United States Patent [19]

Isonaka et al.

[11] **3,841,750**

[45] **Oct. 15, 1974**

[54] **ELECTROPHOTOGRAPHIC TRANSFER-PRINTING DEVICE**

[75] Inventors: **Kenji Isonaka,** Tokorozawa; **Saburo Hokari,** Kawasaki; **Tatsuya Watanabe,** Yokokama; **Masamichi Furukawa,** Kawasaki, all of Japan

[73] Assignee: **Ricoh Co., Ltd.,** Tokyo, Japan

[22] Filed: **May 21, 1973**

[21] Appl. No.: **362,508**

[30] **Foreign Application Priority Data**

May 23, 1972 Japan 47-51010

[52] **U.S. Cl.** ..... **355/3 R,** 355/16, 355/12, 96/1 R, 271/DIG. 2

[51] **Int. Cl.** **G03g 15/18,** G03g 15/00

[58] **Field of Search** ..... 355/3 R, 16, 12; 96/1 R; 271/54, DIG. 2

[56] **References Cited**

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Primary Examiner—Robert P. Greiner
Attorney, Agent, or Firm—Cooper, Dunham, Clark, Griffin & Moran

[57] **ABSTRACT**

A sheet of card material which comprises a dielectric layer disposed over a conductive layer and a photoreceptor bearing an electrostatic latent image are pressed against each other and a transfer-printing roller is passed over them to transfer-print the latent image from the photoreceptor onto the card material. A stripper cooperates with the transfer-printing roller to peel off the card material from the photoreceptor as the transfer-printing roller is moving. A conductive member cuts into the card material while the transfer-printing is carried out in order to correctly position the card material and in order to electrically connect the card material to a selected potential point. Discharge pawls move in slaved relation to the transfer-printing roller to discharge the card material from its transfer-printing position after the electrostatic latent image is transferred to it.

10 Claims, 50 Drawing Figures

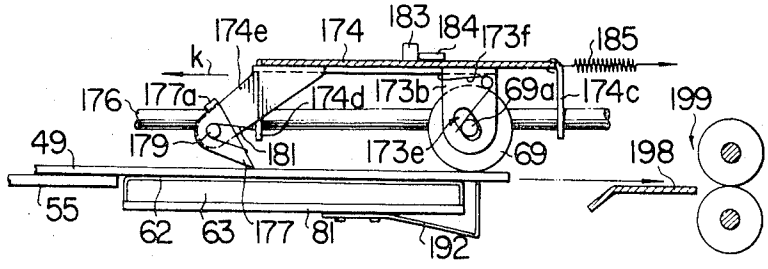


FIG. 1

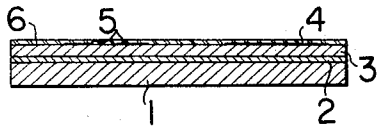


FIG. 2

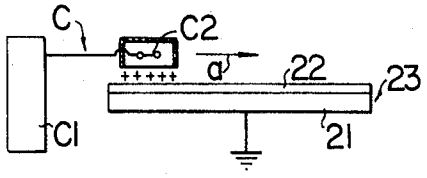
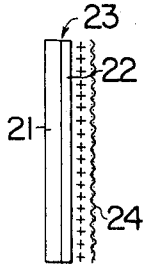


FIG. 3



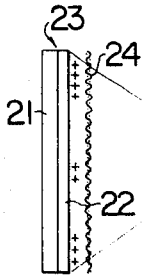


FIG. 4

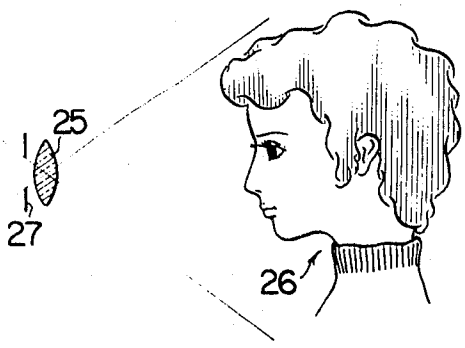


FIG. 5

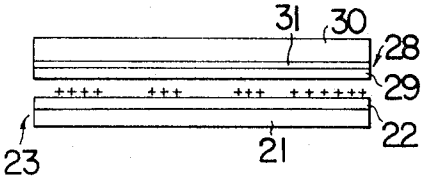
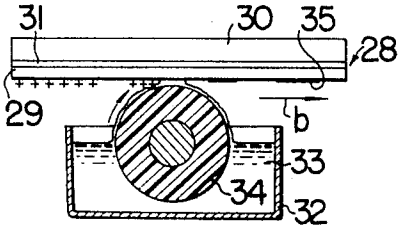


FIG. 6



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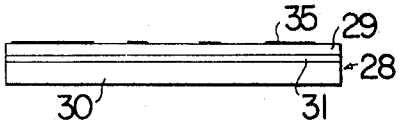
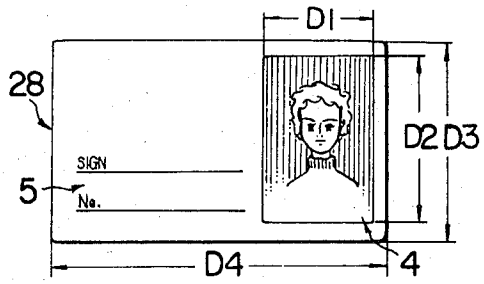


FIG. 8



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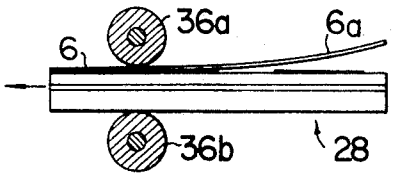

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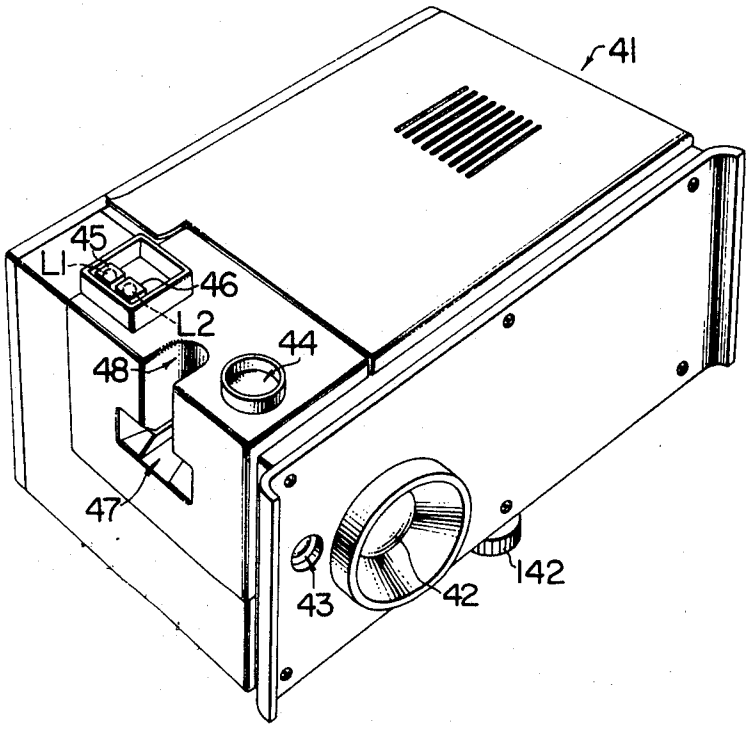
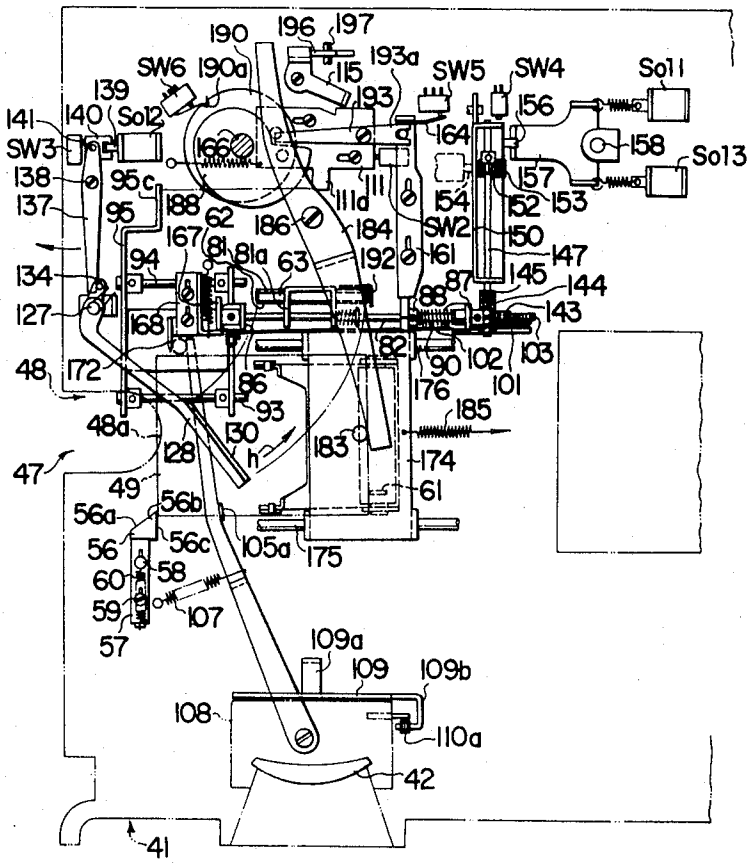


FIG. 11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SW5
SW4
So11
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140
So12
164
158
SW3
166
157
So13
138
95c
111
154
152
153
137
188
62
111d
186
184
SW2
150
95
167
81
81a
63
192
161
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94
145
134
87
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88
143
127
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90
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103
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172
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48a
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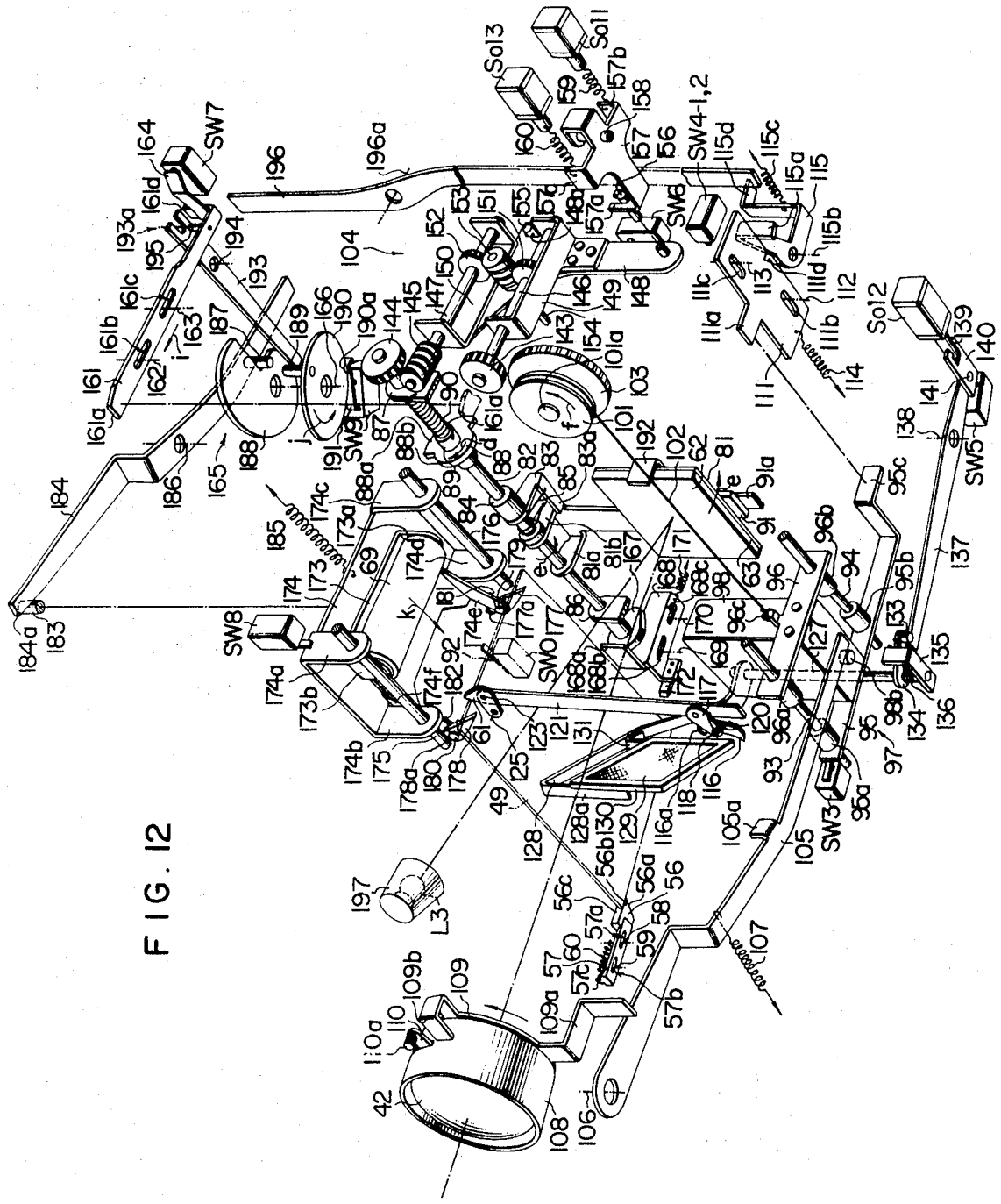
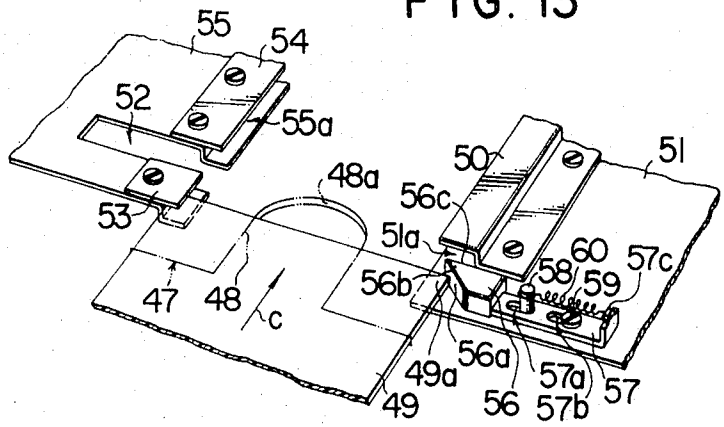


FIG. 12

FIG. 13



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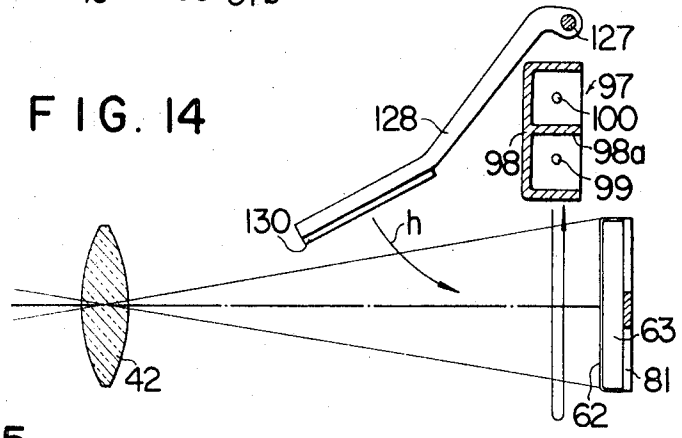
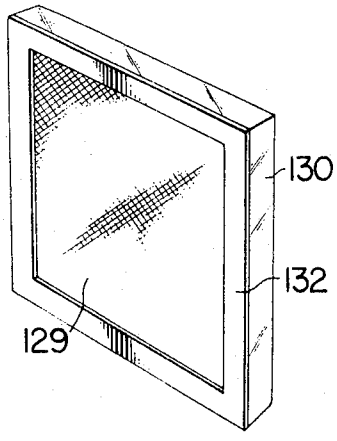


FIG. 15



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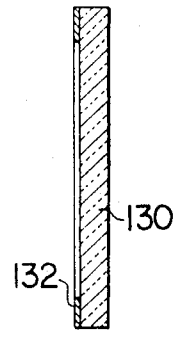

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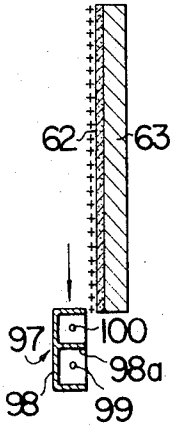

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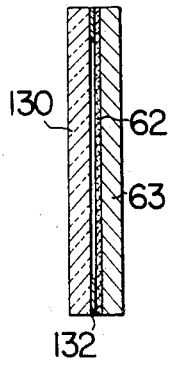

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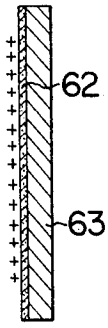

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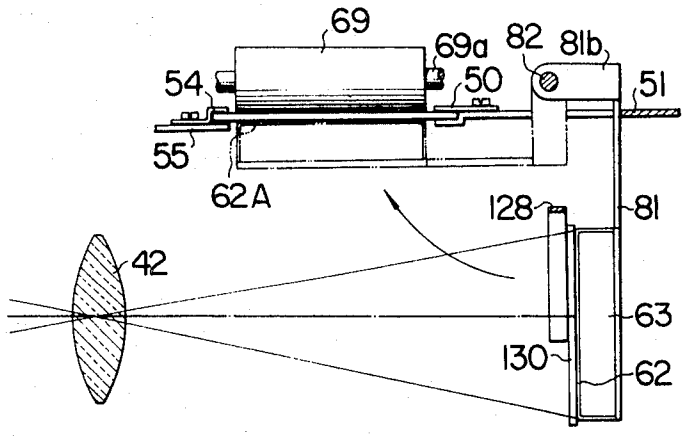

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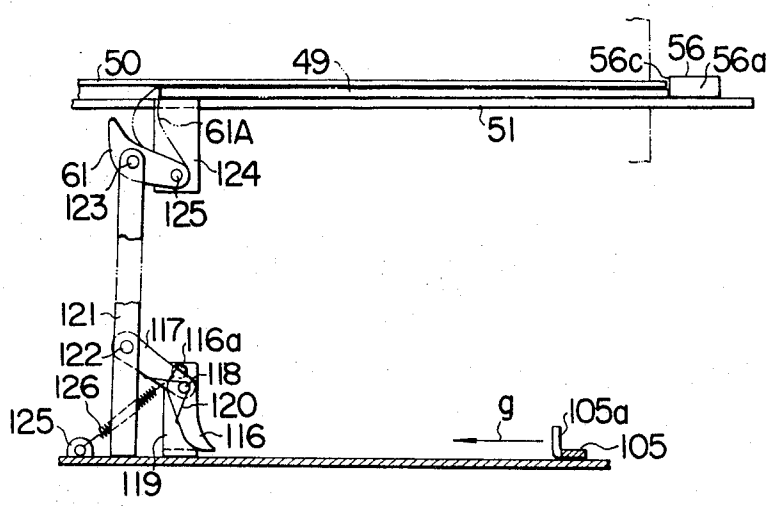

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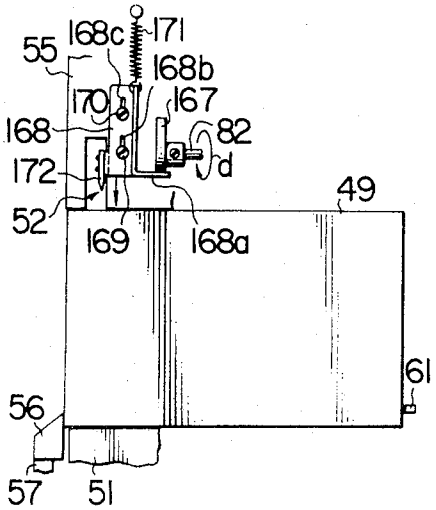

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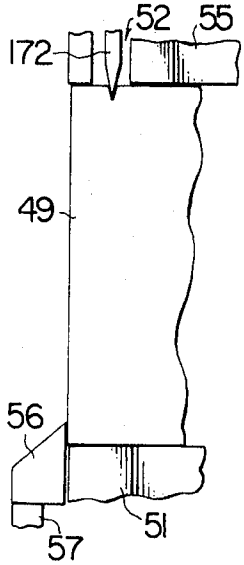

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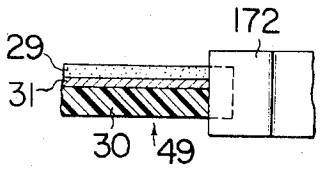

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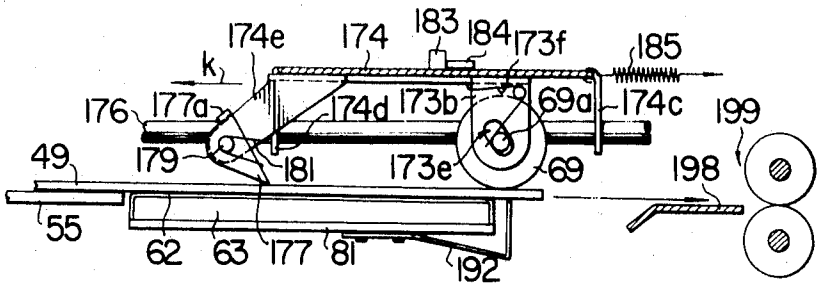


FIG. 26

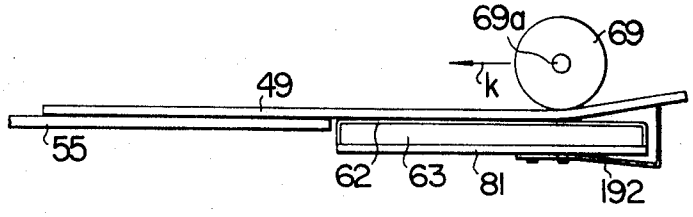


FIG. 27

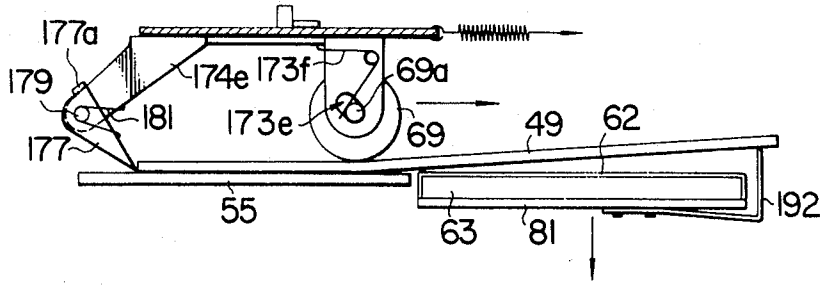


FIG. 28

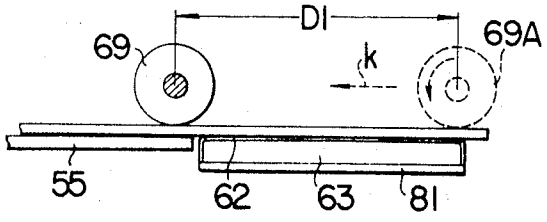


FIG. 29

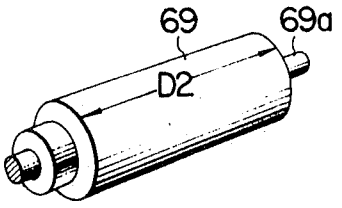
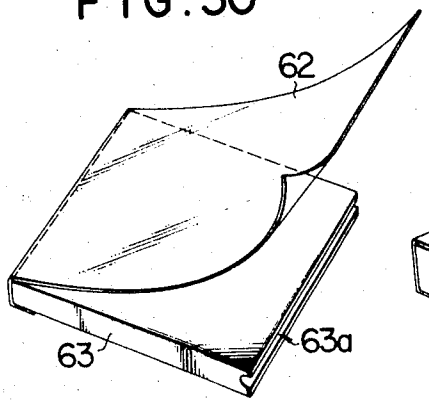


FIG. 30



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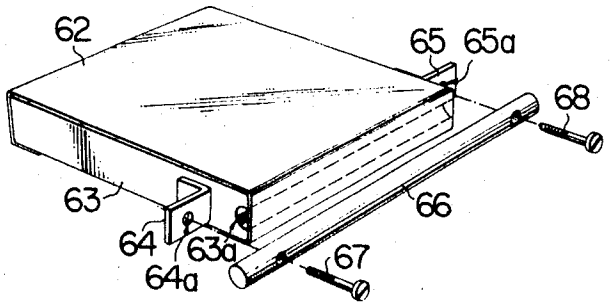

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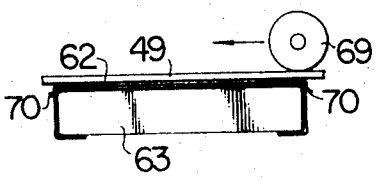

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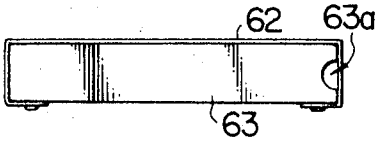
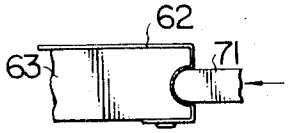


FIG. 34



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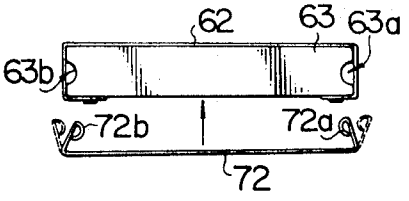

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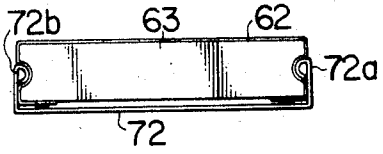

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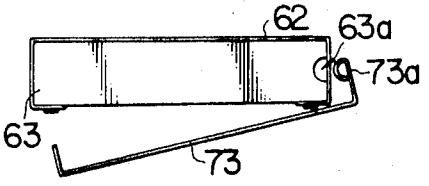


FIG. 39

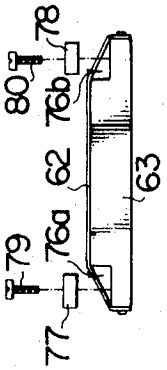


FIG. 38

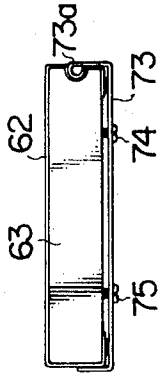


FIG. 40

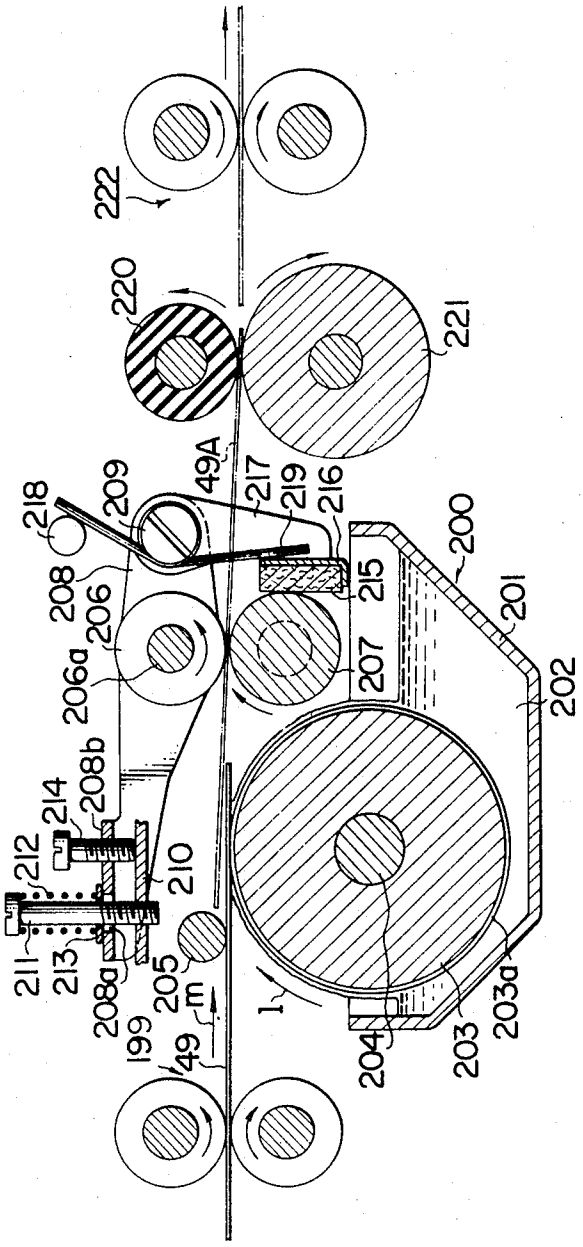


FIG. 41

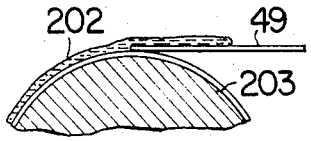


FIG. 42a

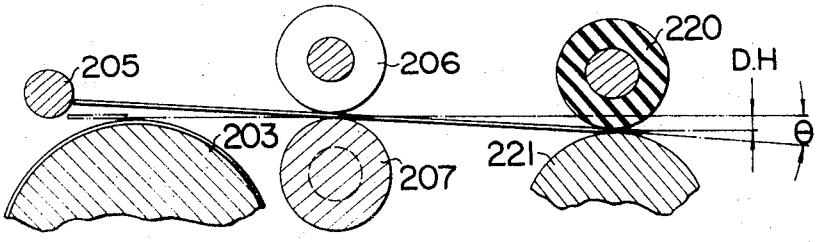


FIG. 42b

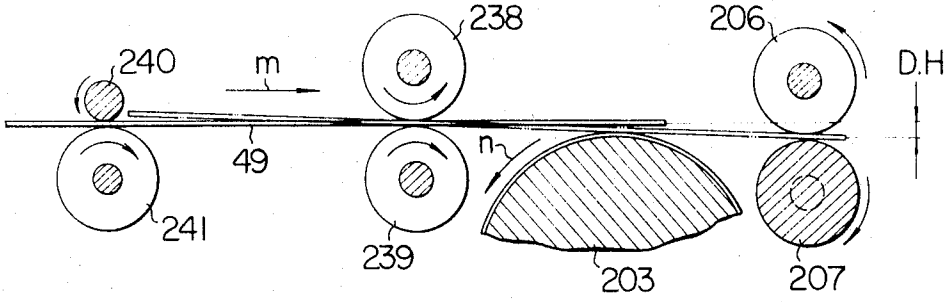


FIG. 43

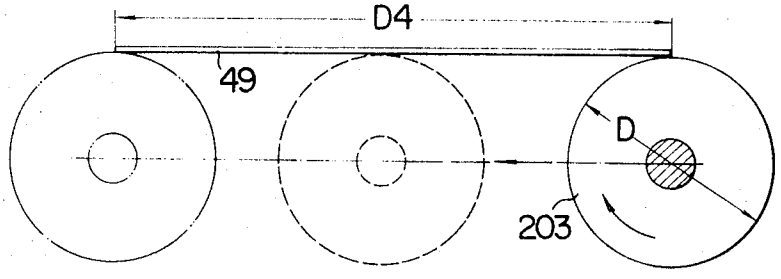


FIG. 44

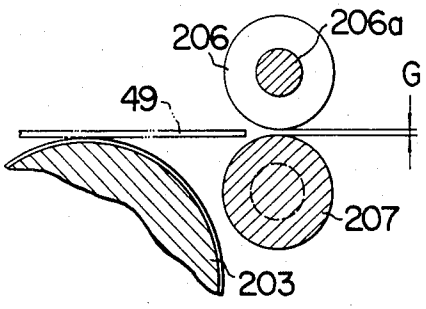


FIG. 45

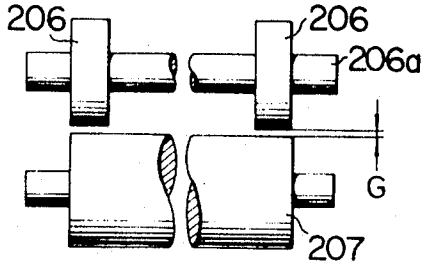


FIG. 46

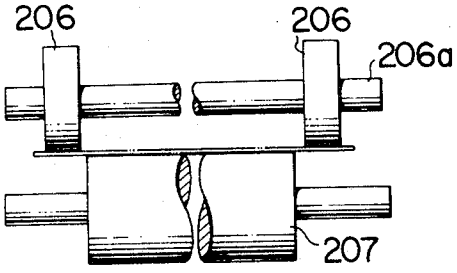


FIG. 47

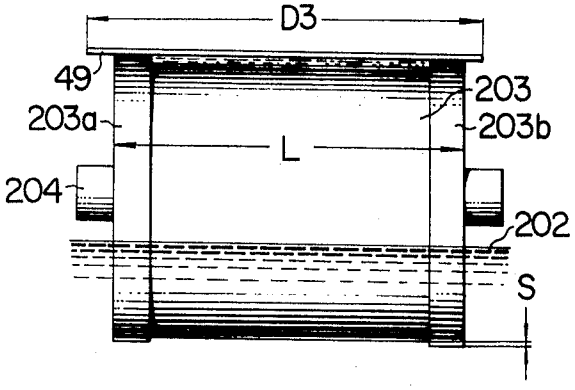


FIG. 48

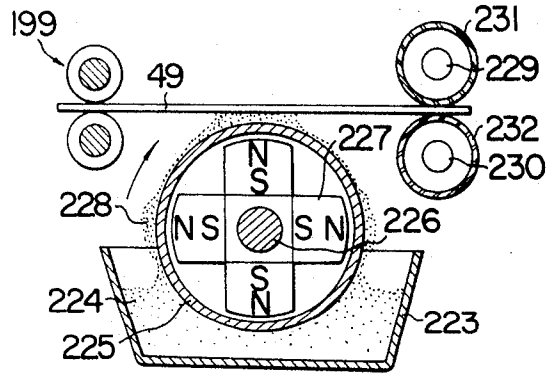
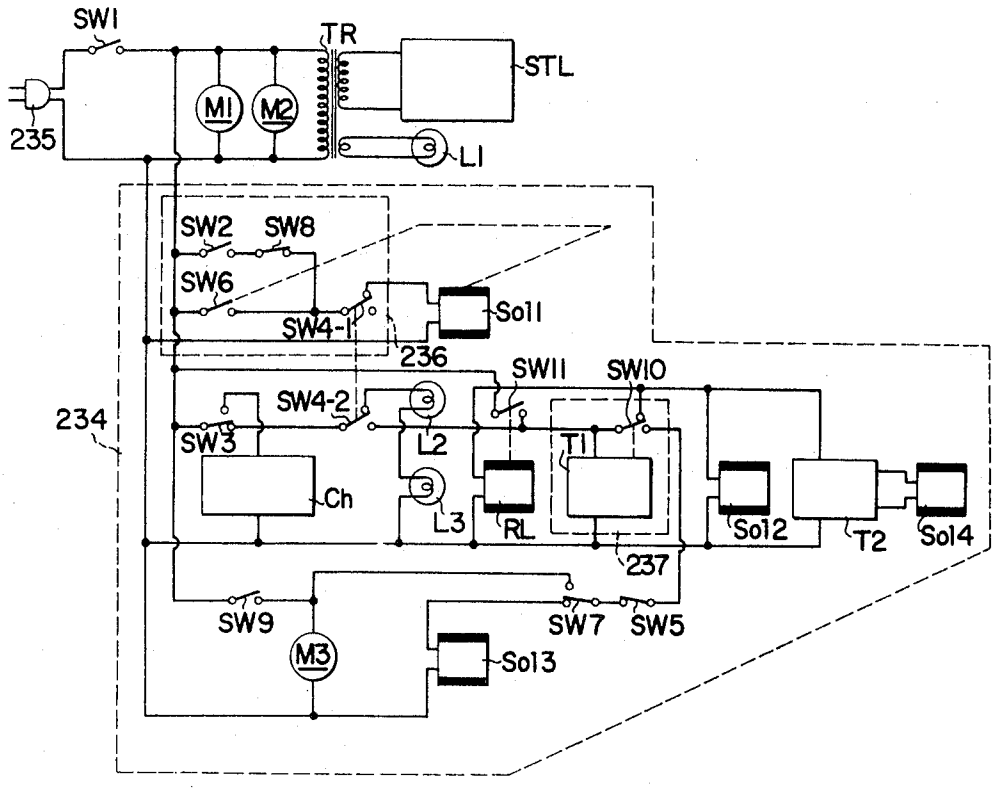


FIG. 49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M2
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L1
SW2
SW8
SW6
SW4-1
Sol1
236
SW11
SW10
234
SW4-2
SW3
L2
T1
Ch
L3
RL
Sol2
T2
Sol4
237
SW9
SW7
SW5
M3
Sol3

ELECTROPHOTOGRAPHIC TRANSFER-PRINTING DEVICE

BACKGROUND OF THE INVENTION

The invention relates to electrophotographic transfer-printing devices. In electrophotography, a photoconductive material layer of a photoreceptor is charged electrically and is exposed to the optical image of an original to form an electrostatic latent image thereof on the photoreceptor. Then, a dielectric material layer of a transfer-printing sheet is pressed against the photoconductive layer bearing the latent image to thereby transfer that image from the photoreceptor to the dielectric material layer of the transferprinting sheet. This technique is commonly used in electrophotography devices in which the photoreceptor is a drum. When drum type photoreceptors are used, the photoreceptor drum is engaged by a pressing drum and the transfer-printing sheet is passed between the pressing drum and the photoreceptor drum. The pressure between the pressing drum and the photoreceptor drum may be high in order to carry out satisfactory transfer-printing.

However, when the photoreceptor is planar, difficulties may be experienced in attempting to apply uniform high pressure between the photoreceptor and the transfer-printing sheet because the area of contact between the two surfaces may be great. This is especially true when the transfer-printing sheet is made of a relatively hard and stiff material, such as for example, the card material used for producing identification cards. It is therefore desirable to find a way to carry out effective transfer-printing when the photoreceptor is planar and the transfer-printing sheet is relatively stiff.

SUMMARY OF THE INVENTION

The invention is in the field of transfer-printing of electrophotographic latent images. One object of the invention is to provide satisfactory transfer-printing of electrostatic latent images when the photoreceptor is planar and the transfer-printing sheet is made of relatively stiff material. Another object of the invention is to ensure proper positioning between a transfer-printing sheet and the photoreceptor during transfer-printing and to ensure suitable electrical potential at the transfer-printing sheet. A further object of the invention is to ensure that the transfer-printing sheet is properly separated from the photoreceptor as soon as transfer-printing of a portion thereof has been completed and to ensure the transfer-printing of a clean latent image of high quality.

These and other objects of the invention are embodied in a device for producing identification cards by first forming an electrostatic latent image of a card user or of an object or a planar photoreceptor, then bringing the latent image bearing side of the photoreceptor in contact with a card material comprising a dielectric layer facing the photoreceptor and a backing conductive layer, and then transfer-printing the latent image from the photoreceptor onto the dielectric layer of the card material.

Transfer-printing is carried out with the help of a transfer-printing roller moving in rolling motion over the card material which is over the photoreceptor. The portion of the card material over which the transfer-printing roller has just passed is gradually lifted from the photoreceptor by a stripper member to ensure proper and clean separation between the two. A sharp conductive member cuts into the card material while the card material and the photoreceptor are pressed together in order to properly position the card material with respect to the photoreceptor and in order to connect the conductive backing of the card material to a suitable electrical potential.

The device embodying the invention permits steady selected pressure to be applied to the card material and to the photoreceptor to carry out satisfactory transfer-printing of the latent image from the photoreceptor onto the card material even when the card material is relatively hard and stiff.

The use of the stripper member allows for gradually peeling off the card material from the photoreceptor as soon as transfer-printing of a portion thereof is finished. This prevents undesirable smearing and otherwise degrading the transferred latent image. Other advantages of the invention will become apparent from the detailed description below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of an identification card produced by an identification card producing apparatus in which the subject invention is incorporated.

FIGS. **2** through **9** are explanatory views of the steps in a method for producing an identification card in which this invention may be used.

FIG. **10** is a perspective view of an identification card producing apparatus in which this invention is incorporated.

FIG. **11** is a plan view of the internal structure of the apparatus of FIG. **10.**

FIG. **12** is a schematic view of the internal structure of the apparatus of FIG. **10** as seen from below.

FIG. **13** is a schematic view showing the construction of the passage for the card material into the apparatus of FIG. **10.**

FIG. **14** is a plan view showing a charging device, a screen and a projecting lens of the apparatus of FIG. **10.**

FIG. **15** is a perspective view of a fine mesh screen.

FIG. **16** is a sectional view of the screen of FIG. **15.**

FIGS. **17** through **19** are sectional views of the charging device and screen in relation to a photoreceptor.

FIG. **20** is a schematic view showing the photoreceptor at a photographing position and at a transfer-printing position.

FIG. **21** is a side view of a return means for positioning a card material.

FIGS. **22** and **23** are plan views showing the manner in which a card material is electrically grounded and fixed in position.

FIG. **24** is a sectional view of a card material and a knife of a transfer-printing device according to the invention.

FIGS. **25, 26,** and **27** are sectional views of a transfer-printing device and a transfer-printing step according to the invention.

FIG. **28** is a schematic view showing the range of movement of a transfer-printing roller of the device according to the invention.

FIG. **29** is a perspective view of the transfer-printing roller showing its construction.

FIGS. 30 and 31 are perspective views showing the manner in which the photoreceptor is mounted on a backing plate.

FIGS. 32 through 39 are side views showing means for stretching the photoreceptor after it is mounted on the backing plate.

FIG. 40 is a sectional view illustrating a developing device for developing the electrostatic latent image formed on the card material by the transfer-printing device according to the invention.

FIGS. 40 through 47 are schematic views showing portions of the developing device of FIG. 40.

FIG. 48 is a sectional view of another embodiment of a developing device.

FIG. 49 is a circuit diagram showing control means for the identification card producing apparatus of FIG. 10.

DETAILED DESCRIPTION

An identification card prepared in accordance with the subject invention is illustrated in FIG. 1 and comprises a supporter 1, a conductive material layer 2 deposited over the supporter 1, and a dielectric layer 3 deposited over the conductive material layer 2. A toner image 4, which may be the photographic image of a person, is on the dielectric layer 3, and markings 5, which may be printed or handwritten matter, stamps and the like are also on the dielectric layer 3. A transparent protective layer 6 is deposited over the dielectric layer 3 to protect the toner image 4 and the markings 5 thereon.

The supporter 1 may be a relatively thick sheet of paper or of a synthetic resinous material and its stiffness may be further increased by applying a backing material to it. The conductive material layer 2 may be deposited on the supporter 1 by vapor deposition of aluminum in vacuum, or by other suitable means. The dielectric material layer 3 may be of a material such as an acrylic resin, methacrylic resin, vinyl chloride or the like, and may be deposited on the conductive material layer 2 by the use of a binder. The dielectric material layer 3 may be formed by using a binder including a photoconductive material, such as zinc oxide, polyvinyl carbazol or the like. If a sheet of a suitable metal or of rubber is used as the supporter 1, the conductive material layer 2 may be eliminated. The toner image 4 may be formed by first forming an electrostatic latent image of a person and then developing the latent image such as by powedered toner particles. The markings 5 may be entered by printing, stamping or handwriting or by any other suitable means. The transparent material layer may be formed by applying a film of vinyl chloride or other synthetic resinous material, or by applying a solution of a synthetic resinous material used as a laminating material, or by immersing the card in such solution.

It is noted that an identification card of the type described above does not rely on silver salt photography and can therefore be produced without the cumbersome steps involved in producing a photographic print. Further, the prior art need to paste a silver salt photographic print onto an identification card, to affix a seal to the card material or to make another type of an impression on the photographic print and on the card material is eliminated, because the entry of markings necessary for identifying the card user may be made directly on the surface of the photographic image either by handwriting, printing, stamping, or the like.

Still further, the toner image formed in accordance with the invention is not subject to fading. The toner image formed on an identification card in accordance with the invention has a sufficient range of half tones, and it is neither too sharp in contrast or too poor in contrast as sometimes happens with ordinary photographic images. The toner image is of high quality and is effective to identify the card user.

The invention may be explained in a simplified manner by reference to the seven basic steps discussed in connection with FIGS. 2 through 9. These steps are as follows:

Step 1 (FIG. 2). A photoreceptor 23 comprises a photoconductive material layer 22 deposited on a supporter 21 which is electrically conductive. The supporter 21 may be made of material such as aluminum, copper or other electrically conductive materials, and the photoconductive material layer 22 may be vapor deposited in vacuum and may comprise materials such as selenium, zinc oxice, poly-N-vinyl carbazol or other photoconductive materials. The photoconductive material layer 22 is uniformly charged throughout its entire surface by a corona discharge produced by a charger C having a wire electrode C2 connected to a high voltage power source C1 and moved in the direction of an arrow *a*.

A high bias voltage of a polarity consistent with the charge characteristics of the photoconductive material layer 22 is impressed on the wire electrode C2 in order to suitably charge the layer 22. For example, if the layer 22 comprises selenium, the bias voltage would be positive. A bias voltage of the opposite polarity is impressed on the supporter 21, or the supporter 21 may be grounded as shown. The supporter 21 may be backed or framed by a suitable insulating plate (not shown).

Step 2 (FIG. 3). A screen 24 is disposed immediately adjacent the photoconductive material layer 22 after the layer 22 is uniformly charged throughout its entire surface. The screen 24 may be a fine mesh screen of a material such as insulated synthetic resinous material sheet formed with a plurality of very small openings by a process such as photo-etching. Alternately, the screen 24 may be a glass sheet ruled with a fine grid of cross lines. The purpose of the screen 24 is to produce a mesh point effect in the image which is projected onto the photoconductive material layer 22 in the next step 3. The size of the opening of the mesh screen 24 is selected to produce dots which are beyond the resolving power of the human eye at a normal reading distance.

Step 3 (FIG. 4). The photoconductive material layer 22 is exposed to an optical image of a person 26 through a projection lens 25. The fine mesh screen 24 is between the photoconductive layer 22 and the projection lens 25. A diaphragm 27 is opened for a suitable period, such as one-thirtieth of a second. The sensitivity of the photoconductive material layer 22 may be increased by using a coloring matter or other sensitivity increasing agent. The spacing between the fine mesh screen 24 and the photoconductive material layer 22 is selected such that the screen mesh can be photographed on the surface of the photoconductive material layer 22 by the projection lens 25. It should be clear that a photographic latent image on the layer 23 may

be formed by photographing either a person **26**, or a photograph or another image thereof, or by photographing another object.

Step **4** (FIG. **5**). After a latent image is formed on the layer **23** in step **4**, a sheet of card material **28** is brought in contact with the photoreceptor **23** such that the dielectric material layer **29** of the card material **28** faces the latent image bearing photoconductive material layer **22** of the photoreceptor **23.** The photoelectric latent image is transferred to the dielectric material layer **29** of the card material **28** by transfer printing. The card material **28** is identical with the card material discussed in connection with FIG. **1**, except that it does not have the transparent layer **6** or the markings **5** or the toner image **4** of the card material shown in FIG. **1.** Transfer printing of the type shown in FIG. **5** can be carried out by pressing the photoreceptor **23** and the card material **28** against each other with sufficient force, such as by a suitable roller arrangement. The conductive material layer **31** of the card material **28** may be electrically grounded, or a bias voltage of a suitable polarity and level may be impressed on the conductive material layer **31**, as is conventional in transfer-printing.

Step **5** (FIGS. **6** and **7**). After step **4**, the card material **28** bears an electrostatic latent image. The purpose of step **5** is to develop this latent image into a visible image. This may be done by suitable developing means such as the means illustrated schematically in FIG. **6** where the card material **28** is conveyed by suitable conveyor means (not shown) in the direction of an arrow *b* and the dielectric material layer **29** thereof is brought in contact with the periphery of a developing roller **34** which is partly immersed in a developing liquid **33** in a container **32.** The developing roller **34** may be a conductive metallic roller made of materials such as copper or aluminum, or may be a conductive rubber roller. The developing liquid **33** includes fine toner particles which are supplied to the electrostatic latent image to convert it into a visible toner image **35.** Any other suitable device for developing electrostatic latent images may be used. The toner contained in the developing agent may comprise fine powder of carbon black or other pigment treated with a resin.

Step **6** (FIG. **8**). Markings such as the signature and identification number, and other particulars of the card user may be entered on the same surface of the card material **28** which bears the developed visible image **35.** The markings may be entered by handwriting, typing, printing, stamping or the like.

Step **7** (FIG. **9**). A transparent protective film **6***a* is laminated onto the surface of the card material **28** which bears the visible image and the markings. The lamination is carried out with the help of laminating rollers **36***a* and **36***b* in a conventional manner. After lamination, the identification card according to the invention is ready for use. It should be clear that instead of laminating, the card material may be protected by other suitable means, such as by synthetic resinous material in liquid form applied to the card material surface, or the card material may be impregnated with such liquid.

The seven steps discussed above are only a brief and simplified explanation of some of the major steps involved in practicing the invention. A specific device embodying the invention is described below.

Referring to FIG. **10**, an identification card producing device according to the invention comprises a casing **41** which has a front side with a taking lens **42** and a finder objective window **43.** The top side of the casing **41** has a finder window **44**, a push-button **45** for a main off-on switch SW1 and a push-button **46** for a shutter release switch SW2. The push-button **45** has a built-in lamp L1 to indicate that the device is on, and the push-button **46** has a built-in lamp L2 to indicate that the shutter release is operable as subsequently described in connection with FIG. **49.**

Referring to FIG. **10** again, a cutout **48** is formed in the upper portion of the card material feed port **47** at the left side of the device **41.** A card material **49** (see FIG. **11**) may be inserted in the port **47** and is pushed rightwardly to a position in which its trailing end is substantially aligned with an innermost edge **48**a of the cutout **48** (FIG. **11**). The card material **49** is identical with the card material **28** discussed above.

Referring to FIG. **13**, support plates **51** and **55** are disposed inwardly of the card material feed port **47** of the casing **41.** The support plate **51** has a support bar **50** mounted on one marginal portion thereof to define a guide recess **51***a*, and the support plate **55** has a cutout **52** and a support bar **54** to define an outer guide recess **55***a*. The two guide plates **51** and **55** are disposed such that the card material **49** inserted through the port **47** moves in the direction of an arrow *c* with the side margins of the card material **49** received within the guide recesses **51***a* and **55***a*. The vertical dimension of the guide recesses **51***a* and **55***a* is such that the card material **49** can be maintained in a horizontal position as the card moves in the direction of the arrow *c*. Referring still to FIG. **13**, a positioning member **56** is disposed at the right forward side of the card material feed port **47.** The positioning member **56** has an inwardly inclined edge **56***a* to guide the right front shoulder **49***a* of the card material **49** as it is inserted into the port **47.** The positioning member **56** is secured to one end of a bar **57** which has slots **57***a* and **57***b* and is slidably supported on the support **51** by a pin **58** extending from the support plate **51** and loosely received in the slot **58***a*. A screw **59** is threaded into the support plate **51** and is loosely received in the slot **57***b* of the bar **58.** The bar **57** has at its right-hand end an upwardly bent portion **57***c*, and a spring **60** connects the upwardly bent portion **57***c* and the pin **58** to urge the bar **57** leftwardly.

When the card material **49** is inserted through the port **47** into the casing **1**, the right front shoulder **49***a* thereof pushes the positioning member **56** out of the card material passage against the biasing force of the spring **60.** As the card material **49** is pushed further into the casing **60**, the left edge of the positioning member **56** is maintained in engagement with the right-hand side of the card material **49.** However, when the trailing end of the card material **49** has passed through this portion of the passage, the positioning member **56** is moved leftwardly by the spring **60**, such that its left-hand portion **56***b* is again disposed in the passage of the card material (FIG. **11**).

The positioning member **56** has a major edge **56***c* which engages the trailing end of the card material **49** to correctly position the card material when it is pushed backwardly by a card material push-back pawl **61** after it has been pushed in to the casing **41.** This position of the card material **49** is shown in FIG. **11.** As described

in detail below, the position of the card material **49** shown in FIG. **11** is the transfer printing position in which the card material **49** and a photoreceptor **62** (FIG. **12**) are pressed against each other so that an electrostatic latent image which is at this time on the photoreceptor **62** is transferred onto the card material **49.** The photoreceptor **62** is identical in construction with the photoreceptor **23** discussed in connection with FIGS. **2** through **5.**

The photoreceptor **62,** and several ways of mounting the photoreceptor **62** onto a backing plate **63** (which corresponds to the backing plate **21** of FIGS. **2** through **5**) are shown in detail in FIGS. **30** through **39.**

Referring to FIGS. **30** and **31,** the photoreceptor **62** is shown as a relatively thin sheet and the backing plate **63** is shown as a relatively thick plate having a U-shaped groove **63***a* at its back edge. The photoreceptor **62** is sufficiently long so that its front and back ends can fold over the front and back ends respectively of the backing plate **63.**

The photoreceptor **62** is used to form thereon an electrostatic latent image and then to transfer this electrostatic latent image onto the card material **49** by transfer printing. A transfer printing operation of this type is illustrated schematically in FIG. **32,** and it can be seen that it is desirable that the photoreceptor **62** be tightly stretched over the backing plate **63** in order to avoid distortions of the transferred image. As seen in FIG. **32,** if the top portion of the photoreceptor **62** is not properly tensioned over the backing plate **63,** wrinkles and other distortions may form as a transfer printing roller **69** is moved in the indicated direction.

Several suitable arrangements for tensioning the photoreceptor **62** over the backing plate **63** are shown in FIGS. **31** and **33** through **39.** Referring to FIG. **31,** a pair of mounting members **64** and **65** are secured to the sides of the backing plate **63** which flank the groove **63***a*. A round bar **66** is inserted in the groove **63***a*, over the folded end of the photoreceptor **62,** and screws **67** and **68** are inserted through suitable openings in the round bar **66** and are threaded into suitable threaded openings **64***a* and **65***a* respectively of the mounting members **64** and **65** to fasten the round bar **66** to the backing plate **63** and to thereby tension the photoreceptor **62.**

Referring to FIG. **33,** the photoreceptor **62** may be secured to the backing plate **63** by suitable screws fastening the folded over ends of the photoreceptor **62** to the underside of the backing plate **63.** Alternately, the folded over ends of the photoreceptor **62** may be adhesively bonded to the underside of the backing plate **63.** When the photoreceptor **62** is secured to the backing plate **63** as shown in FIG. **33,** the photoreceptor **62** may be tensioned by a keep bar **71** disposed as shown in FIG. **34.** The function of the keep bar **71** is similar to that of the round bar **66** shown in FIG. **31.** An alternate way of tensioning the photoreceptor **62** is shown in FIGS. **35** and **36** and involves the use of a resilient stopper plate **72** having stopper ends **72***a* and **72***b*. The stopper plate **72** is attached to the underside of the backing plate **63** and the end stoppers **72***a* and **72***b* thereof are inserted in grooves **63***a* and **63***b* respectively of the backing plate **63** over the folded ends of the photoreceptor **62.** An alternate type of a stopper plate is shown in FIGS. **37** and **38** where a stopper plate **73** has a single stopper end **73***a* which cooperates with a groove **63***a* in the backing plate **63.**

A still alternate manner of tensioning the photoreceptor **62** over the backing plate **63** is illustrated in FIG. **39** and involves the use of a stopper plate **63** having offset portions **76***a* and **76***b* at its front and back ends respectively. After the front and back ends of the photoreceptor **62** are secured to the front and back sides of the backing plate **63** respectively by suitable screws or otherwise, keep bars **77** and **78** are placed on the offset portions **76***a* and **76***b* respectively, over the front and back ends of the photoreceptor **62** respectively, and are fastened to the backing plate **63** by suitable screws **79** and **80** to tension the photoreceptor **62.**

Referring to FIG. **12,** a photoreceptor **62** mounted on a backing plate **63** in one of the several possible ways discussed above is mounted on a photoreceptor support plate **81.** The plate **81** has arms **81***a* and **81***b* that are loosely supported by a shaft **82** disposed on the right side of the card material passage and parallel thereto, so that the photoreceptor **62** is maintained in the photographic position shown in FIG. **12.**

Arm means **83** are disposed to the right of the arm **81***b* and are firmly secured to the shaft **82** at a tubular portion **84** thereof. The arm means **83** are bent substantially in the middle so that the front end **83***a* thereof may be disposed beneath the arm **81***b*. A coil spring **85** urges the arm **81***b* toward a pressing engagement with the forward end **83***a* of the arm means **83.**

The shaft **82** is rotatably supported by fixed supporters **86** and **87,** and a cam **88** having an arcuate major diameter portion **88***a* is secured to a portion of the shaft **82,** on the side of the supporter **87,** by a boss **89** thereof which is fitted over the shaft **82.** The shaft **82** is urged to rotate in the direction of the arrow *e* by the biasing force of a coil spring **90.**

The supporter **81** is maintained in engagement with a plate shaped stopper **91** as the shaft **82** tends to rotate in the direction of the arrow *e* under the biasing force of the spring **90.** The stopper **91** is positioned by a positioning member **91***a* so that the photoreceptor **62** can be correctly positioned at its photographing position relative to the taking lens **42.**

Two rails **93** and **94** are parallel to each other and to the surface of the photoreceptor **62** and are disposed in front of and below the photoreceptor **62.** The rails **93** and **94** have bosses **95***a*, **95***b*, **96***a*, and **96***b* which are fitted over two charging device support bars **95** and **96** respectively to thereby mount the bars **95** and **96** slidably on the rails **93** and **94** respectively.

The rails **93** and **94** of FIG. **12** support a charging device **97** which is illustrated in FIG. **14.** Referring to FIG. **14,** the charging device **97** includes a frame **98** affixed to the charging device support bars **95** and **96** and including wire electrodes **99** and **100** separated from each other by a partition **98***a*. A high bias voltage of a suitable polarity is impressed on the wire electrodes **99** and **100** by a suitable high voltage source Ch (FIG. **49**) in the course of the charging step described below.

Referring back to FIG. **12,** the charging device support bar **96** has at its center a projection **96***c* supporting one end of a wire **102** which is wound on a pulley **101.** The pulley **101** is adapted to be connected through a gear **103,** affixed to a shaft **101***a*, to a drive mechanism **104** connected to a motor M1 (FIG. **49**). Referring to FIG. **49,** upon the energization of a solenoid SOL1 after the shutter release SW2 is closed and a charging initiation command is issued, the gear **103** and the pul-

ley **101** are connected to the drive mechanism **104** to start rotating in the direction of an arrow *f*.

Referring to FIG. **12**, the charging device **97** is originally at its initial position leftwardly of the photographing position shown in the figure while in the initial position, the charging device support bar **95** keeps a switch SW3 in a depressed position. As the pulley **101** starts rotating in the direction of the arrow *f*, the charging device **97** is pulled by the wire **102** and passes by the front of the photoreceptor **62**. At the same time, the switch SW3 is released from the depressed position and actuates the high voltage source Ch (FIG. **49**), which impresses a suitable voltage on the wire electrodes **99** and **100** to thereby charge the entire surface of the photoconductive material layer of the photoreceptor **62** by a corona discharge. The motion of the charging device **97** is illustrated in FIG. **14**.

Referring back to FIG. **12**, a pin **98***b* is secured to the underside of the frame **98** of the charging device **97**. A lever **105** has a front end which is disposed to the right of the pin **98***b* and is pivotally supported at its base by a shaft **106**. The lever **105** is normally urged by the biasing force of a spring **107** to move clockwise. A shutter charging arm **109***a* is integral with a ring **109** mounted on a tube **108** of the projection lens **42**. The arm **109***a* is disposed to the right of the base of the lever **105**. The ring **109** has a pressing arm **109***b* designed to engage a set lever **110** for a shutter (not shown). When the charging device **97** moves from its initial position as described below, the shutter charging arm **109***a* is pushed and moved through the pin **98***d* and the lever **105**. This rotates the ring **109** in the direction of the shown arrow such that the pressing arm **109***b* engages the projection **110***a* of the set lever **110** to thereby charge the shutter. It should be clear that other suitable shutter charging means may be employed. For example, a shutter of the type that is normally set may be employed and may be charged by a suitable motor actuated upon a suitable operation command.

A command to energize the solenoid SOL1 to move the charging device **97** from its initial position and to actuate the high voltage source Ch to start a corona discharge may be issued by a switch SW0 disposed below the passage of the card material **49** and having an actuator **92** adapted to be depressed by the card material **49** as it moves along its passage after being inserted in the card feed port **47** (FIG. **10**). The switch SW0 may be disposed at any other suitable position, and may be replaced by suitable card material sensing means (not shown) using a photoelectric transducer element or the like. Alternatively, the solenoid SOL1 may be actuated in response to the closing of the main switch SW1.

Referring to FIG. **12** again, the charging device support bar **95** extends to the right and has a bent end portion **95***c* adapted to depress a projection **11***a* formed in a plate shaped actuator **111** of a double throw switch SW4-1,2 when the charging device **97** moves from its initial position. The actuator **111** has slots **111**d and **111**c which receive support shafts **112** and **113** respectively for moving the actuator **111** in sliding motion in the same direction as the end portion **95***c* of the support bar **95**. The actuator **111** is urged by the biasing force of a spring **114** to move away from the double throw switch SW4-1,2. When the bent end portion **95***c* of the support bar **95** depresses the projection **111**a, the actuator **111** moves toward the double throw switch SW4-1,2 against the biasing force of a spring **114** to depress the switch SW4-1,2.

The double throw switch SW4-1,2 includes a switch SW4-1 whose function is to deenergize the solenoid SOL1 which actuates the gear **103** and the pulley **101**. Thus, when the switch SW4-1 is closed, the charging device **97** starts returning to its initial position. When a lock lever **115** is brought into engagement with a cutout **111**d formed in the actuator **111**, the actuator **111** is locked in a position for holding the double throw switch SW4-1,2 in its depressed position. It should be understood that the double throw switch SW4-1,2 may be held in its depressed position by a self-holding circuit using a suitable relay (not shown), and that the charging device **97** may be returned to its initial position by eliminating the switch SW4-1 and using a timer (not shown) which is adapted to deenergize the solenoid SOL1 after a predetermined time delay following closing of the main switch SW1. The lock lever **115** is pivotally supported by a shaft **115***b* and is urged by the biasing force of a spring **115***c* to move into engagement with the cutout **111***d* formed in the actuator **111** as described above.

Referring to the left-hand portion of FIG. **12**, a projection **105***a* extends upwardly from the central portion of the arm **105**. A member **116** is loosely mounted on a shaft **118** that is loosely received through an end portion of an arm **117**. The member **116** extends in the path of the pivotal movement of the projection **105**. Referring to FIG. **21** for a clearer illustation, the shaft **118** is rotatably supported by a fixed supporter **119** and has thereon a spring **120** which is also secured to the member **116** and the arm **117**. The member **116** has a portion **116***a* adapted to be engaged by the arm **117** to permit the arm **117** to act as a single unit with the member **116**. The arm **117** is pivotally connected at its other end to a lower portion of a connector **121** that pivotally supports at its upper portion a push-back pawl **61** for pushing back the hard material **49** at the appropriate time. The pawl **61** is pivotally supported at its base through a shaft **125** by a supporter **124** affixed to the underside of a support plate **51**.

When the arm **105** moves in the direction of an arrow *g*, in associateion with the movement of the charging device **97** from its initial position, the member **116** is pressed in the same direction by the projection **105** in the terminating stage of the movement of the arm **105**. When pressed, the member **116** moves clockwise about the shaft **118**, and the arm **117** also moves with the member **116** as a unit by virtue of the biasing force of a spring **120**. The movement of the arm **117** is transmitted through the connector **121** to the pawl **61** which is moved from its position shown in solid line in FIG. **21** to the position shown in its dash and dot line in the same figure. The pawl **61** pushes th card material **49** backwardly and moves it until it engages the edge **56***c* of the positioning member **56**. The force with which the arm **105** pushes the member **116** after the pawl **61** has pushed the card material **49** backwardly is absorbed by the spring **120**.

When the charging device **97** begins to return to its initial position, the arm **105** is also restored to its original position, thereby releasing the member **116** from the pressure applied thereto. When a member **116** is released, the member **116**, the arm **117**, the connector **121** and the pawl **61** are all restored to their original positions by the biasing force of a spring **126** mounted

between the portion 116*a* of the member 116 and a fixed member 125. When the solenoid SOL1 is deenergized and the gear 103 and the pulley 101 are rendered inoperative, the charging device 97 is pulled back to its initial position through the pin 98*b* and the arm 105 by the biasing force of the spring 107 mounted on the arm 105. At the same time the support bar 95 depresses the switch SW2, so that the charging voltage is no longer present.

Referring back to FIG. 12, a screen support arm 128 is secured at its base to an upper end portion of a shaft 127 which is rotatably disposed to the left of the photoreceptor 62 which is at its photographing position. Secured to the support arm 128 is a screen 130 formed with a mesh 129 (FIGS. 15 and 16). The screen 130 is supported by a downwardly bent front end portion 128*a* of the arm 128 and by a stay 131 (FIG. 12). The screen 130 is identical in construction with the screen 24 discussed in connection with FIGS. 3 and 4 and has a margin defining frame 132 made of an electrically conducting material such as metal foil. In FIG. 12, an arm 137 having a pin 133 secured to its front end portion is pivotally supported at its base by the lower end portion of a shaft 127. A lock member 135 is secured to the shaft 127 and is disposed below the arm 134. Mounted on the shaft 127 and disposed between the lock 135 and the arm 134 is a spring 136 which urges the arm 134 to move in the counterclockwise direction in FIG. 11 and to cause the pin 133 to engage one end of a lever 137 from the right in FIG. 11. The lever 137 is pivotally supported by a shaft 138 and is loosely connected at the other end through a shaft 138 to a connector 140 that is in turn pivotally connected to an actuator 139 of a solenoid SOL2.

The actuator 139 of the solenoid SOL2 is in an extended position when the solenoid is deenergized. When the actuator 139 is in this extended position, a connector 140 depresses a switch SW5 as shown in FIG. 12. When the swtich SW4-2 which forms a part of the double throw switch SW4-1,2 is depressed, and the switch SW3 is depressed by the charging device 97 restored to its initial position, a command to energize the solenoid SOL2 is issued and the actuator 139 is withdrawn into the solenoid. This causes the lever 137 to move clockwise in FIG. 11, with the arm 134 pivotting and the shaft 127 rotating in slaved relation to the lever 137 under the biasing force of a spring 136.

The rotation of the shaft 127 moves the screen support arm 128 and the screen 130 in the direction of an arrow *h* shown in FIG. 14, so that the margin defining frame 132 is brought into engagement with the margins of the photoreceptor 62 which has just been charged. When the solenoid SOL2 is energized, the switch SW5 is opened. Opening of the switch SW5 does not affect any of the elements shown in the figure.

After the procedure described above, the photoreceptor 62 is charged, as shown in FIG. 17, by the charging device 97. When the margin defining frame 132 is brought into engagement with the photoreceptor 62, as shown in FIG. 18, an optimum spacing is maintained between the photoreceptor 62 and the screen 130. Because of the frame 132, the charge carried by the margin of the photoreceptor 62 is removed, as shown in FIG. 19, to thereby prevent adhesion of toner particles to the marginal area of the photoreceptor 62 and to prevent such toner particules from smearing or otherwise detracting from the appearance of the identification card produced later. The margin defining frame 132 of the screen 130 may be electrically grounded by suitable means, or a suitable bias voltage can be impressed on it. Alternatively, the electrical charge on the margin of the photoreceptor 62 may be removed by increasing the electrical capacity of the margin defining frame 132.

Referring back to FIG. 12, when the screen 130 is pressed against the photoreceptor 62 that is at the photographing position shown in solid lines in the figure, an optical image of a person or of an object may be projected onto the photoreceptor 62 through the lens 42. A command to release the shutter of the lens 42 is issued, and at the same time a strobe light STL (FIG. 49) is actuated to illuminate the picture or object which is being projected. The optical image formed by the lens 42 is projected onto the photoreceptor 62 through the screen 130, as shown more clearly in FIG. 20. The optical image projected onto the photoreceptor 62 forms an electrostatic latent image thereon. The shutter release switch SW2 may be depressed after the indicating light L2 has been turned on. Prior to shutter release, the casing 41 is correctly positioned vertically by adjusting threaded legs 142 connected to the underside of the casing 41; focusing and trimming are checked through the window 44.

Referring to FIG. 12, the solenoid SOL2 is deenergized when a deenergization comman is issued upon completion of the shutter release. This moves the actuator 139 to its extended position to thereby return the screen support arm 128 and the screen 130 to their original positions through the connector 140, lever 137, arm and shaft 127. The switch SW5 is depressed again. The drive mechanism 104 which provides the driving power for the operations described above includes a gear 143 meshing with the gear 103 and substantially integral with the pulley 101 for pulling the charging device 97 by a wire 102. A worm gear 145 meshes with a gear 144 which is affixed to an end of the shaft 82 which is journalled on the support 87 and mounts the photoreceptor support plate 81. The shafts 146 and 147 to which the gear 143 and the worm gear 145 are affixed are rotatably supported by supporters 149 and 150 affixed to a pivotal bar 148. Secured to the shafts 146 and 147 are gears 151 and 152 respectively which mesh with a normally rotating prime worm gear 153. The pivotal bar 148 is pivotally supported by a shaft 154 for the worm gear 153, and the range of pivotal movement of the bar 148 is defined by a fixed pin 155 received in a slot 148*a* formed in the bar 148.

A pin 156 is secured to a lower end portion of the pivotal bar 148 and is in engagement with a fork 157*a* of a selector 157. The selector 157 is supported by a shaft 158 rotatably supported by a fixed member (not shown) and includes arms 157*b* and 157*c* extending symmetrically therefrom to the right and to the left and connected through springs 159 and 160 to the solenoid SOL1 and to another solenoid SOL3 respectively.

When both solenoids SOL1 and SOL3 are deenergized, they pull on the selector 157 with equal force, and therefore the pivotal bar 148 is placed by the selector 157 in a neutral position. In this neutral position of the bar 148, the gear 143 and the worm gear 145 are away from the gear 103 and the gear 144 respectively. Assuming that the solenoid SOL1 is energized upon receipt of a command to begin charging, the pivotal lever 148 is pushed by the selector 157 and moves counter-

clockwise about the shaft **154** to bring the gear **143** into meshing engagement with the gear **103.** At this time, the pivotal bar **148** depresses with its lower portion a switch SW6 disposed to the right of the bar **148.** The function of the switch SW6 is described below.

The solenoid SOL1 is deenergized when the double throw switch SW4-1,2 is depressed by the movement of the charging device **97** from its initial position to thereby release the gear **143** from engagement with the gear **103.**

After an electrostatic latent image is formed on the photoreceptor **62,** the solenoid SOL3 is energized, and the pivotal bar **148** moves clockwise about the shaft **154** to bring the worm gear **145** into meshing engagement with the gear **144.** This transmits the driving force of the prime worm gear **153** to the shaft **82** and rotates that shaft in the direction of the arrow *d* in FIG. **12** and simultaneously charges the coil spring **90.** The rotation of the shaft **82** moves the arm means **83** in the same direction, and the support plate **81** for the photoreceptor **62** meanwhile moves in slaved relation because of the biasing force of a spring **85** to thereby move the photoreceptor **62** from the photographing position shown in solid lines in FIG. **12** to a transfer printing position.

The transfer printing position of the photoreceptor **62** is shown in dash and dot lines **62***a* in FIG. **20.** In its tranfer-printing position, the photoreceptor **62** is in pressing engagement with the dielectric material layer of the card material **49** in order to transfer the electrostatic latent image from the photoreceptor **62** onto the card material **49.**

Referring back to FIG. **12,** the cam **88** is rotated angularly through an angle of a little over 90° by the shaft **82,** and a front end **161***a* of a connector **161,** which engages the arcuate major diameter portion **88***a* of the cam **88,** is released from that engagement and is brought into engagement with one end of a minor diameter portion **88***b* of the same cam **88.** The connector **161** is slidably supported by fixed shafts **162** and **163** extending through slots **161***b* and **161***c* respectively, and has at its back end a bent portion **161***d* maintained in engagement with an actuator **164** of a switch SW7 to depress that switch.

The connector **161** shifts in the direction of an arrow *i* in FIG. **12** when its front end **161***a* engages one end of the minor diameter portion **88***b* of the cam **88.** This causes the actuator **164** to open the switch SW7, thereby deenergizing the solenoid SOL3. At the same time, a drive shaft **166** of a drive mechanism **165** for driving the transfer-printing roller **69** is driven to cause the shaft **66** to rotate in the direction of an arror *j* in FIG. **12.** When the solenoid SOL3 is deenergized, the driving force exerted by the drive mechanism **104** on the shaft **82** is removed, and the shaft **82** tends to rotate in a direction opposite that of the arror *d* because of the biasing force of the coil spring **90.** However, rotation of the shaft **82** at this time is precluded by the front end **161***a* of the connector **161** which engages the shoulder of the major diameter portion **88***a* of the cam **88** which is contiguous with one end of the minor diameter portion **88***b* of the same cam. Thus, the photoreceptor **62** is maintained in pressing engagement with the card material **49.**

For the transfer-printing operation, it is important that the conductive material layer **31** of the card material **49** be electrically grounded or connected to a suitable reference potential. This operation is described by reference to FIGS. **12, 22,** and **24.** Referring to FIG. **12** an eccentric cam **167** is affixed to an end portion of the shaft **82** on the supporter **86** side thereof. The cam **167** is adapted to push and move a bent edge **168***a* of a ground connector **168** when the shaft **82** rotates angularly through and angle of slightly over 90°. The connector **168** is supported for movement toward and away from the card material **49** by fixed shafts **169** and **170** which are received in slots **168***b* and **168***c* respectively formed in the connector **168.** Referring to FIG. **22,** the connector **168** is disposed in a position in which it is away from the card material **49** because of the biasing force of a spring **171** mounted on the connector **168** when the bent edge **168***a* is not pushed by the cam **167.** A knife **172** is affixed to the connector **168.** When the bent edge **168***a* is pushed and moved by the cam **167,** the knife **172** moves through the cutout **52** in the support plate **55** toward a side edge of the card material **49** and cuts into that side edge as shown in FIGS. **23** and **24** to thereby electrically ground the conductive material layer **31,** and to fix the position of the card material **49.** It should be clear that the conductive material layer **31** may be connected to a suitable reference potential instead of being grounded.

The transfer printing operation is carried out with the help of the transfer-printing roller **69** which is rotatably supported, as shown in FIG. **12,** by legs **173***a* and **173***b* of a stay **173.** Referring to FIG. **25** for greater clarity, each of the legs **173***a* and **173***b* (only **163***b* is shown) has a slot **173***e* whose upper end is tilted in the direction of movement of the transfer-printing roller **69.** The roller **69** is supported by a shaft **69***a* which in turn is loosely received in the slots **173***e* of the stay **173** and is urged downwardly by the biasing force of a spring **173***f.*

The transfer-printing roller **69** is driven by a mechanism **165** which includes a stay **173** fixed to the underside of a carrier **174** that has legs **174***a*, **174***b*, **174***c* and **174***c* slidably supported on parallel rails **175** and **176.** Disposed near the legs **174***b* and **174***d* are arms **174***e* and **174***f* which pivotally support pawls **177** and **178** respectively through shafts **179** and **180.** Springs **181** and **182** are mounted on the shafts **179** and **180** and also between the arms **174***e*, **174***f* and pawls **177, 180** respectively to urge the pawls **177** and **178** to their open position. The pawls **177** and **178** are maintained in their open positions by bent portions **177***a* and **178***a* thereof which abut the arms **174***e* and **174***f* respectively.

Referring to FIG. **25,** the upper surface of the carrier **174** includes a projection **183** positioned against one end **184***a* of a pressing lever **184.** Connected to the back end of the carrier **174** is a spring **185** which urges the carrier **174** rightwardly. As a result, the projection **183** abuts the front end of the lever **184,** and in this state the carrier **174** depresses a switch SW8 whose operation is described below.

Referring back to FIG. **12,** the pressing lever **184** is pivotally supported by a shaft **186** and has at the underside of its other portion a pin **187** that engages a minimum diameter portion of a gradually increasing diameter cam **188** affixed to the drive shaft **166** to which is also affixed a disc **190** having a pin **189** and formed with a cutout **190***a.* When the shaft **166** is not rotating, an actuator **191** of a switch SW9 is in engagement with the cutout **190***a* and the switch is open.

When the switch SW7 is opened and the shaft **166** begins to rotate in the direction of the arrow *j*, the pressing lever **184** is gradually pushed out by the cam **188** to move the carrier **174** in the direction of an arrow *k* (FIG. **25**) against the biasing force of a spring **185.** This makes the transfer printing roller **69** move in slaved relationship to roll over the card material **49.** At the same time, the switch SW8 is opened.

Referring to FIG. **25,** the transfer printing roller **69** starts from its initial position shown in the figure and moves in the direction of the arrow *k* in rolling motion while it is pressed downwardly by the biasing spring **173***f*. The dielectric material layer **29** of the card material **49** is maintained in intimate contact with the photoconductive material layer of the photoreceptor **62** at this time.

In order to ensure good quality of the electrostatic latent image transferred to the card material **49,** the card material **49** is stripped away from the photoreceptor **62** as the roller **69** in moved. This is explained in connection with FIGS. **25** through **27** which show a resilient plate member **192** that has a base affixed to the back of the support plate **81** for the photoreceptor **62** and a free end adapted to be positioned against the leading right portion of the card material **49** when the photoreceptor **62** is placed at its transfer-printing position.

When the transfer-printing roller **69** is in its initial position shown in FIG. **25,** the free end of the plate member **192** is flexed down. However, when the transfer-printing roller starts moving in the direction of the arrow *k*, the card material **49** starts being stripped and moved upwardly under the action of the resilient plate member **192,** as shown in FIGS. **26** and **27.**

After the roller **69** has moved all the way to the left to carry out the transfer-printing operation, the pressing lever **184** which pushes and moves the pin **183** on the carrier **174** is pushed out and brought into engagement with a maximum diameter portion of the cam **188** and is rapidly brought into engagement with the minimum dimension portion of the same came **188** so as to start moving the carrier **174** back to its starting position under the biasing force of the spring **185.** By the time the pressing lever **184** is pushed out by the maximum diameter portion of the cam **188,** the transfer-printing roller **69** is at the position shown in FIG. **27** in which the transfer-printing of the latent image is finished. At this time the pawls **177** and **178** are in engagement with the trailing edge of the card material **49** after sliding leftwardly on its surface. Thus, when the carrier **174** starts moving rightwardly to its initial position, the pawls **177** and **178** move the card material **49** forwardly (to the right in FIGS. **25** through **27**). At this time, the knife **172** disengages the card material **49.** The range of movement of the transfer-printing roller **69** is defined by the longitudinal dimension D1 of the latent image while its transverse dimension is defined by an optimal pressing width D2 (FIGS. **29** and **8**) of the roller **69.**

When pushed out by the maximum diameter portion of the cam **188,** the pressing lever **184** engages the release lever **196** which in turns moves the lock lever **115** away from the actuator **111** of the double throw switch SW4-1,2. The actuator **111** is thus allowed to be moved away from the switch by the biasing spring **114** to thereby open the switch SW4-1,2.

The disc **190** rotates while depressing the actuator **191** of a switch SW9. The pin **189** of the disc **190** engages the lever **193** at the terminating stages of rotation of the disc **190** and pushes the lever **193.** The lever **193** has a fork **193***a* engaging a pin **195** of the connector **161.** Thus, the lever **193** moves the connector **161** in a direction opposite that of the arrow *i*. This depresses the switch SW7 again, and the front end **161***a* of the connector **161** is released from the cam **88.** The switch SW9 serves to continue to maintain the drive shaft **166** operative after the switch SW7 is depressed again. Thus, it is when the actuator **191** of the switch SW9 is brought into engagement with the cutout **190***a* of the disc **190** that the drive shaft **166** stops rotating. At this time the lever **184** has been brought into engagement with the minimum diameter portion of the cam **188** and the transfer-printing roller **69** has been returned to its initial position. The double throw switch SW4-1,2 has just been opened.

When the front end **161***a* of the connector **161** is released from the cam **88,** the shaft **82** is also freed. As a result, the support plate **81** of the photoreceptor **62** is restored to its original position by the action of the spring **90,** and the shaft **82** returns to its original position to thereby restore cams **88** and **167** to their original positions. The grounding connector **168** releases the knife **172** from the card material **49** and restores the knife **172** to its original position. The release of the knife **172** from the card material **49** takes place slightly earlier than the start of the return movement of the carrier **174,** so that the card material **49** can be moved out by the pawls **177** and **178.**

Residual charge from the photoreceptor **66** is removed by a lamp L3 which is on when the double throw switch SW4-1,2 is open to illuminate the photoreceptor **62** when it is in the photographing position.

It should be clear that the solenoid SOL1 and SOL3 and the pivotal bar **148** of the drive mechanism **104** discussed above may be replaced by a combination of a wrapping connection device and a clutch.

After the operations described above are completed, the card material **49** bears an electrostatic latent image, and it is moved forwardly by the pawls **177** and **178.** The card material **49** is passed through a guide plate **198** and a pair of rollers **199** (FIG. **25**) and is fed to a developing device **200** (shown in FIG. **40**) for developing of the electrostatic latent image thereon.

Referring to FIG. **44** for an explanation of the developing operation, the card material **49,** with the electrostatic latent image thereon facing downwardly, is fed forwardly in the direction of the arrow *m* by the rollers **199.** A container **201** contains a developing agent comprising fine particles of a pigment, such as carbon black treated with a resin in a carrier liquid of high electrical resistance, such as petroleum. A developing roller **203** is made of the same material as the developing roller **34** discussed in connection with FIG. **6** and has flanges **203***a* and **203***b* (shown in FIG. **47**) so that its peripheral surface has a width slightly greater than the transverse dimension of the latent image on the card material **49** but is less than the transferse dimension of the card material **49.** In order to provide a sufficient quantity of developing agent **202,** the developing roller **203** rotates in the direction of an arrow *l* at a rate greater than the rate at which the card material **49** is conveyed. The bottom of the developing roller **203** is immersed in the developing agent **202.** The height S of the flanges **203***a* and

203*b* is such that the developing surface of the roller **203** and the portion of the card material **49** which bears the latent image are spaced apart from each other to preclude degrading the image on the card material **49**. Such degrading would occur by streaking and otherwise if the developing roller contacted the latent image portion of the card material **49** and if the relative speeds between the two contacting surfaces were different. It has been found that the optimum value of the distance S (FIG. **47**) is in the range from about 0.2 mm to 1 mm. The distance L (FIG. **47**) between the opposite ends of the roller **203** is slightly smaller than the width D3 of the card material **49** so as to prevent developing agent from reaching the top surface of the card material **49**. The developing roller **203** is supported by a shaft **204** which is in turn rotatably supported by suitable means and is adapted to be rotated continuously.

Referring back to FIG. **40**, a hold-down roller **205** is to the left of the developing roller **203** and above the path of the card material **49**. A hold-down roller **206** consisting of two roller elements and a squeezing roller **207** press against each other and are disposed to the right of the developing roller **203** and rotate in the indicated directions. The roller **206** is supported by a shaft **206***a* which is in turn rotatably supported by an arm **208**. The arm **208** is supported by a shaft **209** and is bent at one of its ends to form a bent edge **208***b*. This bent edge **208***b* has an opening **208***a* that loosely receives a screw **211** threadably connected to a fixed plate **210**. The screw **211** has a spring **212** which urges the arm **208** downwardly through a washer **213**. An adjusting screw **214** is threaded into the bent edge **208***b* so that its front end abuts the plate **210**. By turning the adjusting screw **214**, it is possible to adjust the gap G between the two rollers **206** and **207** (FIGS. **11** and **45**).

Referring to FIG. **40**, the circumferential surface of the squeezing roller **207** is made of a hard material such as a metal, and a cleaner **215** made of a material such as felt is maintained in pressing engagement with the roller **207**. The cleaner **215** is supported on a frame **216** affixed to an arm **217** which is loosely mounted on the shaft **209**. A spring **219** mounted on the shaft **209** engages at one of its end a fixed pin **218** and urges by its other end the cleaner **215** is pressing engagement with the roller **207**.

A hold-down roller **220** and a blotter roller **221** are maintained in pressing engagement and rotate in the indicated directions to feed the card material **49** to the right in FIG. **40**. The dimensions of the blotter roller **221** are such that its circumference is equal to the length of the card material **49** (i.e., the circumference of the roller **221** of FIG. **40** is equal to the length D4 of the card material **49** shown in FIG. **43**).

When the card material **49** is conveyed with its image bearing surface facing downwardly by the pair of conveyor rollers **199** in the direction of the arrow *m* in FIG. **40**, the card material **49** moves while being held down by the hold-down roller **206**, and its leading end is brought into engagement with the periphery of the developing roller **203**. Developing agent **202** is supplied to the image bearing surface of the card material **49** by the developing roller **203**. After the developing roller **203**, the leading end of the card material **49** is nipped by the rollers **206** and **207** and is moved toward the rollers **220** and **221**. The dimensions of the developing roller **203** are such that its circumference is slightly greater than the longitudinal dimension D4 of the card material **49**. The distance between the top of the developing roller **203** and the point of contact between the hold-down roller **220** and the blotter roller **221** is slightly smaller than the longitudinal dimension D4 of the card material **49**.

When the card material **49** is at the position designated **49***a* in FIG. **40**, i.e., the position at which the leading edge of the card material **49** is nipped by the rollers **220** and **221**, the trailing end of the card material **49** is released from engagement with the hold-down roller **205**. The gap between the rollers **206** and **207** is at a position which is higher than the gap between the rollers **220** and **221**, such that the leading end of the card **49** which is between the rollers **220** and **221** is lower than the rest of the card material **49**. Referring to FIG. **42***a*, the leading end of the card material **49** which is between the rollers **220** and **221** is lower than the portion of the card material **49** that is between the rollers **206** and **207** by a distance D.H, and the card is inclined, with its leading end downwardly, by an angle θ. The distance D.H is preferably 1 mm to 10 mm.

When the card material **49** is at the position **49**A, it moves along an inclined path in which the leading edge of the card material **49** is lower than its trailing end, and the trailing end is released from engagement with the developing roller **203** as shown in FIG. **42***a*. This is effective to prevent the staining of the underside of the card material **49** by developing agent thrown over the trailing edge of the card material **49**, i.e., the situation illustrated in FIG. **41** is prevented so that the upper side of the card material **49** remains free of smears.

The electrostatic latent image on the card material **49** is developed into a visible toner image by the developing agent supplied by the roller **203**, and the card is then ejected from the casing **41** by a pair of discharge rollers **222**.

The hold-down roller **206** shown in FIG. **40** may alternately comprise two roller elements axially spaced from each other. This alternate embodiment of the hold-down roller **206** is shown in FIG. **45** and comprises the two rollers **206** axially spaced from each other and supported by a common shaft **206***a*. The spacing between the rollers **206** may be as shown in FIG. **45**, or it may be as shown in FIG. **46** where the rollers **206** are axially outwardly of the axially opposite ends of the rollers **207**.

The developing roller **203** shown in FIG. **42** rotates in the direction of an arrow *n* which is opposite to the direction of the arrow *l* shown in FIG. **40**, while the card material **49** in FIG. **42***b* moves in the direction of the arrow *m* as in the case of the card material **49** of FIG. **40**. Because the developing roller **203** and the card material **49** move in opposite directions in FIG. **42**, the relative speed between the two becomes high and the angular speed of the developing roller of FIG. **42** can be reduced to substantially less than the angular speed of the developing roller shown in FIG. **42***a*. However, since the card material **49** receives a supply of the developing agent at its leading end, the top surface of this leading end portion of the card material **49** in FIG. **42***b* may be stained with developing agent. This can be precluded by rollers arranged in the manner shown in FIG. **42***b* where the card material **49** is fed and flexed in the indicated manner. In FIG. **42***b*, the relative heights of the circumferential surfaces of the shown

rollers 241, 239, 203 and 207 are such that the leading end of the card material 49 is spaced from the developing roller 203 as the card material 49 is fed to the right in FIG. 42*b*. Then, the leading end of the card material 49 is moved downwardly by the roller 206, while the trailing end of the card material 49 is released by the hold-down roller 240, such that the card material 49 moves to the position shown in broken lines in the figure, in which position the image bearing portion of the card material 49 is against the developing roller 203, and the image can be developed into a visible image. With the relative positions of the rollers 240, 241, 238, 239, 203, 206 and 207 as shown in FIG. 42*b*, staining of the backside (top side) of the card material 49 is prevented and only the latent image is developed into a visible image.

The electrostatic latent image on the card material 49 may be developed by developing agents other than the wet developing agent discussed above. FIG. 48 shows a developing device using a dry developing agent and comprising a container 223 storing a quantity of dry developing agent 224 consisting of a toner and iron powder or other ferromagnetic carrier, and a cylinder 225 made of aluminum or other nonmagnetic material and immersed partly in the developing agent 224. Built in the cylinder 225 are a plurality of magnets 227 supported by a shaft 226. The magnets 227 are rotated in the direction of the shown arrow at a rate higher than the rate of movement of the card material. In the device of FIG. 48, the dry developing agent 224 forms a magnetic brush 228 on the outer periphery of the cylinder 225, as defined by the magnetic field of each magnet 227. The magnetic brush 228 moves with the cylinder 225 as the magnets 227 rotate, and it brought into sliding engagement with the latent image bearing surface of the card material 49, so that the toner supplied to the electrostatic latent image develops it into a visible toner image. The card material 49 is then nipped by a pair of fixing cylinders 231 and 232 having built-in heaters 229 and 230 respectively and maintained in pressing engagement with each other. The toner image of the card material is heated and fixed by the fixing cylinders 231 and 232 before the card material 49 is discharged from the casing 41. It should be understood that other fixing means may be used with the dry developing method described above.

After the card material 49 is discharged from the casing 41, markings serving to identify the card user or other markings may be made on the card material 49. Then, a thin protective film of polyester or other material may be laminated to the surface of the card material 49 to complete the identification card produced in accordance with the invention.

The electrical control device for the identification card producing device discussed above is shown in FIG. 49, in which the contacts of the switches are shown at the positions in which they are when the device is not operating.

Referring to FIG. 49, a motor M1 drives a drive shaft 154 of the drive mechanism 104 that moves the charging device 97 and the photoreceptor 62, a motor M2 drives the developing device 200, and a transformer TR has a secondary driving the strobe light device STL and a secondary supplying power to the indicating light L1 for the main off-on switch. A control circuit 234 includes a high voltage source Ch for impressing a high bias voltage on the charging device 97, a motor M3 for driving the shaft 166 of the drive mechanism 165 for the transfer-printing roller 69, a solenoid SOL1 for actuating the selector of the drive mechanism 104, and a solenoid SOL3 and a solenoid SOL2 for actuating the screen 130 which are connected in shunt with each other and to an alternating current source through a plug 235 and a main off-on switch SW1.

The solenoid SOL1 is connected, through one normally closed switch SW4-1 of the double throw switch SW4-1,2, to a self-holding circuit 236 comprising the shutter release switch SW2 connected to the main switch SW1, the normally open switch SW8 connected in series to switch SW2, and the normally open holding switch SW6 connected in shunt with switches SW2 and SW6 and with the main switch SW1. The switch SW8 is depressed by the carrier 174 for the transfer-printing roller 69 and is maintained in closed position when the transfer printing roller is at its starting position. The other switch SW4-2 of the double throw switch SW4-1,2 acts as a change-over switch for a circuit comprising the light L2 indicating satisfactory shutter release and the discharging lamp L3 connected in series to lamp L2, and a circuit comprising the solenoid SOL2. When the double throw switch SW4-1,2 is not depressed by the actuator 111, the contact of the switch SW4-2 is engaged with the circuit comprising the indication lamp L2.

The switch SW4-2 and high voltage impressing device Ch are connected to the change-over switch SW3, which in turn is connected to the main off-on switch SW1, and is depressed by the support bar 95 when the charging device 97 is stationary at its initial position with its contact in engagement with the switch SW4-2.

In the circuit comprising solenoid SOL2, the first timer T1 and its switch SW10 are connected in shunt to each other and comprise a first timing device 237, and the solenoid SOL2 is connected in shunt to a relay RL and to a second timer T2 and to witch SW10. A switch SW11 for relay RL connects the first timer T1 and its switch SW10 to the main off-on switch SW1, while a solenoid SOL4 for actuating the shutter and the strobe light device STL is connected to a second timer T2.

The switch SW10 is connected to the normally opened switch SW5 which is depressed and closed by the connector 140 when solenoid SOL2 is deenergized. The switch SW5 is connected to the change-over switch SW7 which is depressed and actuated by the connector 161 for switching between the circuit comprising solenoid SOL3 and circuit comprising motor M3. When the connector 161 abuts the major diameter portion 88*a* of the cam 88, the switch SW7 is depressed by the connector 161 and its contact is engaged by the solenoid SOL3. The motor M3 is connected to the main off-on switch SW1 through the normally open switch SW9 adapted to be actuated by the disc 190 having the cutout 190*a*. However, when the disc 190 is not operating, its actuator 191 is brought into engagement with the cutout 190*a* and the switch SW9 is opened.

When the push-button 45 is depressed to close the main off-on switch SW1, the motors M1 and M2 start rotating and the transformer TR1 is actuated by the current across its primary. Thus the strobe device STL is ready, and the indication lamp L1 is on to indicate that the main off-on switch SW1 is closed. The push-

button 45 is of the type which is maintained in an operative position when deprssed and can be brought to an inoperative position when pulled out. The satisfactory shutter release indicating lamp L2 and the discharging lamp L3 are turned on through the switches SW3 and SW4-2. The discharging lamp L3 is disposed in a dark chamber of the device, and it is not usually possible to ascertain from outside the device if the lamp L3 is on or off. The lamp L2 is therefore provided so that an operator of the device can readily ascertain whether the discharging lamp L3 is on or off. A tungsten lamp or other suitable types of lamps may be used as the discharging lamp L3.

The push-button 46 is depressed after the operator of the device has ascertained that the main switch SW1 is on (by observing the indication lamp L1) and that the satisfactory shutter release indication lamp L2 is on. The depression of the push-button 46 temporarily actuates the switch SW2 to energize the solenoid SOL1 through the switches SW8 and SW4-1. The solenoid SOL1 is self-held by the closing of the switch SW6 through the pivotal bar 148. The solenoid SOL1 should be self-held because the push-button 46 is of the automatic restoration type, and the switch SW2 is opened when the push-button 46 is released.

After the solenoid SOL is energized, the charging device 97 is moved from its initial position and this brings the switch SW3 into engagement with the high voltage source *Ch*. Changing over of the switch SW3 to the high voltage source turns off the satisfactory shutter release indicating lamp L2 and the discharging lamp L3, so that the photoreceptor 62 may be charged by the charging device 97 and the shutter may be cocked.

At about the time that the charging device 97 reaches the end of its movement from its initial position toward the photographing position, the actuator 111 is pushed and is moved to depress the double throw switch SW4-1,2. The opening of the switch SW4-1 deenergizes the solenoid SOL1 and moves the charging device 97 back to its initial position. The switch SW4-2 is brought into engagement with the first timer T1 side while the switch SW3 is brought into engagement with the switch SW4-2 by the restoration of the charging device 97 to its initial position.

When the switches SW3 and SW4-2 are brought to the positions discussed immediately above, the first timer T1 is turned on through the switch SW4-2, while the relay RL, the solenoid SOL2 and the second timer T2 are turned on through the switch SW10. The relay RL2 causes the switch SW11 to hold its circuit, and the solenoid SOL2 brings the screen 130 to a position in which it is over the photoreceptor 62. Thereafter, the second timer T2 is turned off to actuate the solenoid SOL4 which releases the shutter and simultaneously turns on the strobe device STL to make it flash in synchronism with the shutter release. The relay RL is made to close the switch SW11 to hold its circuit for the following reason: If the charging device 97 bounced one or more times, however slightly, when it is restored to its original position, the switch SW3 may be opened and closed to thereby disturb the solenoids SOL2 and the screen 130. This may cause the switch SW3 to open at an undesirable time and would cause the charging device 97 to stop on its way back to its initial position.

The first timer T1 remains on until the shutter is released. It goes off after the shutter releases to thereby bring the switch SW10 into engagement with the switch SW5 side. The switch SW5 is opened and closed by energization of the solenoid SOL. However, deenergization of the solenoid SOL2 brings the switch SW5 to a closed position. When the switch SW10 is engaged with the switch SW5, the solenoid SOL3 is energized through switch SW7 to thereby rotate the shaft 82 and move the photoreceptor 62 from the photographing position to the transfer-printing position.

After the photoreceptor 62 is brought into the transfer-printing position in which it is pressed against the card material 49, the SW7 is brought into engagement with the motor M3 side by the cooperation between the cam 88 and the connector 161 to thereby turn on the motor M3. The motor M3 thus rotates the shaft 166 to move the transfer-printing roller across the back side of the card material 49. the rotation of the disc 190 causes the switch SW9 to thereby turn off the motor M3.

At about the time the transfer-printing roller 69 reaches the end of its movement from its initial position, the double throw switch SW4-1,2 is opened by the cooperation between the cam 188 and the lever 184, and is restored to its initial position. At this time, the motor M3 is maintained on by the switch SW9 and continues rotating. Thereafter, the switch SW9 is opened by the disc 190, and the motor M3 is turned off.

By this time, the card material 49 on which an electrostatic latent image is formed by transfer-printing from the photoreceptor 62 has moved toward the developing device 200 which is rendered operative by the motor M2. The latent image is developed into a visible toner image by the developing device 200, and then the card material is discharged from the device 41. When the double throw switch SW4-1,2 is restored to its initial position, the lamp L2 which indicates satisfactory shutter release is turned on and the discharging lamp L3 is also turned on to illuminate the photoreceptor 62, which has returned to the photographic position by this time, to thereby remove residual charges from the photoreceptor 62.

The switch SW8 serves to prevent the charging device 97 from being actuated inadvertently while the transfer-printing roller is in operation.

We claim:

1. An electrophotographic transfer-printing device for transferring an electrostatic latent image formed on a planar photoconductive material layer of a photoreceptor onto a dielectric material layer of a card material comprising: means for positioning the photoreceptor and the card material against each other with the photoconductive material layer of the photoreceptor facing the dielectric material layer of the card material, a transfer-printing roller, means for moving the transfer-printing roller in rolling motion over the combination of the card material and the photoreceptor to press the card material against the photoreceptor, said transfer roller starting its rolling motion from an initial position at one end of the combination of the card material and the photoreceptor, and a resilient stripper continuously engaging the end of the card material adjacent the initial position of the transfer roller and continuously biasing the last recited end of the card material in a direction away from the photoreceptor to gradually raise the card material from the photoreceptor as the rolling motion of the transfer-printing roller proceeds from the initial position toward an end position, thereby gradually peeling off from the photoreceptor

the portions of the card material which have received the transfer-printed latent image from the photoreceptor.

2. An electrophotographic transfer-printing device as in claim 1 including discharge pawls, a supporter connected to the transfer-printing roller to move in slaved relation therewith, means for pivotally connecting the discharge pawls to the supporter to maintain said pawls out of engagement with the card material as the transfer roller moves away from its initial position and to maintain said pawls in engagement with the card material upon motion of the transfer roller toward its initial position to thereby move the card material away from the photoreceptor when the transfer roller is returned to its initial position.

3. An electrophographic transfer-printing device as in claim 2 wherein the end portion of the card material adjacent the initial position of the transfer roller is the leading end of the card material, and wherein said pawls engage the trailing end of the card material.

4. An electrophotographic transfer-printing device as in claim 1 wherein the card material includes a conductive layer backing the dielectric material layer, said device including a sharp-edged conductive member, means for moving the conductive member to cause its sharp edge to cut into the card material when the card material is pressed against the photoreceptor by the transfer-printing roller in order to position the transfer-printing sheet at a fixed position with respect to the photoreceptor, said conductive member moving into electrical contact with the conductive layer of the card material when the sharp edge cuts into card material, and means for electrically connecting the conductive member to a selected potential to thereby place the conductive layer backing of the card material at said selected potential.

5. An electrophotographic transfer-printing device as in claim 1 wherein the photoreceptor includes a supporter and including means for connecting the resilient stripper to said supporter of the photoreceptor.

6. An electrophotographic transfer-printing device as in claim 5 wherein the resilient stripper comprises an L-shaped resilient plate having one end affixed to the photoreceptor supporter and having its other end abutting the end of the card material adjacent the initial position of the transfer roller.

7. An electrophotographic transfer-printing device as in claim 6 wherein the photoreceptor supporter comprises a plate, means for securing a photoreceptor sheet to the top side of the plate, and wherein the resilient member has an end section affixed to the underside of the plate.

8. An electrophotographic transfer-printing device for transferring an electrostatic latent image formed on a planar photoconductive material layer of a photoreceptor onto a dielectric material layer of a card material comprising: means for positioning the photoreceptor and the card material against each other with the photoconductive material layer of the photoreceptor facing the dielectric material layer of the card material, a transfer-printing roller, means for moving the transfer-printing roller in rolling motion over the combination of the card material and the photoreceptor to press the card material against the photoreceptor, said transfer roller starting its rolling motion from an initial position at one end of the combination of the card material and the photoreceptor, a resilient stripper engaging the end of the card material adjacent the initial position of the transfer roller and biasing the last recited end of the card material in a direction away from the photoreceptor to gradually raise the card material from the photoreceptor as the rolling motion of the transfer-printing roller proceeds from the initial position toward an end position, thereby gradually peeling off from the photoreceptor the portions of the card material which have received the transfer-printed latent image from the photoreceptor, discharge pawls, a supporter connected to the transfer-printing roller to move in slaved relation therewith, means for pivotally connecting the discharge pawls to the supporter to maintain said pawls out of engagement with the card material as the transfer roller moves away from its initial position and to maintain said pawls in engagement with the card material upon motion of the transfer roller toward its initial position to thereby move the card material away from the photoreceptor when the transfer roller is returned to its initial position.

9. An electrophotographic transfer-printing device as in claim 8 wherein the end portion of the card material adjacent the initial position of the transfer roller is the leading end of the card material, and wherein said pawls engage the trailing end of the card material.

10. An electrophotographic transfer-printing device for transferring an electrostatic latent image formed on a planar photoconductive material layer of a photoreceptor onto a dielectric material layer of a card material comprising: means for positioning the photoreceptor and the card material against each other with the photoconductive material layer of the photoreceptor facing the dielectric material layer of the card material, a transfer-printing roller, means for moving the transfer-printing roller in rolling motion over the combination of the card material and the photoreceptor to press the card material against the photoreceptor, said transfer roller starting its rolling motion from an initial position at one end of the combination of the card material and the photoreceptor, a resilient stripper engaging the end of the card material adjacent the initial position of the transfer roller and biasing the last recited end of the card material in a direction away from the photoreceptor to gradually raise the card material from the photoreceptor as the rolling motion of the transfer-printing roller proceeds from the initial position toward an end position, thereby gradually peeling off from the photoreceptor the portions of the card material which have received the transfer-printed latent image from the photoreceptor, wherein the card material includes a conductive layer backing the dielectric material layer, said device including a sharp-edged conductive member, means for moving the conductive member to cause its sharp edge to cut into the card material when the card material is pressed against the photoreceptor by the transfer-printing roller in order to position the transfer-printing sheet at a fixed position with respect to the photoreceptor, said conductive member moving into electrical contact with the conductive layer of the card material when the sharp edge cuts into card material, and means for electrically connecting the conductive member to a selected potential to thereby place the conductive layer backing of the card material at said selected potential.

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