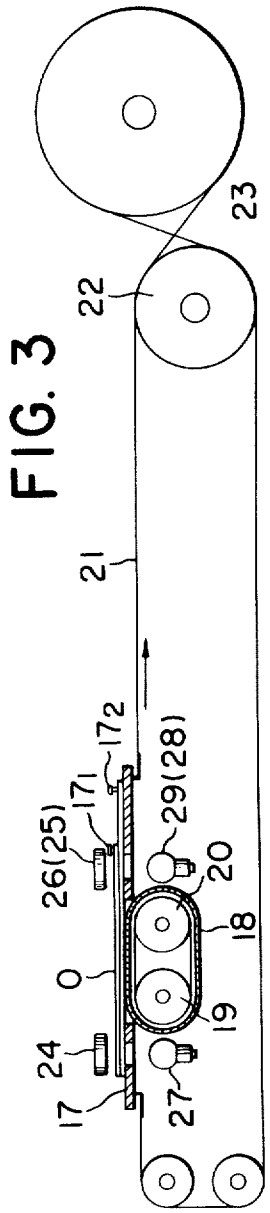

23
22
21
172
171
26(25)
29(28)
20
18
0
19
24
17
27

FIG. 4

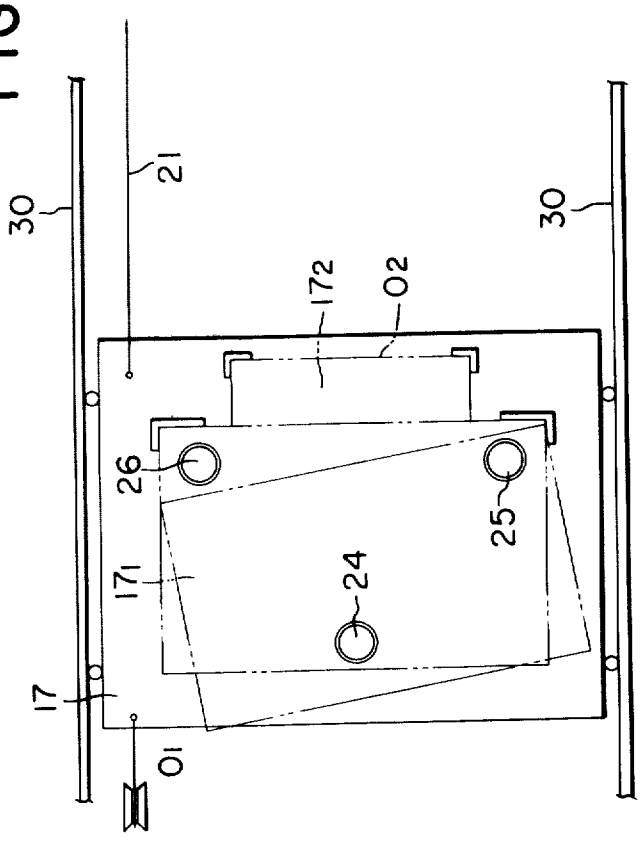

30
21
30
172
02
26
25
171
24
17
01

FIG. 5

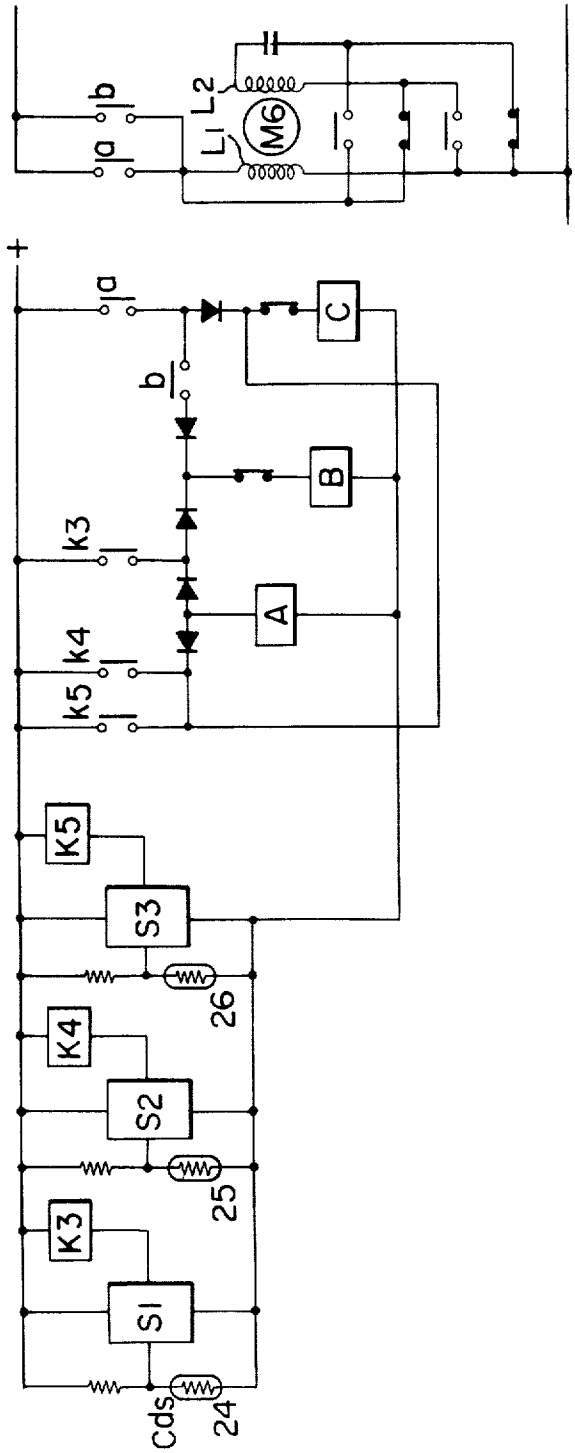


FIG. 6

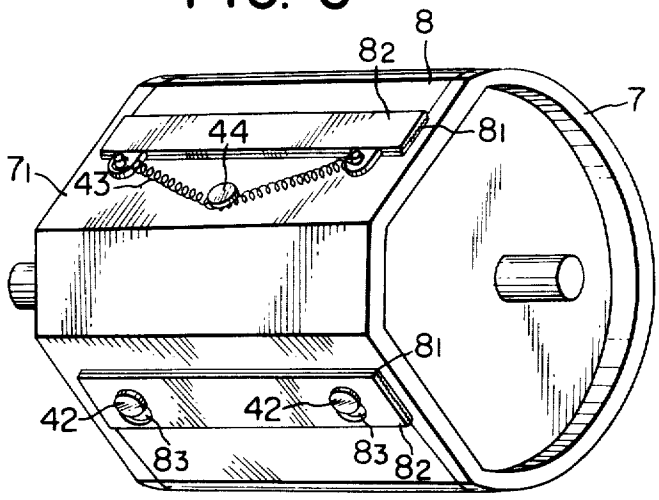

8
82
7
44
81
71
43
81
42
42
83
83
82

FIG. 8

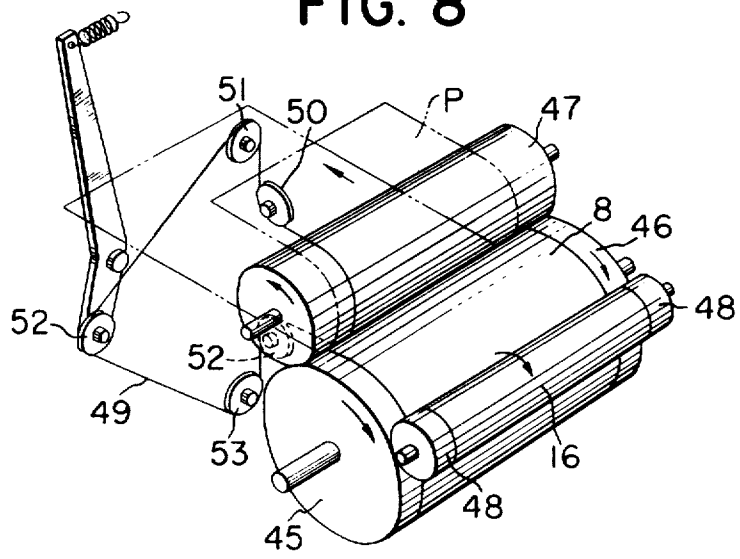

51
50
P
47
8
46
48
52
52
49
53
16
48
45

FIG. 7

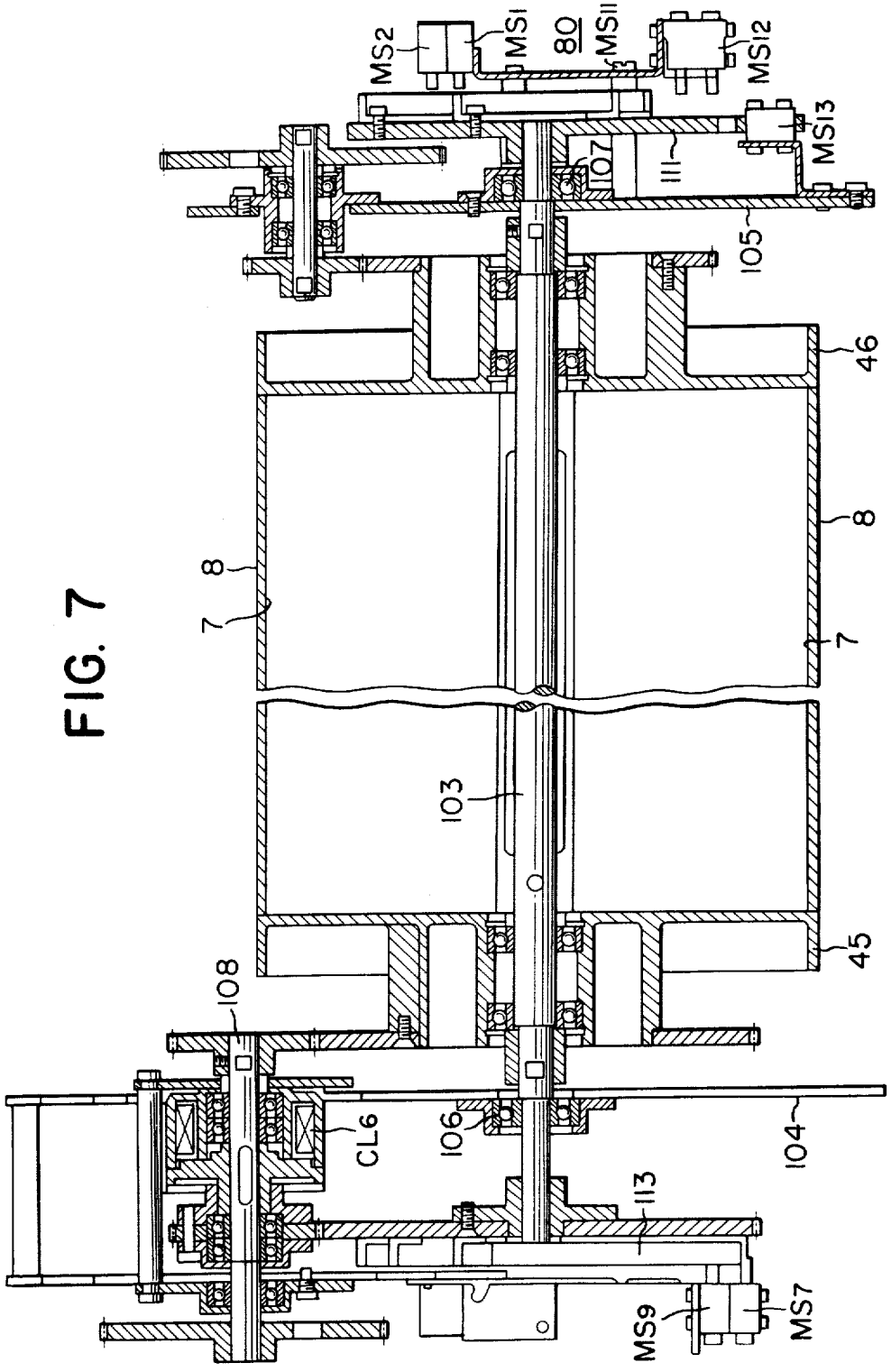

MS2
MS1
80
MS11
MS12
MS13
107
111
105
46
8
7
103
45
108
CL6
106
104
113
MS9
MS7

FIG. 9

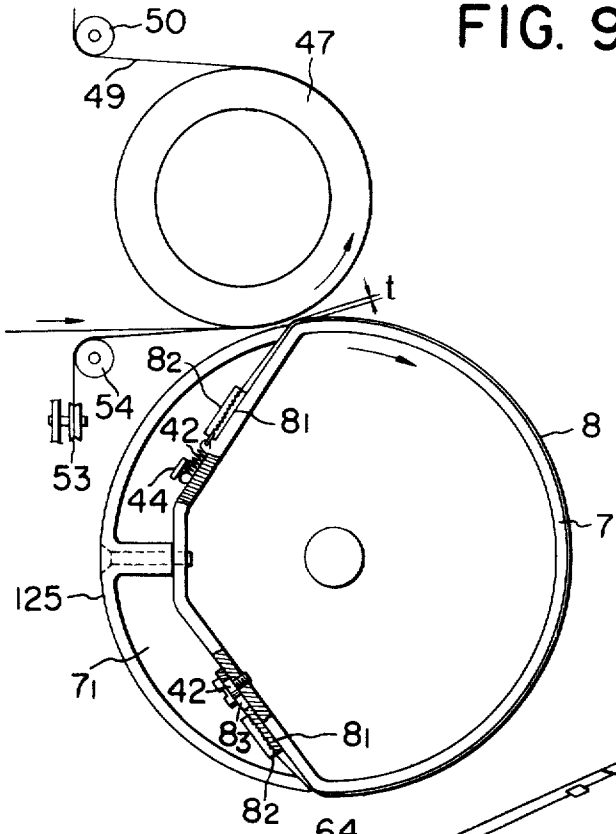

50
47
49
t
82
54
42
81
8
53
44
7
125
71
42
83
81
82

FIG. 10

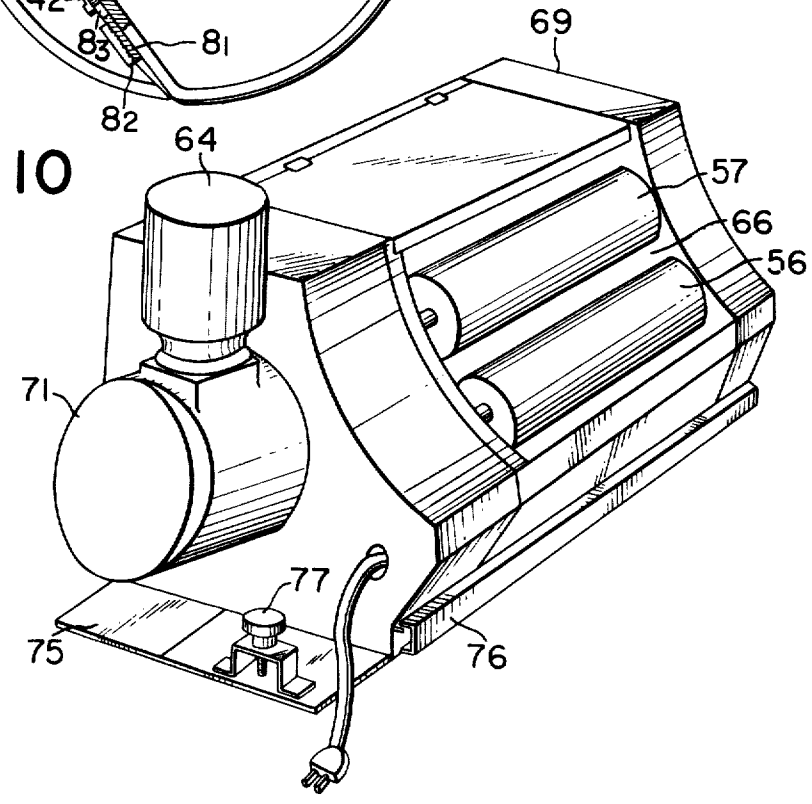
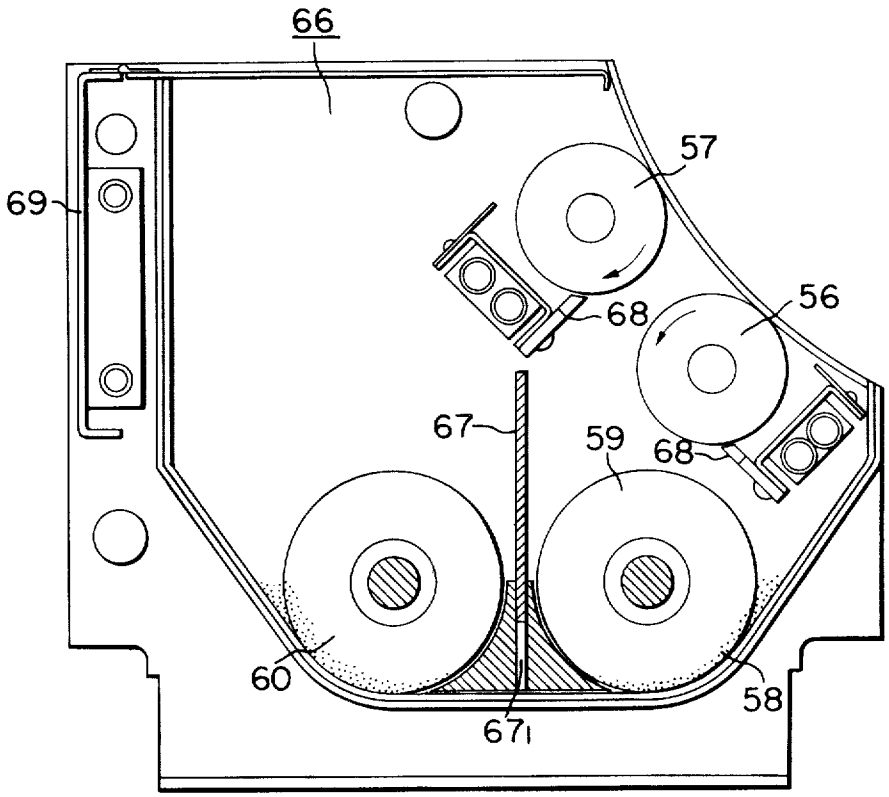

69
64
57
66
56
71
77
75
76

FIG. 11



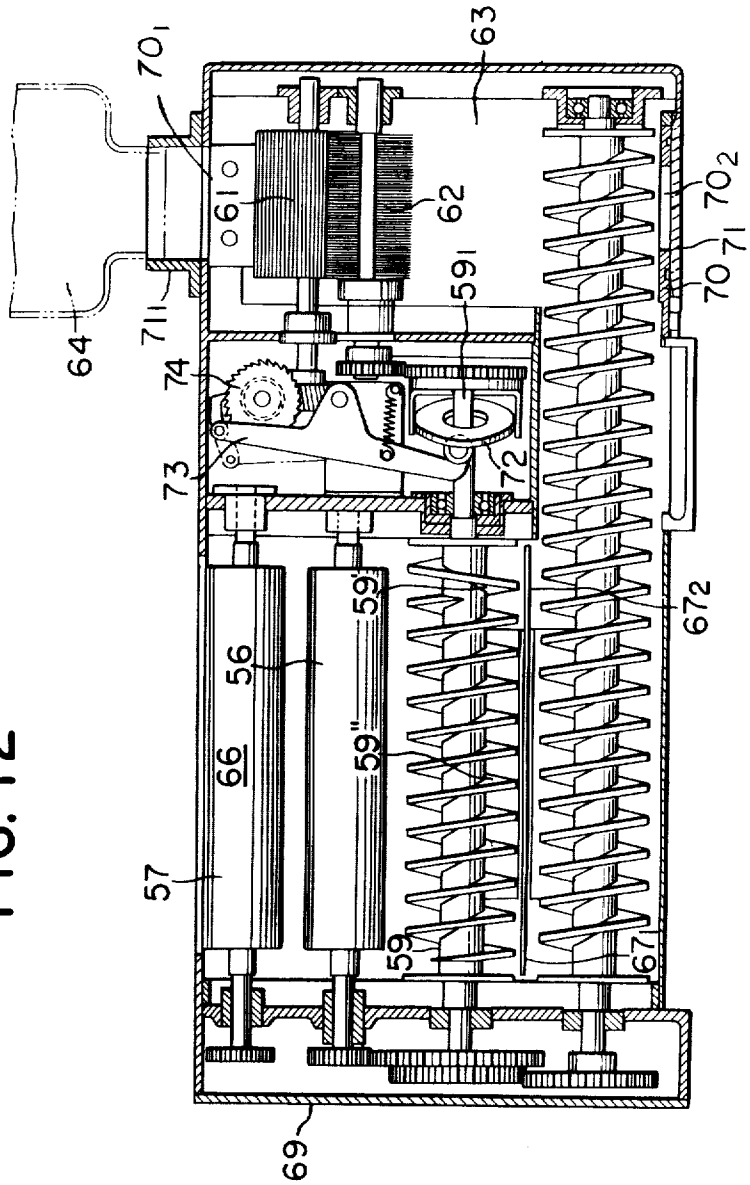


FIG. 12

FIG. 13

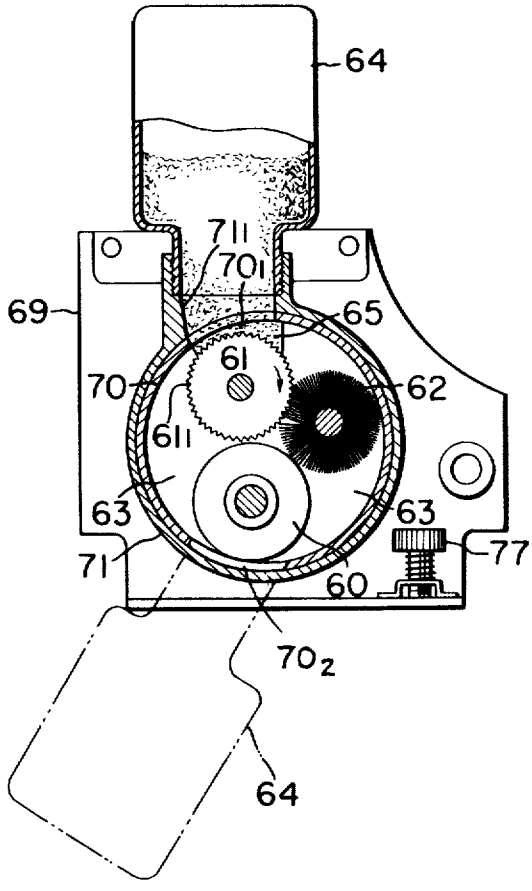


FIG. 14

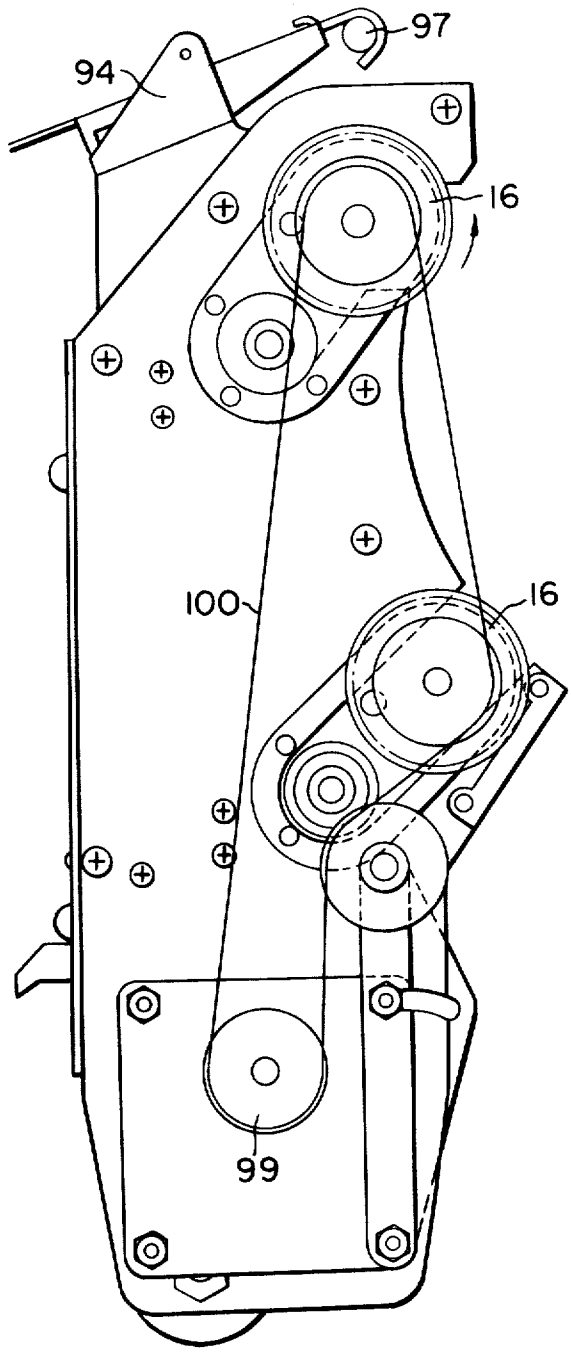


FIG. 15

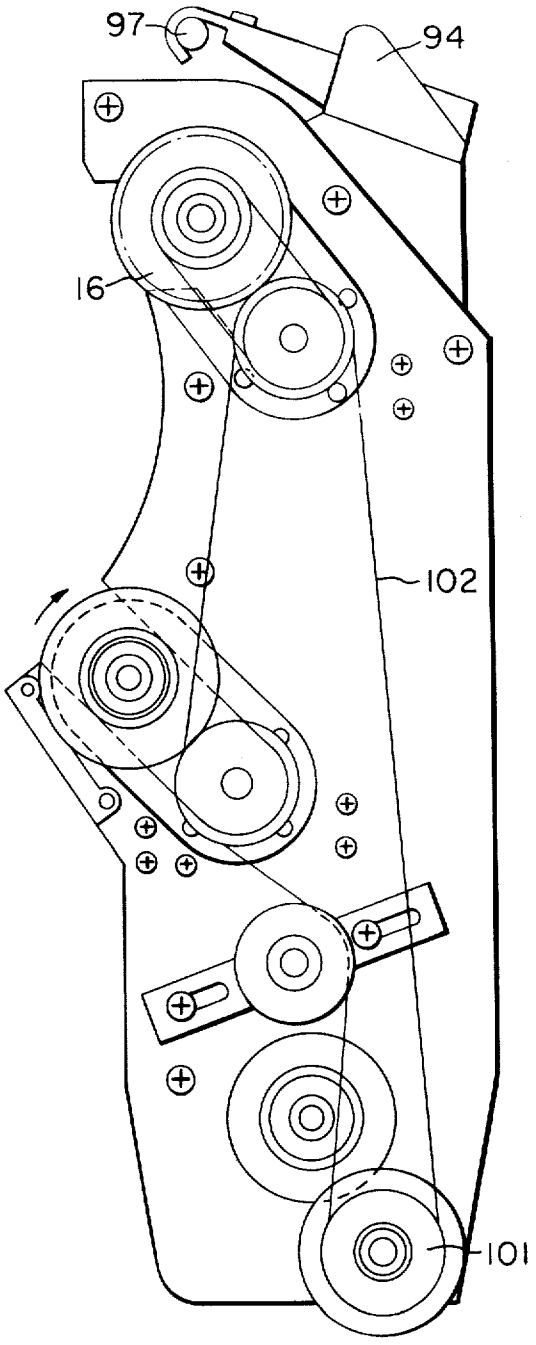


FIG. 16

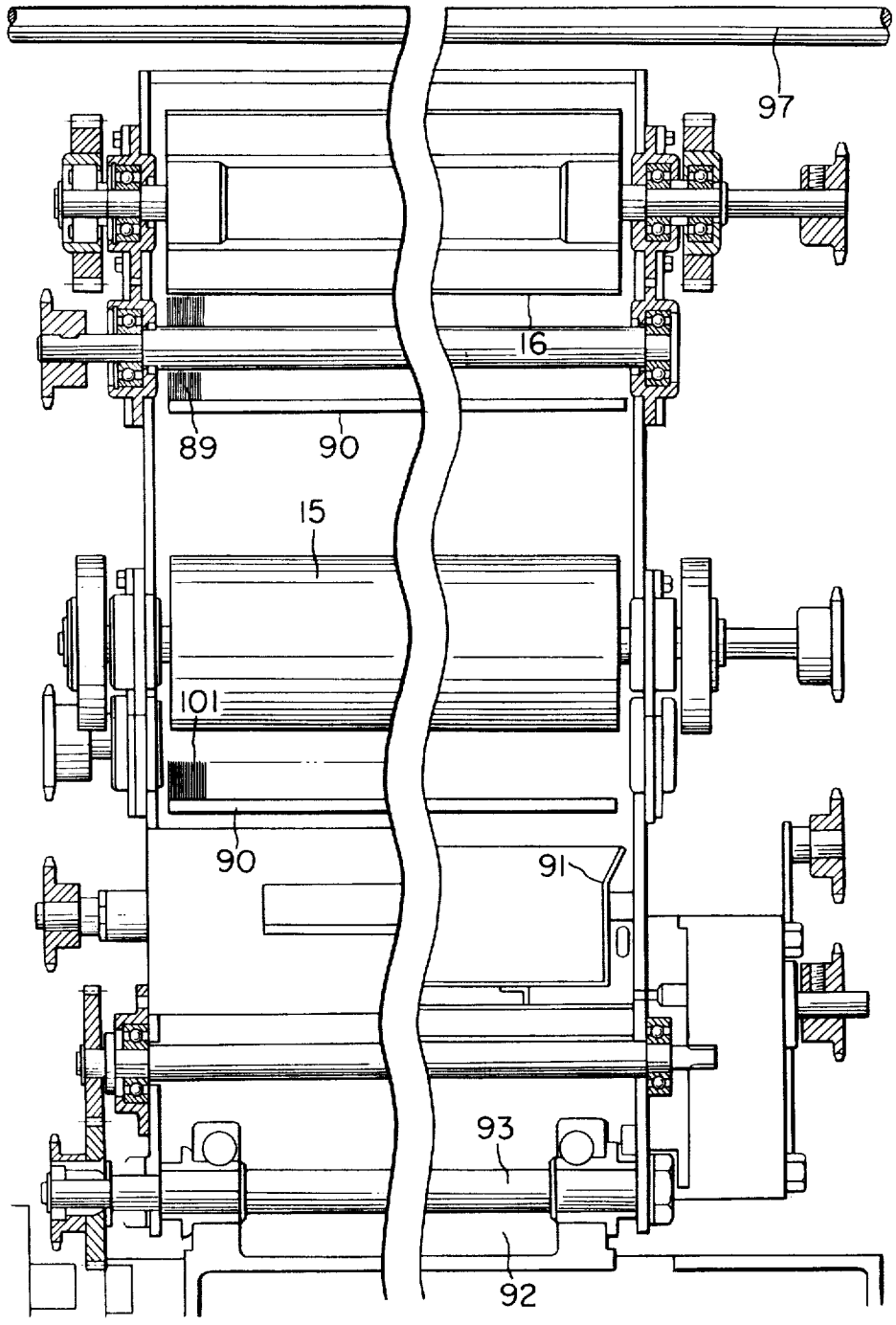


FIG. 17

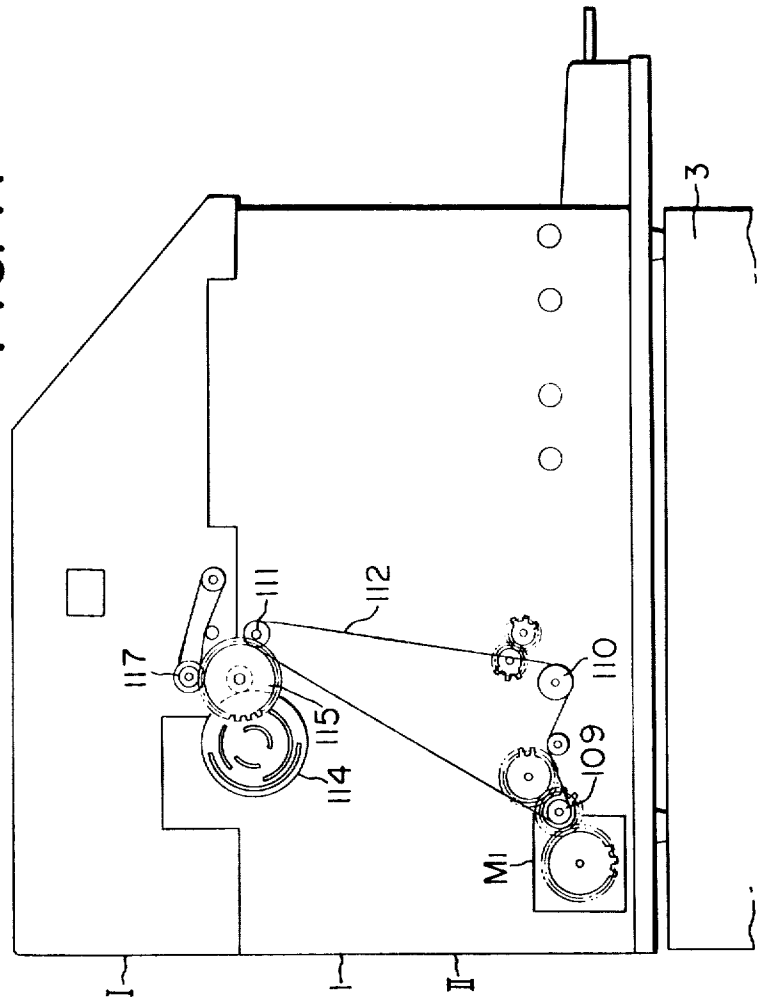


FIG. 18

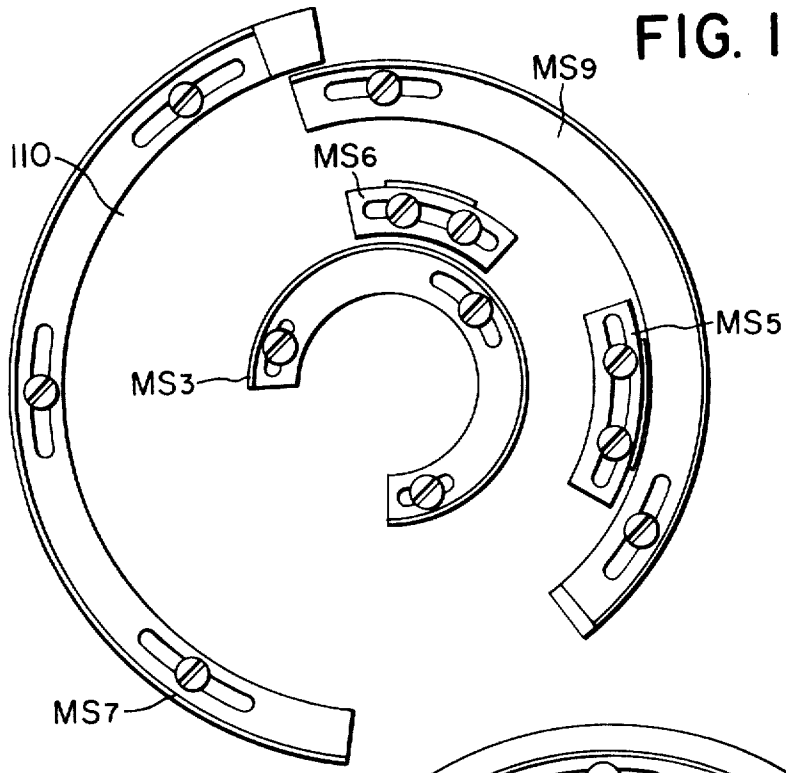


FIG. 19

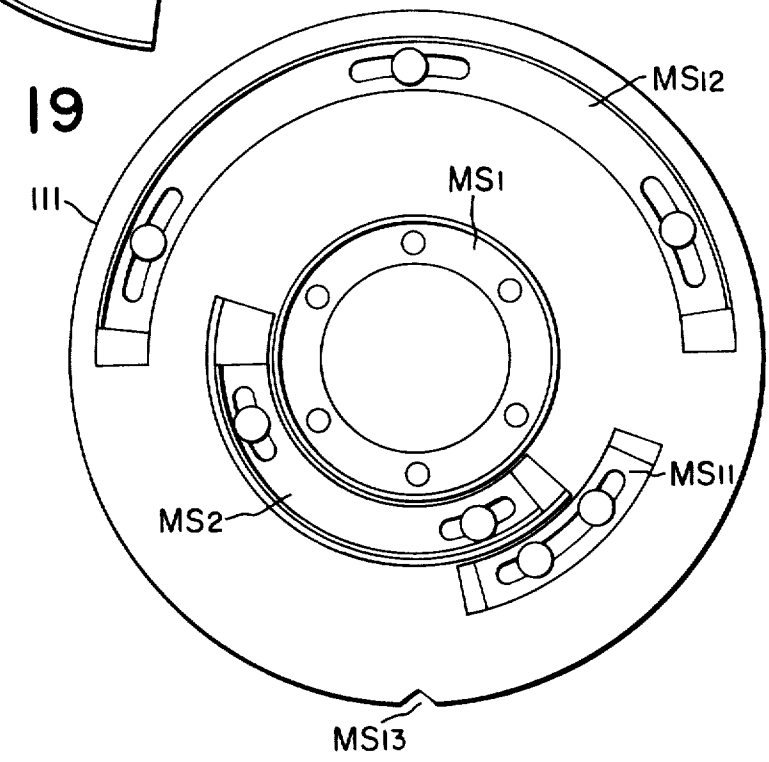


FIG. 20

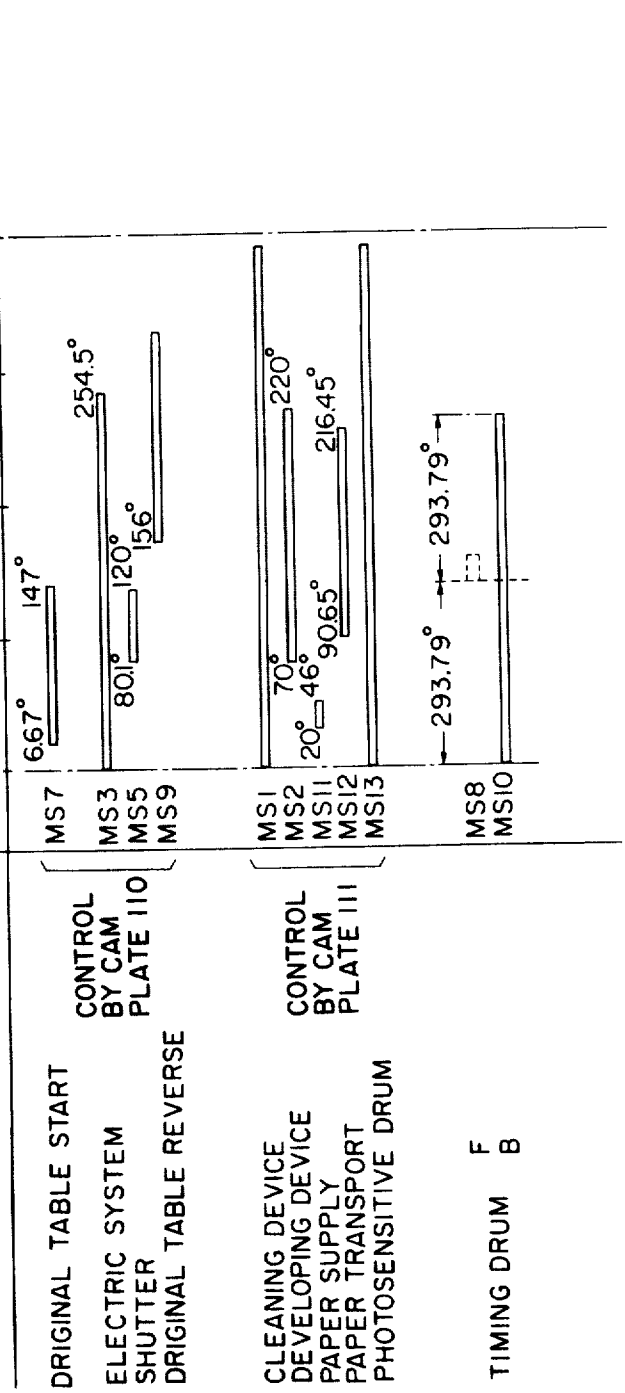

ROTATION ANGLE
START
90°
180°
270°
360°
USE
DRIGINAL TABLE START
ELECTRIC SYSTEM
SHUTTER
DRIGINAL TABLE REVERSE
CONTROL BY CAM PLATE 110
MS7
MS3
MS5
MS9
6.67°
147°
80.11°
120°
254.5°
156°
CLEANING DEVICE
DEVELOPING DEVICE
PAPER SUPPLY
PAPER TRANSPORT
PHOTOSENSITIVE DRUM
CONTROL BY CAM PLATE 111
MS1
MS2
MS11
MS12
MS13
20°
46°
70°
90.65°
216.45°
220°
293.79°
293.79°
TIMING DRUM
F
B
MS8
MS10

FIG. 21

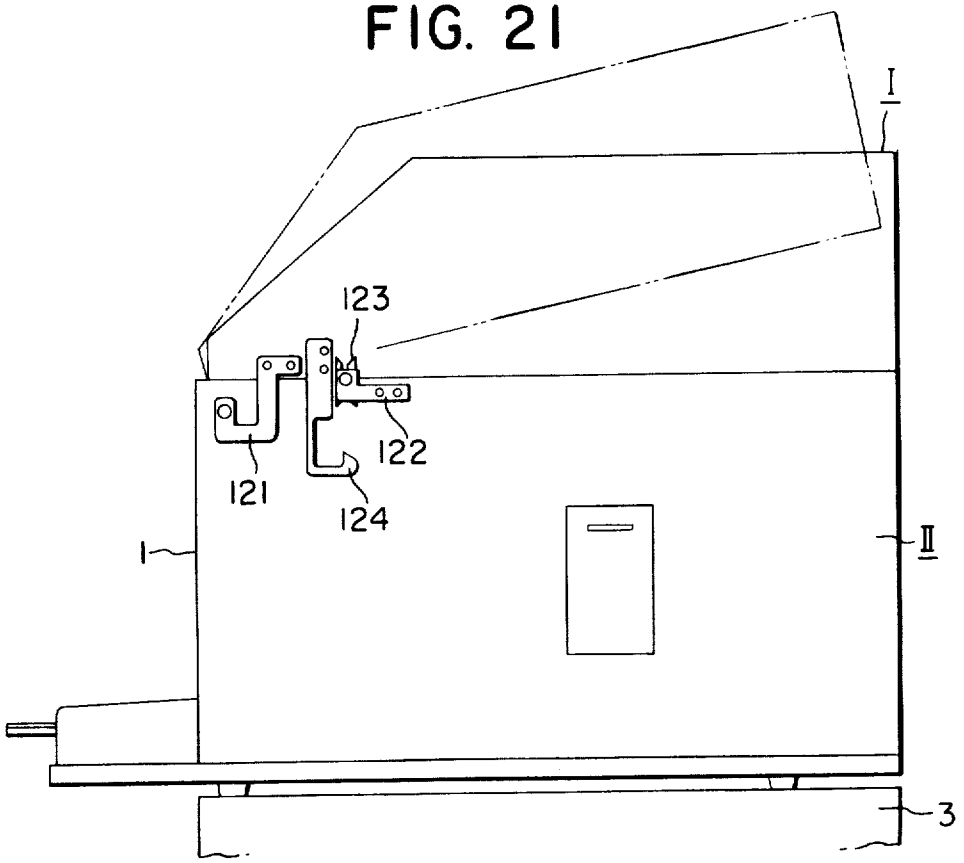


FIG. 22

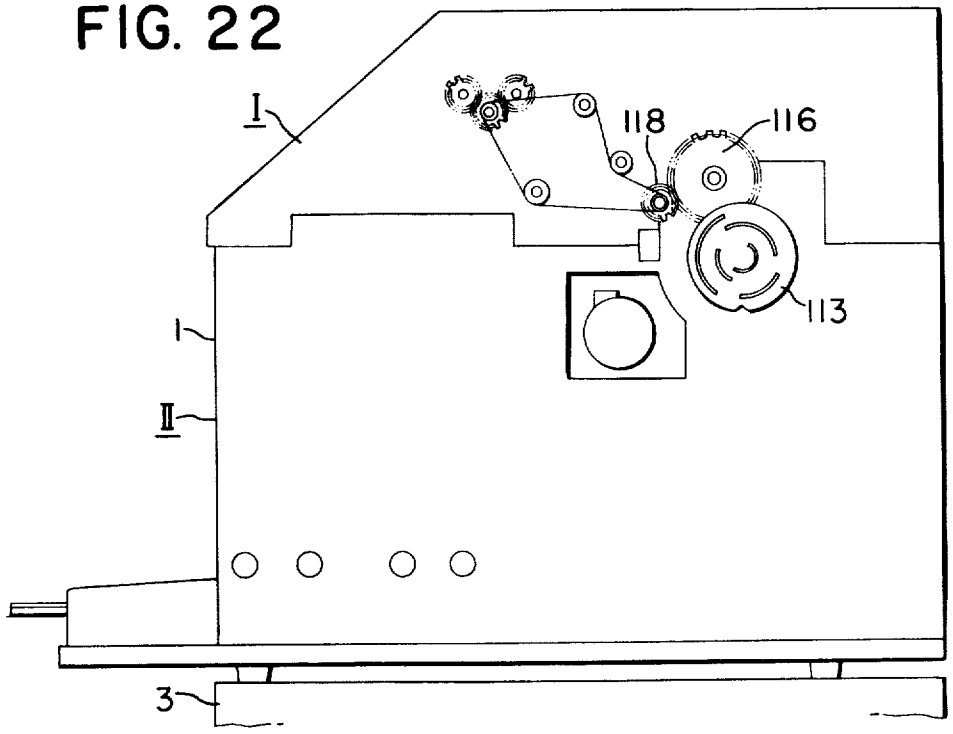


FIG. 23(a)

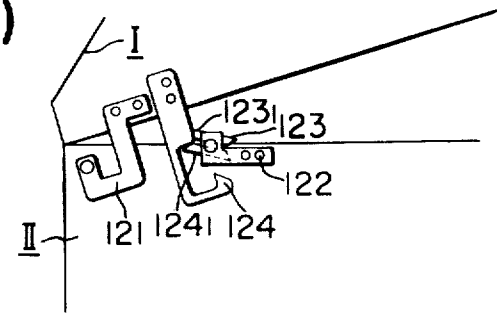


FIG. 23(b)

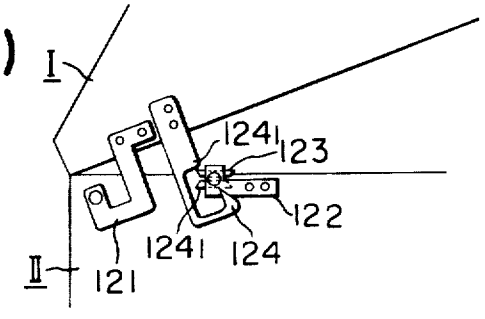
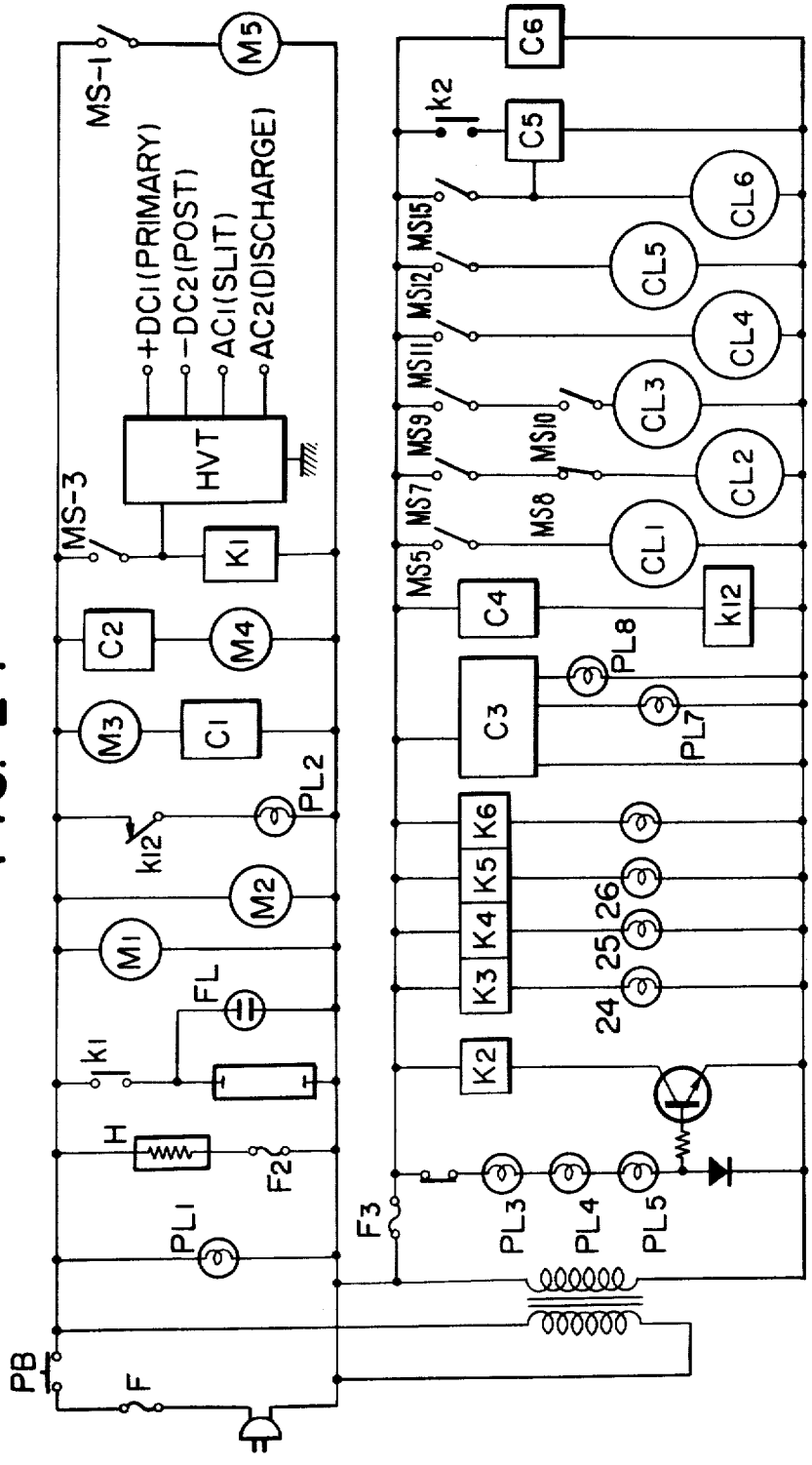


FIG. 24


MS-1
M5
+DC1(PRIMARY)
-DC2(POST)
AC1(SLIT)
AC2(DISCHARGE)
HVT
MS-3
K1
C2
M4
M3
C1
PL2
K12
M2
M1
FL
K1
H
F2
PL1
PB
F
C6
K2
C5
MS15
MS12
MS11
MS9
MS10
MS7
MS8
MS5
CL6
CL5
CL4
CL3
CL2
CL1
C4
K12
PL8
C3
PL7
K6
K5
K4
K3
K2
26
25
24
F3
PL3
PL4
PL5

ELECTRONIC PHOTOGRAPHIC COPYING MACHINE

This is a division, of application Ser. No. 211,276, filed Dec. 23, 1971.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to generally an electronic photographic copying machine, and more particularly to an electronic photographic copying machine of the type capable of automatically, rapidly and economically reproducing the transparent, semi-transparent or opaque originals in the form of sheet, especially the bank bills or the like.

2. Description of the Prior Art

In the reproduction of bank bills or the like, the original is, in general, copied on a silver salt film, which is used as the original to copy on paper by various photocopying processes such as electrostatic processes. Therefore two steps are required to obtain one copy, and the photocopying machines are complex in arrangement and operation, large in size, and expensive and require a relatively long time to make a copy. Of the various electrostatic processes, xerography is in generally widely used. The photoconductive layer used in xerography is exposed so that it tends to be mechanically damaged. Furthermore, there is a problem of its durability so that its photocopying ability is lost in a relatively shorter time when a large number of copies are made. Therefore, the photoconductive layer must be replaced from time to time, thus resulting in high cost.

SUMMARY OF THE INVENTION

The present invention contemplates to eliminate the defects encountered in the prior art photocopying processes and machines, and to reproduce the bank bills or the like automatically, rapidly and economically.

A primary object of the present invention is therefore to provide an improved electronic photographic copying machine.

Another object of the present invention is to provide an electronic photographic copying machine adapted for use in offices.

A further object of the present invention is to provide an electronic photographic copying machine capable of transferring image on ordinary paper or the like at high speed.

A still further object of the present invention is to provide an electronic photographic copying machine in which an original is exposed through slits twice or more in one receprocation thereof, and is projected upon a photosensitive member, whereby copying speed can be much enhanced.

A still further object of the present invention is to provide an improved electronic photographic copying machine capable of automatically placing an original in right position on an original holder or the like.

A still further object of the present invention is to provide an improved electronic photographic copying machine having an original holder or the like upon which two originals of different sizes can be placed so that they can be reproduced simultaneously.

A still further object of the present invention is to provide an improved electronic photographic copying machine in which the inlet of a developing agent container can be directed upwardly and downwardly while the container is attached to a developing device, whereby the supply of new developing agent and removal of used developing agent can be much facilitated.

Another object of the present invention is to provide an improved electronic photographic copying machine in which a predetermined amount of developing agent can be supplied into the developing chamber of the developing device in response to the rotation of developing brush rollers.

Another object of the present invention is to provide an electronic photographic copying machine in which a part of its casing is detachably attached so that the removal of jammed copying paper and the inspection and repair of various devices disposed within the casing can be much facilitated.

Another object of the present invention is to provide an improved electronic photographic copying machine in which the attachment of a photosensitive member to a drum and the removal thereof from the drum can be made in a simple manner.

Briefly stated, the present invention is based upon an electronic photographic process disclosed in U.S. Pat. No. 3,438,706 comprising the steps of uniformly charging the surface of a photosensitive member comprising a support, a photoconductive layer, and an insulating layer; projecting the image of an original upon the surface of said photosensitive member simultaneously when said photosensitive member is subjected to the second charging with the polarity opposite to that of said first charging step or a-c corona discharge; and, if required, emitting the radiation to illiminate said photosensitive member, thereby forming an electrostatic latent image of high contrast. The originals such as bank bills or the like can be directly copied on ordinary paper or the like, and an electronic photographic copying machine in accordance with present invention is simple in construction and operation and small in size, and is capable of reproducing copies at high speed and at less cost.

The above and other objects, features and advantages of the present invention will become more apparent from the following description of the preferred embodiments thereof taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a perspective view of an electronic photographic copying machine in accordance with the present invention;

FIG. **2** is a longitudinal sectional view of the electronic photographic copying machine shown in FIG. **1**;

FIG. **3** is a longitudinal sectional view of an original transporation device in the machine;

FIG. **4** is a top view of the original transporation device;

FIG. **5** is a diagram of a control circuit for the original transporation device;

FIG. **6** is a perspective view of a photosensitive drum;

FIG. **7** is a longitudinal sectional view of the photosensitive drum;

FIG. **8** is a perspective view used to explain the relation between the photosensitive drum and a transfer roller;

FIG. **9** is a transverse sectional view of the device shown in FIG. **8**;

FIG. **10** is a perspective view of a developing device;

FIG. 11 is a transverse sectional view of the developing device;

FIG. 12 is a top view of the developing device with a cover removed;

FIG. 13 is a sectional view of a toner supply section;

FIGS. 14 and 15 are left and right side views of a cleaning device, respectively;

FIG. 16 is a front view of the cleaning device;

FIG. 17 is a side view of the copying machine used for explanation of driving mechanism of the machine;

FIGS. 18 and 19 are front views of control cam mounting disks;

FIG. 20 is a flow chart used to explain the sequence of operations of switches;

FIG. 21 and FIGS. 23 (a) and (b) are views used to explain the mode of opening and closing an upper main body of the copying machine with respect to the lower main body;

FIG. 22 is a side view used for explanation of driveing means; and

FIG. 24 is an electric circuit diagram of the copying machine.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, an electronic photocopying machine in accordance with the present invention generally designated by 1 comprises a main body section 2 and a carriage section 3. At the center of the front wall of the machine 1 is formed an original inlet-outlet 4 through which is inserted an original, and a copy C is discharged from a copy outlet 5 onto a copy stand 6.

Next referring to FIG. 2 illustrating the longitudinal sectional view of the photocopying machine, an electronic photographic drum 7 in accordance with the present invention comprises a photosensitive member 8 which in turn comprises a surface insulating layer, a photoconductive layer, and an insulating supporting layer laminated in the order named. Around the photosensitive drum 7 which rotates in the direction indicated by the arrow are disposed a first or primary charger 9, a simultaneous image-projection-and-discharge device 10, a whole-surface-exposing device, a developing device 12, a third charger 13, an image transfer device 14, and a cleaning device 15 in the order named.

The first charger 9 applies the DC corona discharge to the surface of the sensitive member 8 fixed around the drum 7, thereby imparting thereto the positive or negative charge. Next the simultaneous image-projection-and-discharging device 10 applies to the photosensitive drum 7 the d-c corona discharge of the polarity opposite to that of the d-c discharge applied by the first charger 9 or the a-c corona discharge, simultaneously when the light image of the original is projected upon the photosensitive drum 7. As a result, an electrostatic latent image is formed upon the photosensitive drum 7.

The whole-surface-exposing device 11 uniformly exposes or illuminates the whole surface of the photosensitive drum at which the electrostatic latent image is formed to impart the external field thereto, thereby improving the contrast of the electrostatic latent image. The whole-surface-illumination device is not necessarily required. The latent image thus formed is developed by the developing device 12 which applies the toner of the polarity opposite or same to that of the latent image. It is preferable to employ the fur-brush, magnet-brush, cascade or wet developing method as the needs demand.

The third charger 13 is not necessarily required, but is used to impart the charge of an appropriate polarity to the copying medium P (which is generally paper) in order to enhance the electrostatic transfer of the powder image formed upon the photosensitive drum 7 to the copying paper P by the image transfer device 14. After the image has been transferred, the toner still remaining upon the photosensitive drum 7 is wiped off by a cleaning roller 16 in the cleaning device 15.

In addition to the peripheral devices 9–16 disposed around the photosensitive drum 7, the photocopying machine in accordance with the present invention further includes an original transportation or feed device, an optical system for projecting the image of the original upon the photosensitive drum, a copy paper feeding device, a copying paper separating device, a fixing device and so on, and the present invention is characterized by the arrangements thereof as will become more apparent from the following description of the various devices.

ORIGINAL TRANSPORTATION DEVICE

As shown in FIGS. 3 and 4, the original transportation device generally comprises an original holder or stand 17 upon which is placed the original O inserted through the original inlet-outlet 4, a pair of conveyor belts 18 wrapped around rollers 19 and 20 and disposed below the both lengthwise sides of the original stand 17 a wire 21 for transporting the original stand 17, wrapped around a pulley 22 and a capstan 23, photoconductive cells 24, 25 and 26, and light sources 27, 28 and 29. The original stand 17 is adapted to receive and hold the originals of two different sizes at 17_1 and 17_2, respectively, and is transported along a pair of guide rails 30.

The original O (which is, for example, a bank bill) is inserted into the inlet 4 with the image to be copied faced upward. Then the light from the light source 27 to the photoconductive cells 24 is interrupted by the original O so that a switching circuit S1 in a control circuit shown in FIG. 5 is actuated to energize an output relay K3 to close its contacts, thereby energizing relays A and B. As a result, a motor M6 for transporting the original is energized to rotate the conveyor belt 18 so that the original O is automatically moved onto the section 17_1 of the original holder 17. The original O interrupts light from the light sources 28 and 29 to the photoconductive cells 25 and 26 respectively so that both switching circuits S2 and S3 are simultaneously actuated to energize output relays K4 and K5 to close their contacts. As a result, the relays A, B and C are energized, and a drum clutch CL5 is engaged so that the original stand 17 is transported in the direction indicated by the arrow through the capstan 23, the pulley 22 and the wire 21. When light is received by the cells 24, 25 and 26 from the light sources 27, 28 and 29 as the original stand 17 is moved away therefrom, the switching circuits S1, S2 and S3 are de-energized so that the output relays K3, K4 and K5 are de-energized. Therefore, their contacts are opened, and the relays A, B and C are de-energized, whereby the motor M6 is stopped.

When the original O is fed at an angle relative to the longitudinal axis of the original stand 17, either of the photoconductive cells 25 and 26 receives light from the

light source 25 and 26. In this case, the motor M6 is driven to correct the position of the original O on the original stand 17, but the drum clutch CL5 is not engaged. Only after the original O is placed correctly upon the original stand 17 so that both the photoconductive cells 25 and 26 are interrupted from receiving the light from the light sources 28 and 29, the drum clutch CL5 is engaged to transport the original stand 17.

When the original stand 17 is reversed in direction from the going to the return stroke, microswitches MS7–MS10 (which are mounted upon the photosensitive drum 7) are closed to reverse the capstan 23. As a result, the original holder 17 is returned to the initial position, shown in FIG. 3, at which the light from the light sources 28 and 29 to the photoconductive cells 25 and 26 are interrupted so that the output relays K3 and K4 are energized to energize the relays A and C. Since the relay B is not energized, the auxiliary coil L_2 of the motor M6 is excited in the direction opposite to that of the main winding L_1 so that the motor M6 is reversed to reverse the conveyor belt 18. As a result, the original O is discharged through the outlet 5, and the operator may pull the original O from the outlet. Then, the light from the light source 27 is intercepted by the photoconductive cell 24 so that the relay A is de-energized. As a consequence, the motor M6 is stopped.

The photoconductive cell 24 and the conveyor belt 18 may be so arranged that the relay A remains energized so long as the original O is pulled away from the stand 17 by the operator. This arrangement is advantageous in that even when the original O is inserted again after one cycle of photocopying process has been completed, the motor M6 is not driven in the direction in which the original O is moved upon the stand 17.

When a plurality of copies are desired from the same original O, a copy-number-setting dial 31 (See FIG. 1) is set to 2 or M. The original stand 17 is reciprocated as many times as the number of copies set. That is, when the original stand 17 is returned to its initial position and the photoconductive cells 25 and 26 are interrupted from receiving light from the light sources 28 and 29, the conveyor belt 18 is driven to move the original O toward the outlet. When the light from the light sources 28 and 29 is received again by the photoconductive cells 25 and 26, the original O is returned to the original stand 17.

When it is desired to copy a number of different bills for the same client, a form O_2 in which are filled the name and account number of the client is plated at 17_2 on the original stand 17, and the bills O_1 are sequentially fed into the photocopying machine. In this manner, the originals or bills O_1 can be copied together with the form O_1 on the same copying papers.

A plurality of rollers may be used in place of the conveyor belts 18, and microswitches may be employed instead of the photoconductive cells 24, 25 and 26.

OPTICAL SYSTEM FOR EXPOSURE

The exposure system is housed in a dust-proof chamber 33 partitioned by a partition wall 32 as shown in FIG. 2, so that the optical system is completely separated from the devices disposed above the dust-proof chamber 33. Therefore, the optical system and especially its reflectors 36–38 and lenses 34 and 35 are completely prevented from being contaminated by the developing agent or the like. Furthermore, the independent optical system chamber facilitates the assembly, adjustment of the optical elements, and periodic cleaning and maintenance services of the optical system. According to the present invention, two slit-exposures are made in one going stroke of the original stand 17, so that there are two slit-exposure devices 39 and 40.

The image light emitted from the exposure device 39 is directed along the optical path P_1 comprising the lens 34 and two reflecting mirrors 36 and 38, whereas the light emitted from the exposure device 40 is directed along the optical path P_2 comprising the lens 35 and two reflecting mirrors 37 and 38, to the photosensitive layer 8 on the drum 7 through the simultaneous image-projection-and-charging device 10. When the image is projected by the first slit-exposure device 39, the lens 35 in the second optical path P_2 is closed by a shutter 41 in order to prevent the image light in the second path P_2 from being projected upon the drum 7. Simiarly, the lens 34 is closed by a shutter 41′ when the image is projected along the second optical path P_2. The shutters 41 and 41′ are actuated by an electromagnetic clutch which is energized by a microswitch MS5 which in turn is closed and opened as the drum 7 rotates.

DEVICES ASSOCIATED WITH FORMATION OF ELECTROSTATIC LATENT IMAGE

As shown in FIGS. 6 and 7, the photosensitive drum 7 is cut away at 7_1 in parallel with the axis of the drum. Both ends of the photosensitive member 8 in the form of a sheet are retained by retaining plates 8_1 and 8_2 as best shown in FIG. 6. After the photosensitive member 8 is wrapped around the cylindrical surface of the drum 7, engaging holes 8_3 formed in the retaining plates 8_1 and 8_2 at one end of the photosensitive member 8 are fitted over retaining pins 42 extending from the cutaway portion 7_1 of the drum 7, whereas a spring 43 whose both ends are securely fixed to the retaining plates 8_1 and 8_2 at the other end of the photosensitive member 8 is hooked to a retaining pin 44 extending from the cutaway portion 7_1. Thus, the photosensitive member 8 may be securely maintained around the drum 7.

On both sides of the drum 7 are coaxially disposed disks 45 and 46 which rotate independently of each other, and a pair of guide rollers 48 attached to both sides of the cleaning roller 16 are made into contact with the disks 45 and 46 respectively. Similarly the side portions of an image transfer roller 47 which is slightly longer than the axial length of the drum 7, ride over the disks 45 and 46 as shown in FIGS. 8 and 9. The diameter of the disks 45 and 46 is equal to that of the drum 7 including the photosensitive member 8 wrapped therearound so that the transfer roller 47 may be firmly pressed against the photosensitive member 8.

A copying-paper separating belt 49 is wrapped around the transfer roller 47 through 180°, and is guided by pulleys 50–54 to be moved in unison with the transfer roller 47. It is seen that the separating belt 49 is moved away from the path of the copying paper by the pulleys 50–54.

As the photosensitive member 8 on the drum 7 is moved away from the transfer roller 47, the spacing t is formed therebetween as shown in FIG. 9, but the disks 45 and 46 keep contact with the transfer roller 47 as described hereinbefore so that it is rotated, and the

separating belt **49** wrapped therearound is transported. In other words, even when the drum **7** is stopped, the transfer roller **47** is rotated, and the separating belt **49** is transported so that copying paper P can be positively fed into the fixing device **55**, and that the local heating of the transfer roller and separating belt from the fixing device **55** can be prevented.

The drum **7** starts rotation when both the photoconductive cells **25** and **26** are interrupted from receiving light from their light sources **28** and **29** by the original O. The photosensitive drum is first charged by the first charger **9**, and then by the second charger **10** simultaneously when the image of the original O is projected upon the photosensitive drum **7** and is illuminated uniformly by the whole-surface-illumination device **11** to form an electostatic latent image having high contrast.

DEVELOPING DEVICE

As shown in FIGS. **10-13**, the developing device comprises a pair of developing rollers **56** and **57**, a pair of screws **59** and **60** for mixing and feeding developing agent **58**, a toner feed roller **61** for feeding a predetermined amount of toner, a toner transfer brush **62**, and a toner supply chamber **63**. Toner fed from a hopper **64** drops into the recesses of the knurled toner feed roller **61**, and a doctor blade **65** in contact with the feed roller **61** prevents excess toner from dropping onto the toner transfer brush **62**. That is, a predetermined amount of toner is always fed to the screw **60** in the supply chamber **63** through the toner transfer brush **62**. Toner is mixed with carrier iron powder to provide the developing agent **58** which is fed into a developing chamber **66** by the mixing and conveyor screw **60**. In the developing chamber **66**, the developing agent is circulated in a predetermined direction through holes 67_1 and 67_2 through a partition wall **67** by the pair of screws **59** and **60**. The screw thread **59'** at the left end of the screw **59** is reversed in direction so that the developing agent can be positively forced into the hole 67_2 toward the screw **60** at the intersection between the reversed screw thread **59'** and the forward screw thread **59''**. Developing agent being fed by the screw **59** is magnetically attracted by the pair of developing rollers **56** and **57** which are rotating at 100–300 rpm. The developing agent is transferred from the pair of developing rollers **56** and **57** to the photsensitive member **8**, whereby the electrostatic latent image formed thereupon in the manner described hereinbefore may be developed into a visible powder image. Control blades **68** are provided in order to control the amount and uniform attachment of developing agent on the developing rollers **56** and **57**.

The screw **60** is extended into a cylinder **70** disposed in casing **69** of the developing device, and another cylinder **71** is rotatably fitted into the cylinder **70**. The toner container **64** is detachably attached to the cylinder **71** as shown in the chain lines in FIG. **12** in such a manner that when the cylinder **71** is rotated to the position indicated by the solid lines, the opening 71_1 of the cylinder **71** coincides with the developing agent supply inlet or opening 70_1 of the cylinder **70**.

Therefore, a predetermined amount of toner is supplied to the feed roller **61**. In order to adjust the amount of toner to be supplied, a cam **72** carried by the shaft 59_1 of the screw **59** is inclined so that a lever **73** in contact with the cam **72** changes its angle or inclination. As a result, the angle of rotation of a ratchet wheel **74** can be varied so that the number of rotations of the feed roller **61** relative to one rotation of the shaft 59_1 can be changed. Thus, the amount of toner to be supplied can be adjusted.

When the developing agent **58** is fatigued after a long use so that it must be exchanged with new developing agent, the cylinder **71** is rotated to displace the toner container **64** to the position indicated by the chain lines, whereby the opening 71_1 of the cylinder **71** coincides with the developing agent discharge outlet or opening 70_2 of the cylinder **70**, and then the screw driving motor is reversed to return the developing agent in the developing chamber **66** into the toner supply chamber **63**. Therefore, the developing agent is returned into the toner container **64**. Thus, unlike the prior art developing device, it is not required to remove the developing device from the main body of the photocopying machine for exchange of developing agent.

In the instant embodiment, the magnet brush developing method is illustrated, but it is understood that the fur brush developing method may be also employed.

As shown in FIG. **10**, the casing **69** of the developing device is mounted upon a supporting plate **75**, and is moved along guide rails **76** to the operative position at which the developing device is securely held to the main body of the photocopying machine with a locking knob **77**.

COPYING PAPER FEED DEVICE, IMAGE TRANSFER DEVICE, DEVICE FOR SEPARATING COPYING PAPER, AND FIXING DEVICE

Copying papers P on a copying paper stand **78** (See FIG. **2**) are fed one by one by a feed roller **79** whose rotation is controlled in response to the signal from a cam mechanism in the control unit **80** (See FIG. **7**) which in turn is controlled by a microswitch **MS11** attached to the feed roller **79**. Copying paper P is transported by a pair of feed rollers **81** to a second pair of feed rollers **82**. The first pair of feed rollers **81** are initially stopped so that copying paper P is bowed, and the leading edge of copying paper is aligned with the axes of the first pair of feed rollers **81**. In the instant embodiment, sheet copying papers are used, but it is understood that a rolled copying paper is also used when cutting means for cutting a rolled copying paper into a predetermined size.

The first pair of feed rollers **81** start to rotate when the control switch **MS 12** is actuated by the cam mechanism in the control unit **80** as shown in FIGS. **7**, **14**, and **15**, and copying paper P is transported by the second pair of feed rollers **82** which are normally rotated, toward the image transfer device. In the image transfer device, the copying paper is registered with the zone of the photosensitive drum **7** upon which is formed the toner image, and is pressed by the transfer roller **47** against the photosensitive drum **7**. As a result, the toner image is transferred upon the copying paper.

As shown in FIGS. **6** and **8**, the copying paper P to which has been transferred the toner image from the drum **7** is deparated from the photosensitive drum **7** because the side edge of the copying paper P is sandwiched between the separating belt **49** and the transfer roller **47**. Thereafter, copying paper is transported toward the fixing device by a separating pawl **83** in light contact with the transfer roller **47**.

The fixing device comprises a conveyor belt **84** made of wire netting, infrared lamps **85**, and a reflector **86**.

the temperature in the fixing device is always maintained at a predetermined level so that the toner may be fused and fixed to the copying paper to provide a permanent record.

A fan or the like may be provided to suction the air in the loop of the conveyor belt **84** so that the copying paper may be firmly pressed against the belt **84** and the temperature rise of the belt made of wire netting can be positively prevented. The fixed copying paper is discharged by pairs of discharge rollers **87** and **88** onto a receiving tray **6.**

CLEANING DEVICE

As shown in FIGS. **14, 15** and **16,** the cleaning roller made of rubber around the peripheral surface of which is applied fabric, removes toner still remaining on the photosensitive drum **7** after the toner image has been transferred to the copying paper P. The toner attached to the cleaning roller **16** in turn is removed by a brush roller **89,** and the toner attached to the brush roller **89** is removed by a beating member **90** and is dropped into a bag or container **91.**

A supporting member **92** of the cleaning device **15** is pivoted with a pin **93** to the main body, and an ear **94** formed at the upper portion of the cleaning device **15** is loosely engaged with a pin **97** extending from a casing **96.** The cleaning roller **16** is pressed against the photosensitive drum **7** under an appropriate pressure of a spring **98.** The rotation of a driving motor (not shown) is transmitted through a gear **99,** and a chain **100** to the cleaning roller **16,** whereas the rotation is transmitted to the brush roller **89** through a gear **101** and a chain **102.**

OTHER MECHANISMS

As shown in FIG. **7,** a rotary shaft **103** of the photosensitive drum **7** is supported through bearings **106** and **107** by side walls **104** and **105,** and is driven by a gear shaft **108** which carries an electromagnetic clutch CL6 at one end thereof and is driven by a main motor M1 through gears **109, 110,** and **111** and a chain **112** wrapped therearound as shown in FIG. **17.** The shaft **108** also rotates a cam disk **113** in the control unit **80.** When light is interrupted by the original O to be received by the photoconductive cells **25** and **26** (See FIGS. **3** and **4**), a switch MS13 is closed to actuate the electromagnetic clutch CL6, whereby the photosensitive drum **7** is started to rotate. At the same time, the cam disks **113** and **114** starts to rotate, and the switches MS1, MS2, MS11, MS12, MS13, MS5, MS3, MS9, and MS7 mounted upon the disks **113** and **114** (See FIGS. **18** and **19**) are actuated in the sequence shown in FIG. **20,** whereby the photocopying machine can be controlled.

According to the present invention, the upper main body **1** which carries the transfer roller **47** is detachably mounted on the lower main body **11** which carries the photosensitive drum **7** so that the removal of jammed copying paper can be facilitated, and other servicings can be much enhanced. The gears **115** and **116** carried by the lower main body **11** are in mesh with the gears **117** and **118** carried by the upper main body **1** as shown in FIGS. **17** and **22** so that the power for driving the feed rollers and discharge rollers **81, 82, 87,** and **88** and the rollers **119** and **120** for driving the conveyor belt **84** in the fixing device all of which are disposed in the upper main body **1** can be transmitted from the motor mounted in the lower main body **11.** It is seen that the power transmission systems in the upper and lower main bodies **1** and **11** can be also easily coupled and disconnected.

As shown in FIG. **21,** hinge arms **121** securely fixed to the side walls of the upper main body **1** are pivoted to the lower main body **11,** and a ratchet pawl wheel **123** is fixed to each of supporting arms **122** fixed to the side walls of the lower main body **11.** Pawls **124** for engagement with the ratchet pawl wheel **123** are securely fixed to the upper main body **1.**

When the upper main body **1** is opened as indicated by the two-dot chain lines as shown in FIG. **21,** the pawls **124** causes the ratchet pawl wheel **123** to rotate. When the upper main body **11** is slightly lowered in the position shown in FIG. **23**(a), a notch 124_1 of the pawl **124** engages with a ratchet pawl 123_1 so that the upper main body **1** can be maintained in opened position. When the upper main body **1** is raised to bring the ratchet pawl wheel **123** to the position shown in FIG. **23**(b) by the pawl **124,** the notch 124_1 is released from the ratchet pawl 123_1 so that the upper main body **1** can be losed.

The carriage **3** shown in FIGS. **1, 2, 17** and **22** incorporates therein an electric unit and a toner collecting device for collecting toner scattered from the developing device.

ELECTRIC CIRCUITS

Upon depression of a power switch P. B., a pilot lamp PL1 is turned on, and simultaneously the main motor M1 and a fan motor M2 for collecting scattered toner are started and normally driven, and when the original O is inserted to interrupt light from the light source to the photoconductive cell **24,** the output relay K3 is energized, and the control circuit C5 for controlling the transportation of original is actuated so as to transport the original O. When the original O is correctly placed on the original stand **17,** and interrupts light to the photoconductive cells **25** and **26,** the output relays K3–K6 are energized so as to engage the clutch CL5, whereby the photosensitive drum **7** starts to rotate. Since the microswitch MS13 is closed, the drum continues its rotation, and when the control microswitch MS3 attached to the drum is closed, a high voltage transformer HVT and a relay K1 are energized to turn on an illumination lamp FL. Since the microswitch MS11 attached to the photosensitive drum is closed, copying paper is fed toward the photosensitive drum while closing the switch MS12, and the toner image formed upon the photosensitive drum is transferred upon copying paper. A motor M5 for driving the cleaning device is driven when the microswitch MS1 is closed. The reciprocation of the original stand **17** is controlled by clutches CL2 and CL3 which in turn are controlled by microswitches MS7 and MS9 attached to the photosensitive drum and switches MS8 and MS10 attached to the timing drum.

In the photocopying machine in accordance with the present invention, two copies are obtained from one original. Therefore, a timing switch MS5 is attached to the photosensitive drum in order to control a shutter control clutch CL1 to alternately close the shutters **41** and **41'**.

In FIG. **24,** H designates a heater in the fixing device; F2, and a fuse for the heater H. The relay K2 constitutes an interlocking circuit for disconnecting the contacts K2 when lamps PL3–PL5 for CdS are turned

off so as to de-energize the original transportation control circuit C5 to prevent the original from being transported for exposure.

An alarm circuit C3 is provided for flickering a pilot lamp PL7 or PL8 when copying paper is jammed. C4 is a timer circuit for exposure; K11, contacts which are closed when the photosensitive drum is stopped, so as to control the circuit C4; and C6, an electronic counter circuit for counting the number of copies reproduced and de-energizing the control circuit C5, when the desired number of copies are reproduced, so as to stop the feeding of copying papers. M3 is an exhaust fan motor; and C1, a control circuit which varies the rotational speed of the exhaust fan motor M3 when the heater H reaches a predetermined temperature in order to exhaust the heated air out of the fixing device, whereby the overheat can be prevented. F is a fuse for protecting an AC power source circuit; F3, a fuse for protecting a DC power source; and PL2, a lamp for preliminary exposure.

As described above, according to the present invention, around the photosensitive drum are disposed the first charger, the second charger or simultaneous image-projection-and-charging device; the whole-surface-illumination device; the developing device; the third charger, if required; the image transfer device, and the cleaning device in the order named. On one side of the photosensitive drum is disposed two slit-exposure optical systems, and above the optical systems are disposed the original transportation device and the copying paper feed device. Therefore, two images of the same original can be reproduced on the same copying paper by one reciprocation of the original stand and hence the original. The photocopying machine in accordance with the present invention can be made compact in size. Since the fixing device is disposed in the uppermost portion in the casing, other devices, and especially the optical systems can be prevented from being heated. Therefore the heat problems can be easily solved, and the lenses can be sufficiently protected. Since the optical systems are housed within the independent dust-proof chamber, they are prevented from being contaminated with toner and the like.

The original is automatically fed upon the original stand under the control of detecting means, and is placed correctly upon the stand when the latter is reciprocated. There is no fear that jamming of original occurs in the original transportation path. The original stand is provided with two original receiving sections so that two originals of different sizes can be reproduced at the same time.

The photosensitive member in the form of sheet can be securely placed around the drum because one end of the photosensitive member is retained in position on the cutaway portion of the drum with the pins, whereas the other end thereof is retained in position with the spring. Therefore, even when the photosensitive member is expanded or contracted by heat, it can be made into close contact with the drum. Furthermore, the photosensitive member can be easily replaced. Since the drum is cutaway in the manner described hereinbefore, it may be stopped while the transfer roller rotates, and the copying paper feed device is actuated.

The toner supply chamber is defined by the cylinder fitted into the developing device, and the toner container is attached to the cylinder which is rotatably fitted into the first cylinder. The screw is extended into the toner supply chamber so that toner supplied from the container can be immediately fed into the developing chamber. When the screws are reversed in rotation, the developing agent can be returned from the developing chamber to the toner supply chamber and then into the toner container. Therefore, the need of removing the developing device for exchange of developing agent can be eliminated.

Copying paper is sandwiched between the transfer roller and the separating belt, and is moved away from the drum along the transfer roller so that the copying paper which is attached to the drum under the electrostatic force can be easily and smoothly separated from the drum.

Toner remaining on the photosensitive drum can be removed by the cleaning roller made of rubber or synthetic resin, and toner attached to the cleaning roller can be removed by the brush roller in contact with the cleaning roller. Thus, the photosensitive drum can be completely cleaned by the simple cleaning device. If necessary, the cleaning roller may be knurled.

The heated air in the loop of wire netting conveyor belt in the fixing device can be exhausted so that the copying paper can be securely pressed against the belt and prevented from making contact with the heater. Furthermore the temperature rise of the conveyor belt can be prevented.

The upper main body in which are mounted the transfer roller, the separating belt, and the cleaning device, is hinged to the lower main body in which is mounted the drum in such a manner that the upper main body may be opened along the copying paper feed device. Therefore the removal of jammed copying paper can be much enhanced.

To remove the photosensitive member attached around the drum, the cleaning device is moved away from the drum, and thereafter the upper main body is opened in the manner described hereinbefore. A dust-proof cover 125 fixed to the drum to cover the cutaway portion thereof is removed, and the spring and engaging holes at the ends of the photosensitive member are disengaged from the retaining pins on the cutaway portion of the drum. Thus, the photosensitive member can be removed from the drum. In reversing the steps described above, the photosensitive member can be easily attached around the drum.

Since the cleaning device can be moved away from the drum, the inspection, adjustment, repair and maintenance of the chargers, the whole-surface-illumination devices and so on disposed around the drum can be easily carried out.

It is understood that the present invention is not limited to the embodiment described hereinbefore with reference to the accompanying drawings, and that various variations and modifications can be effected without departing from the scope of the present invention. For example, any of the conventional electrophotographic processes can be employed in the photocopying machine in accordance with the present invention.

In summary, the advantages of the photocopying machine in accordance with the present invention will be described.

Since the main body of the photocopying machine comprises the upper and lower main bodies which can be separated from each other, the removal of jammed copying paper, the inspection, adjustment, repair and

the like of the fixing device, the image transfer device and the cleaning device can be much facilitated without disassemblying the machine.

Even when the original is inserted into the inlet in any position, it is automatically placed in correct position. Therefore, the operator can reproduce a large number of copies without fatigue and without excercising much care in insertion of original.

Even when original makes one rotation, it is exposed twice. Therefore, the copying speed can be much enhanced. Since the original is not subjected to bending, even the original which has a tendency of being folded may be completely copied.

The toner supply container is attached to and detached from the developing device, with its inlet remained upstanding. Therefore, the supply of new toner can be much facilitated.

Since the developing agent can be supplied from the developing agent supply container to the inside of the developing device, the images of the reproduced copies can be much improved in quality.

The photosensitive member can be attached to the drum in a simple manner, and for replacement thereof, it is not required to remove the whole drum from the machine.

We claim:

1. An electrophotographic copying machine comprising a repetitively usable electrophotographic photosensitive member; a group of elements including an electrostatic latent image forming means, developing means, transferring means and cleaning means, said elements being disposed sequentially around said photosensitive member, and said developing means and cleaning means being contactable with said photosensitive member; transfer material feeding means; fixing means; a lower main body portion for supporting said photosensitive member, electrostatic latent image forming means, developing means and cleaning means; and an upper main body portion for supporting said transferring means and said fixing means wherein, upon separation of said lower and upper main body portions, said photosensitive member and a path for the transfer material are accessible.

* * * * *