

[54] **COLOR ELECTROSTATIC COPYING APPARATUS**

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

[58] Field of Search..... 355/4, 10, 16, 72; 96/1.2; 271/64, DIG. 9

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Attorney, Agent, or Firm—Flynn & Frishauf

[57] **ABSTRACT**

A color electrostatic copying apparatus comprising a rotatable and vertically movable optical device including a plurality of film carriers, a plurality of optical units and a plurality of copying paper holding units, these three groups of members being arranged in optically facing relationship; a light projector including a plurality of filters so arranged as to face said optical units and a plurality of light sources; developing and washing devices disposed at the lower part of the apparatus so as to face said copying paper holding units; and means for feeding a plurality of sheets of copying paper to said copying paper holding units and drawing out said sheets therefrom.

5 Claims, 29 Drawing Figures

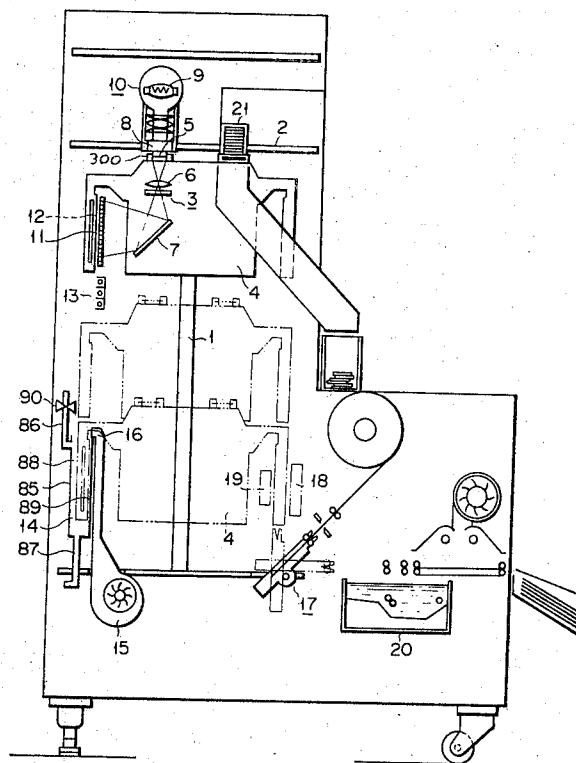


FIG. 1

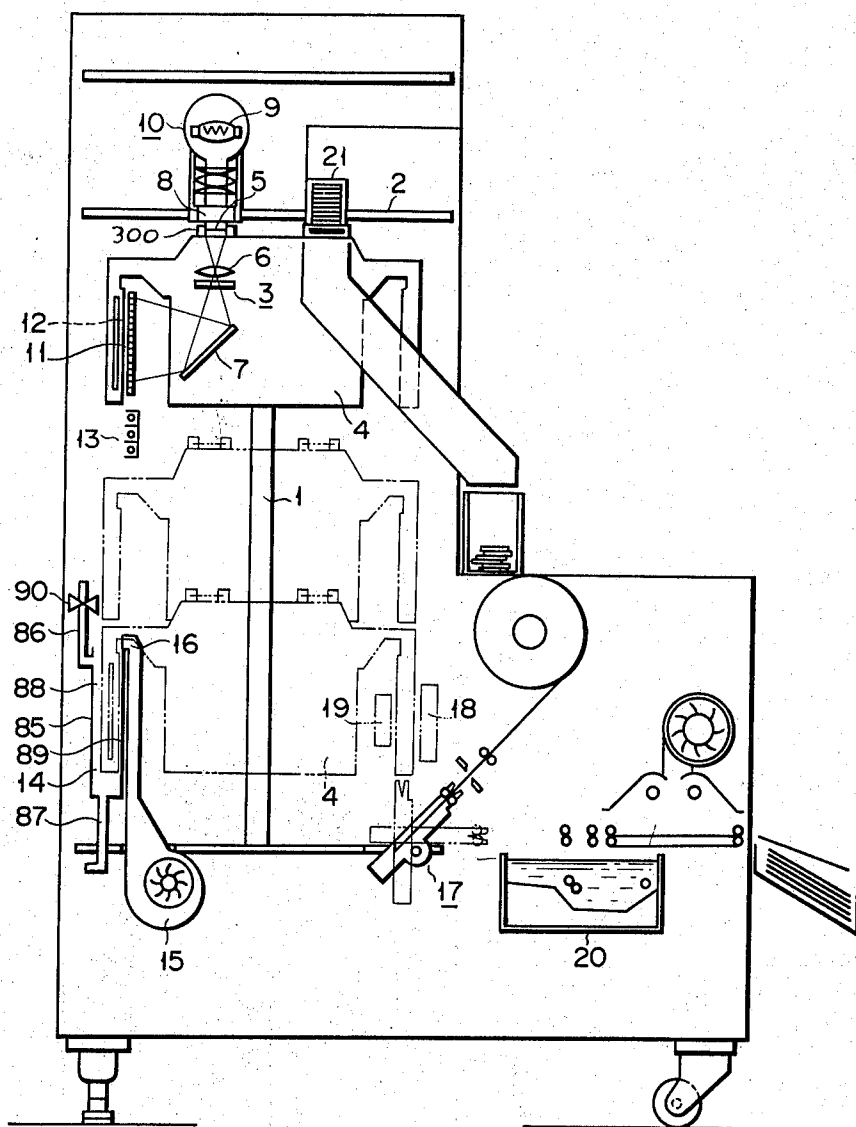


FIG. 2

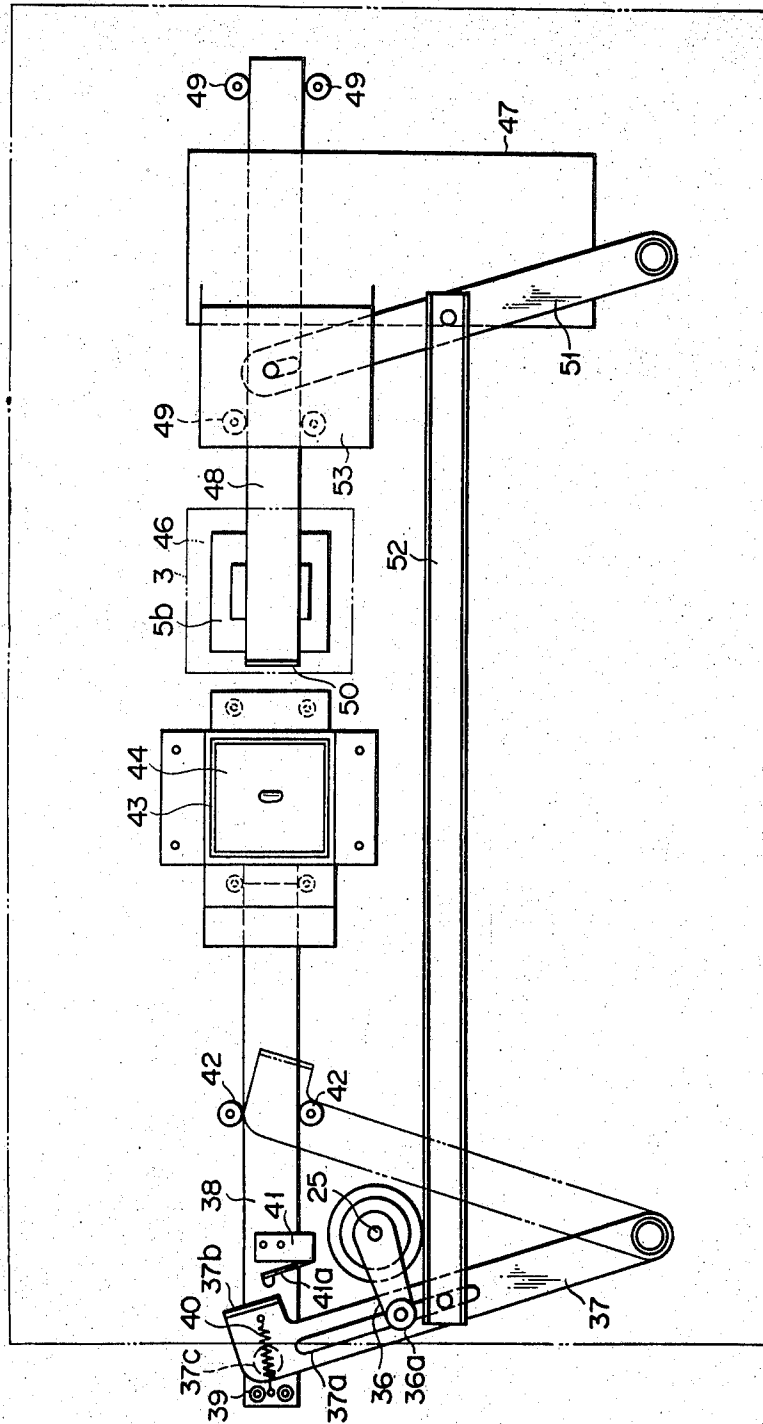


FIG. 3

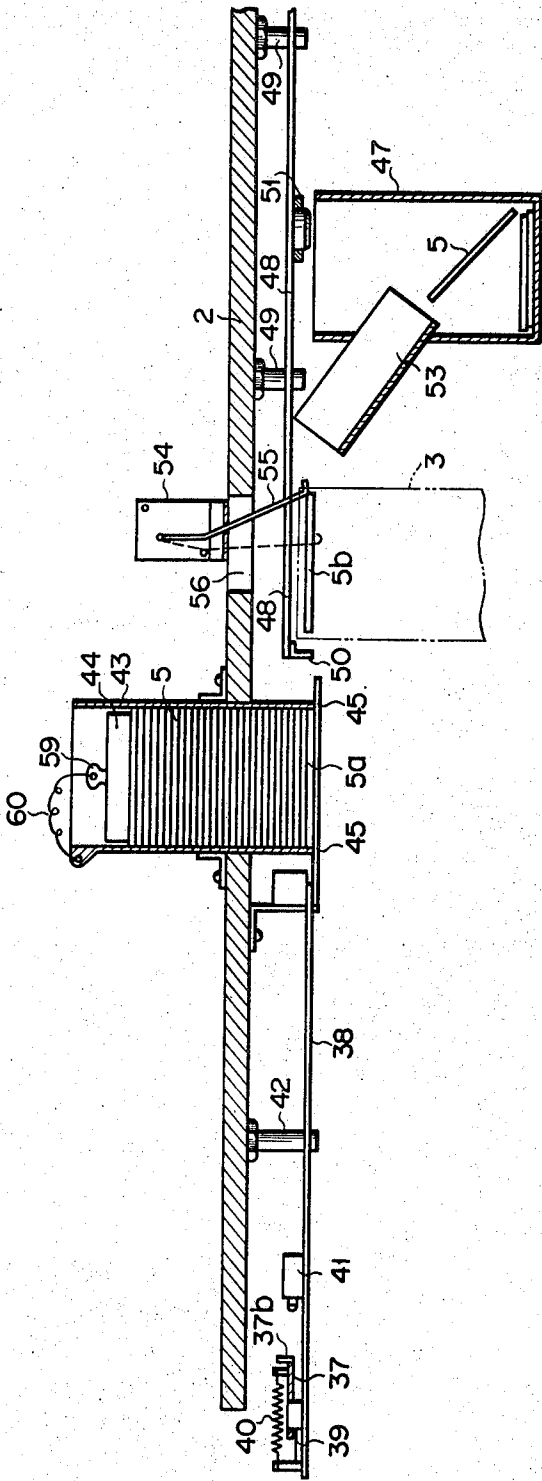


FIG. 4

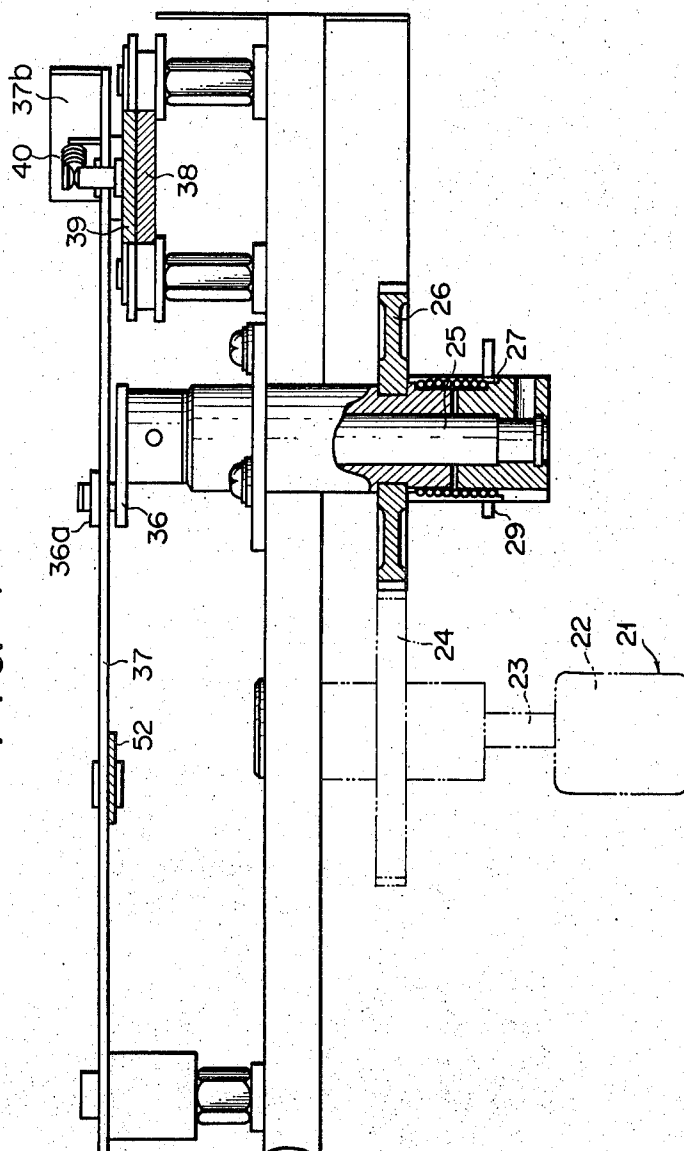


FIG. 5B

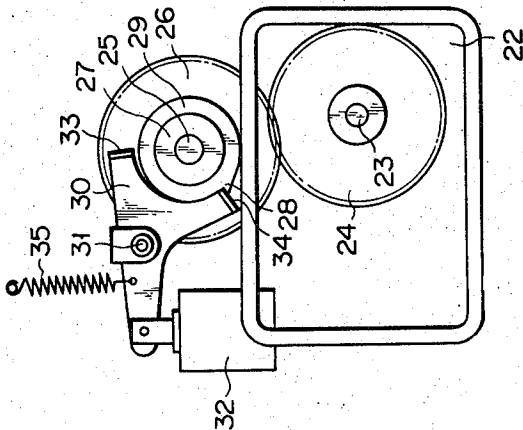


FIG. 5A

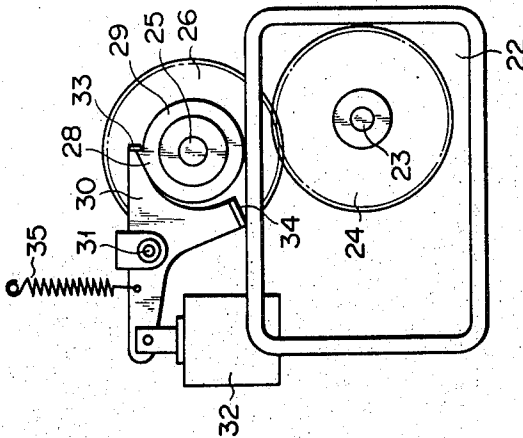


FIG. 6

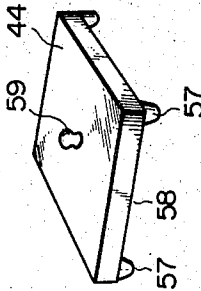


FIG. 7A

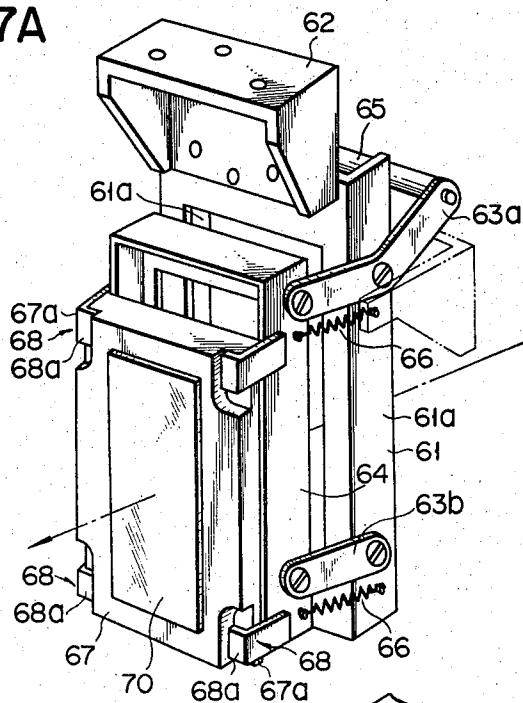


FIG. 7B

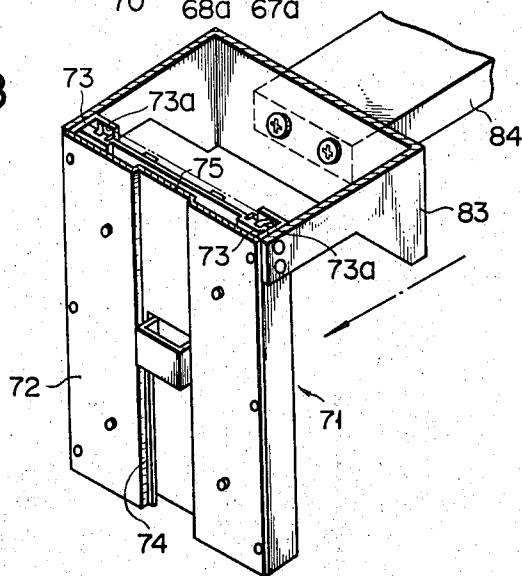


FIG. 8

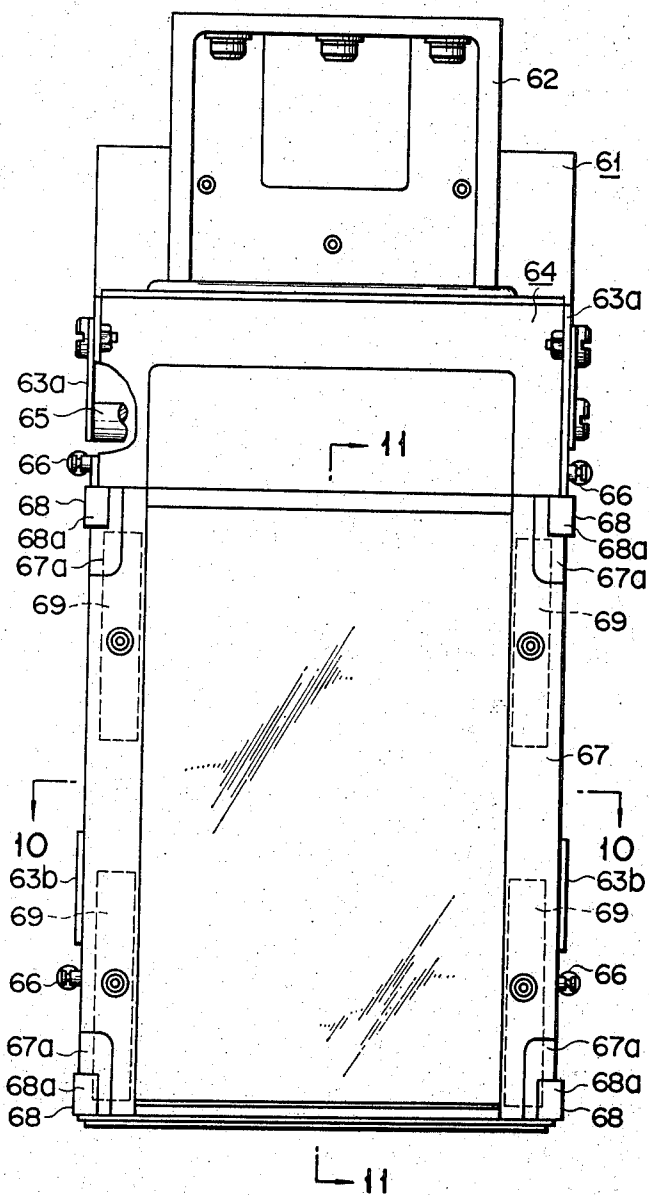


FIG. 9

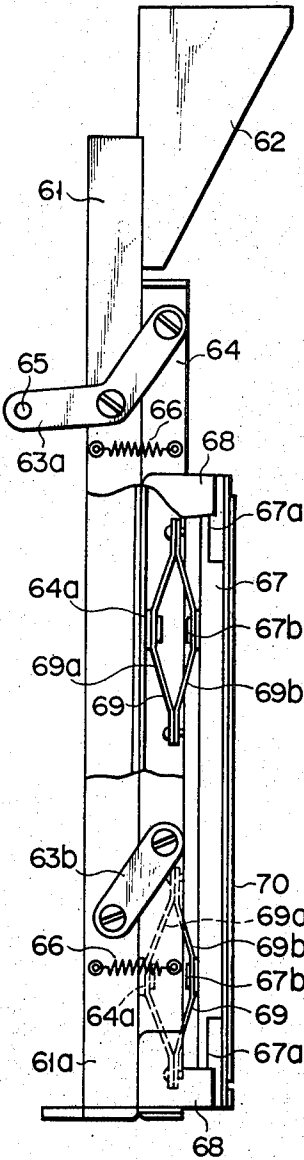


FIG. 12

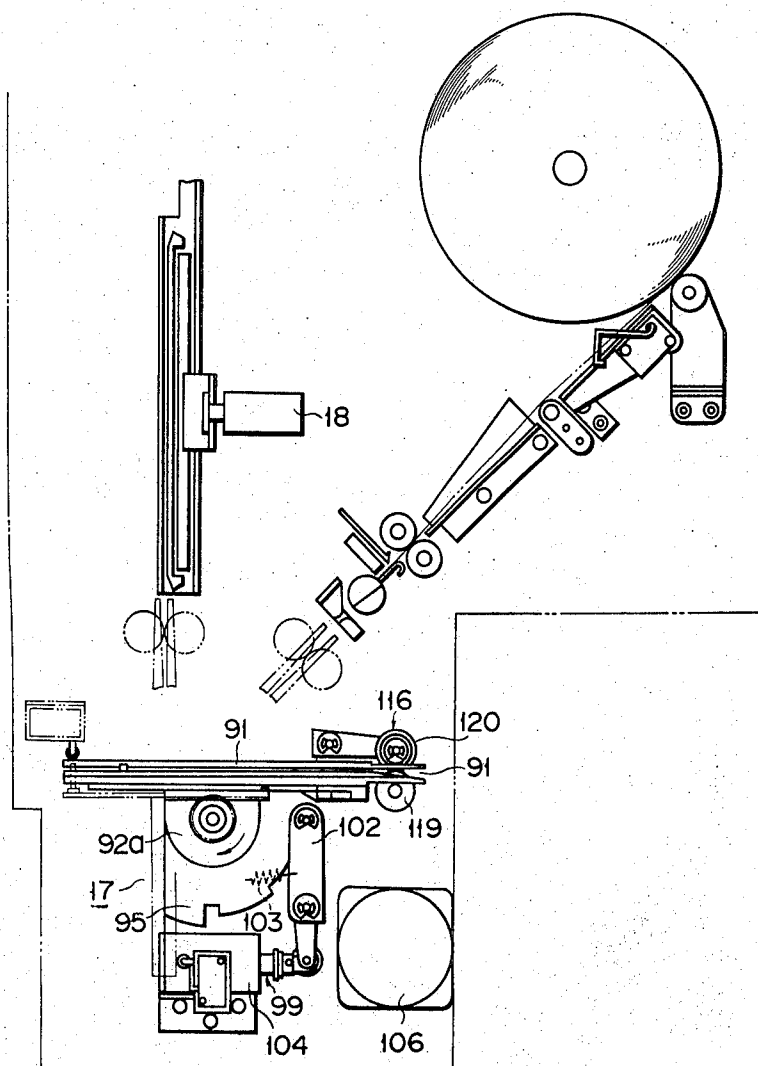


FIG. 13

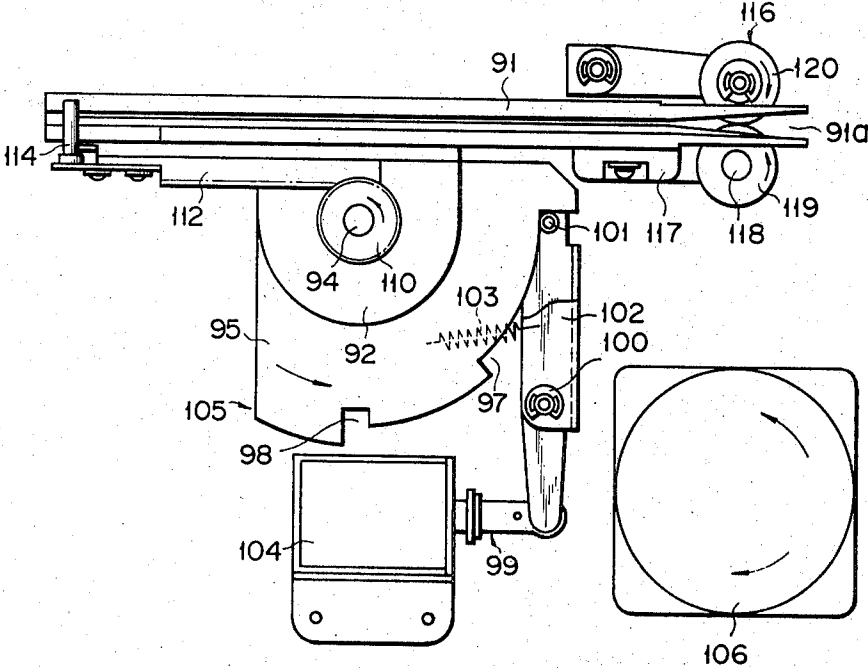


FIG. 14

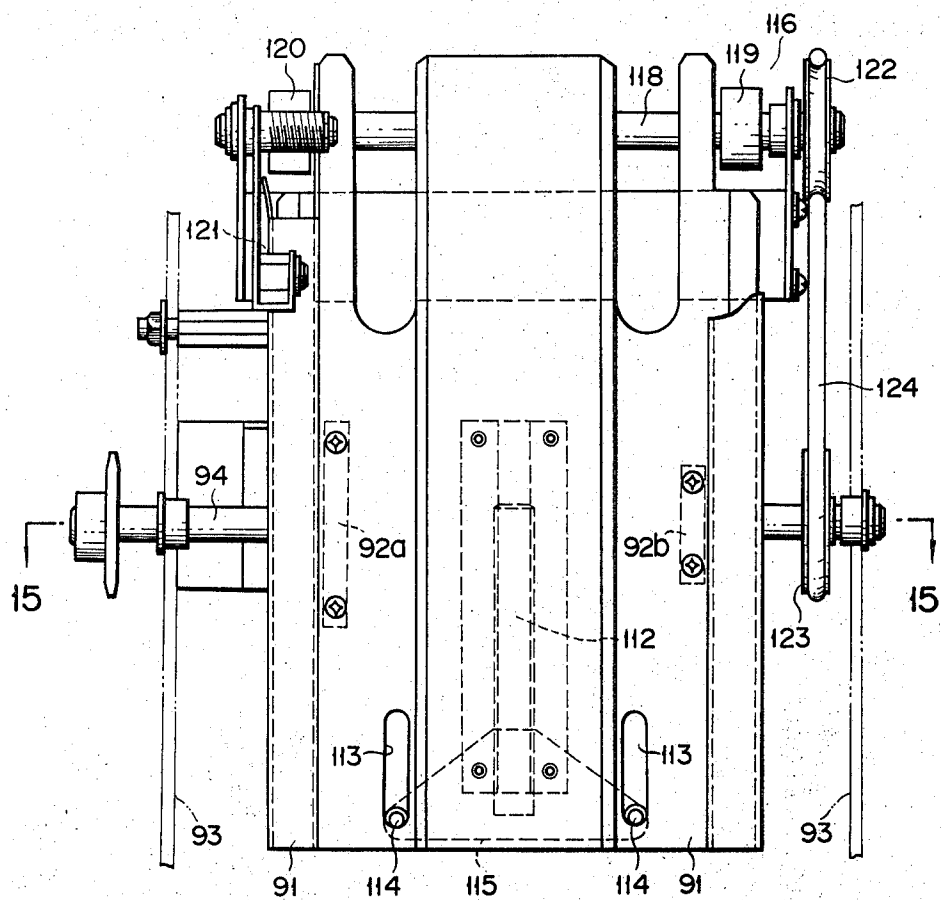


FIG. 15

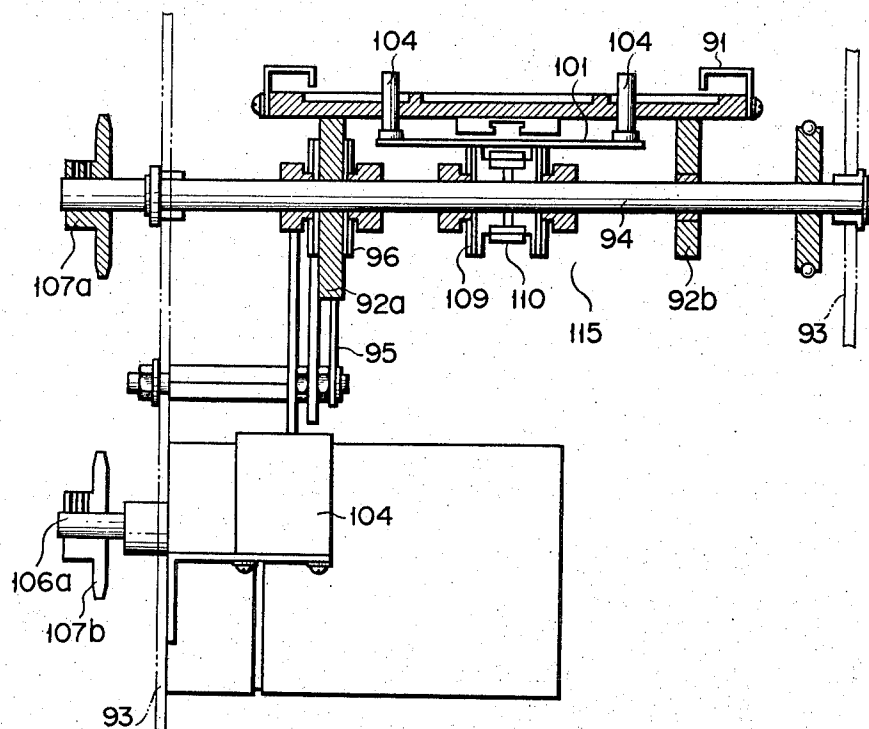


FIG. 16

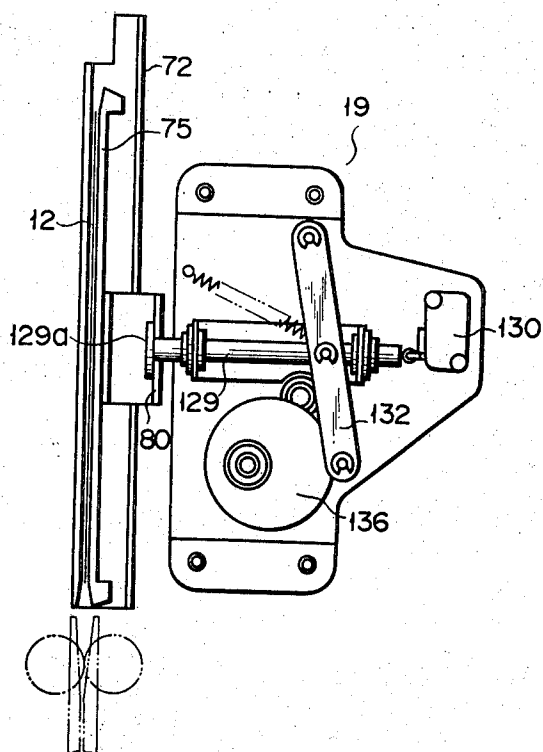


FIG. 17

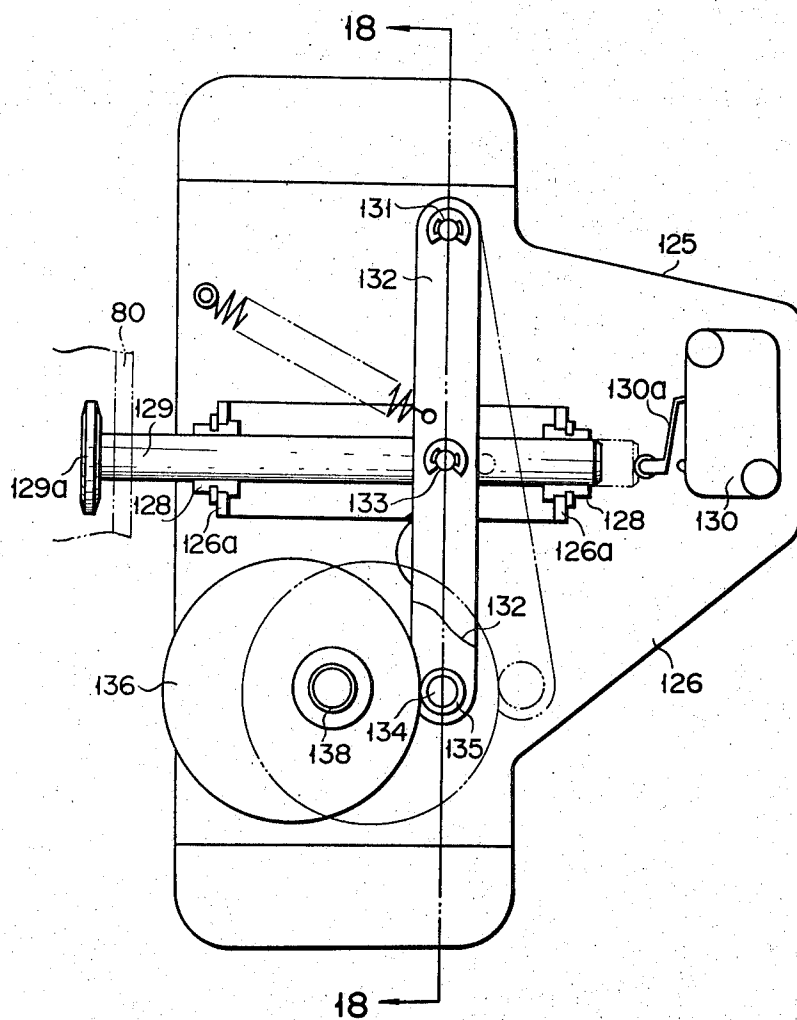


FIG. 18

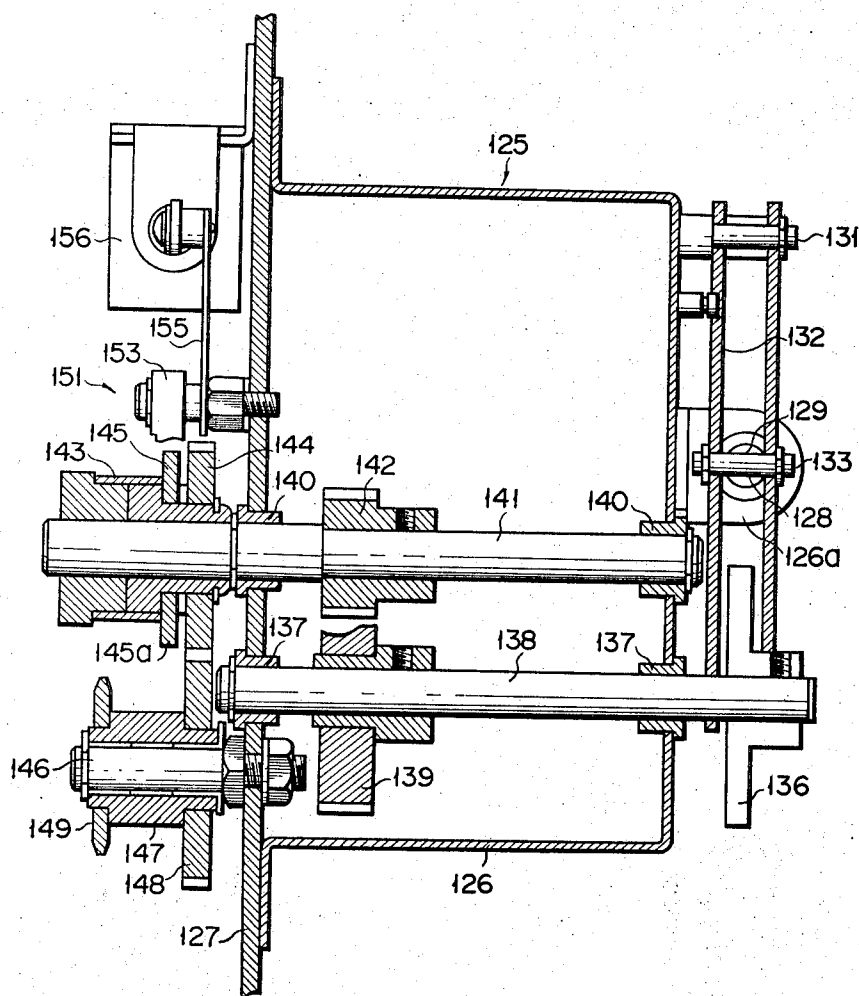


FIG. 19

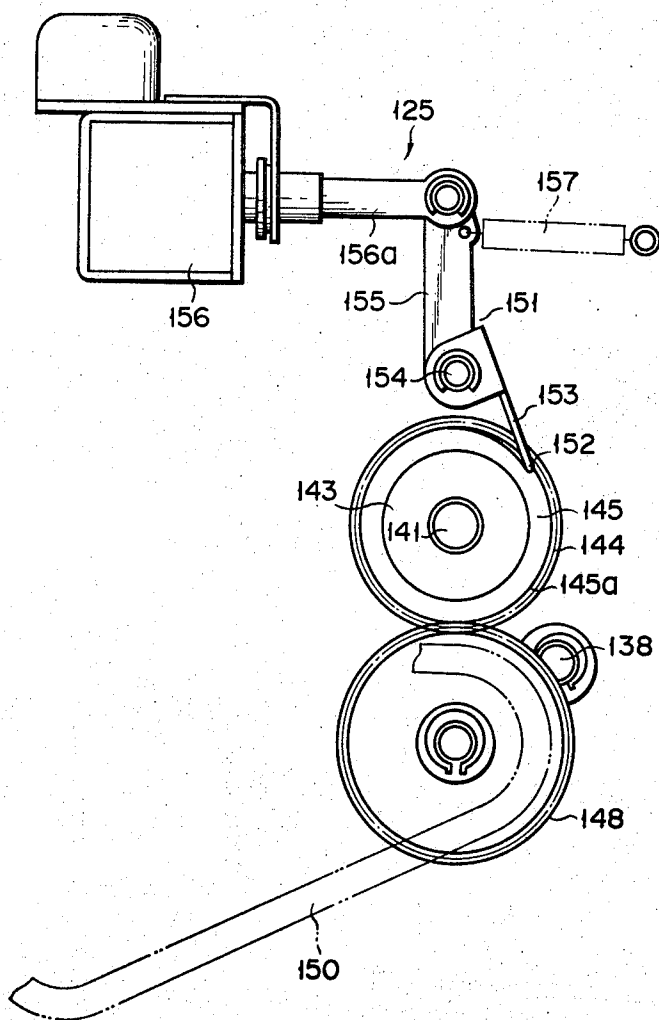
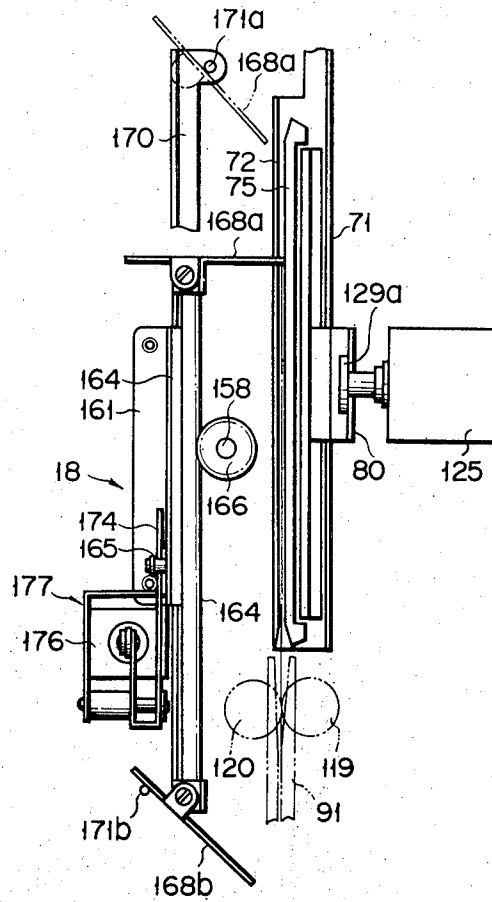


FIG. 20



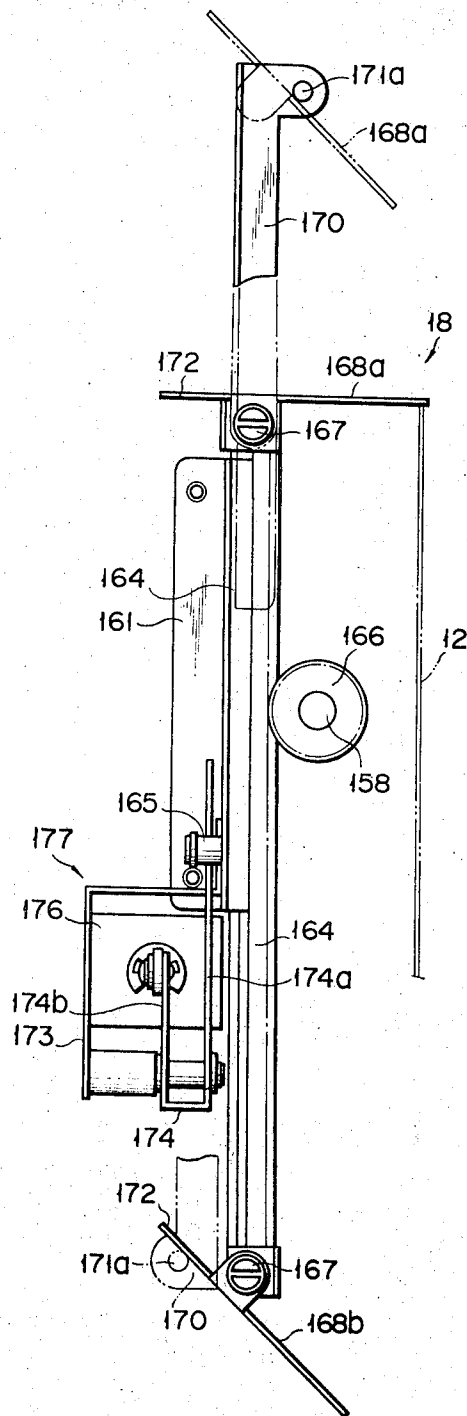


FIG. 21

FIG. 22

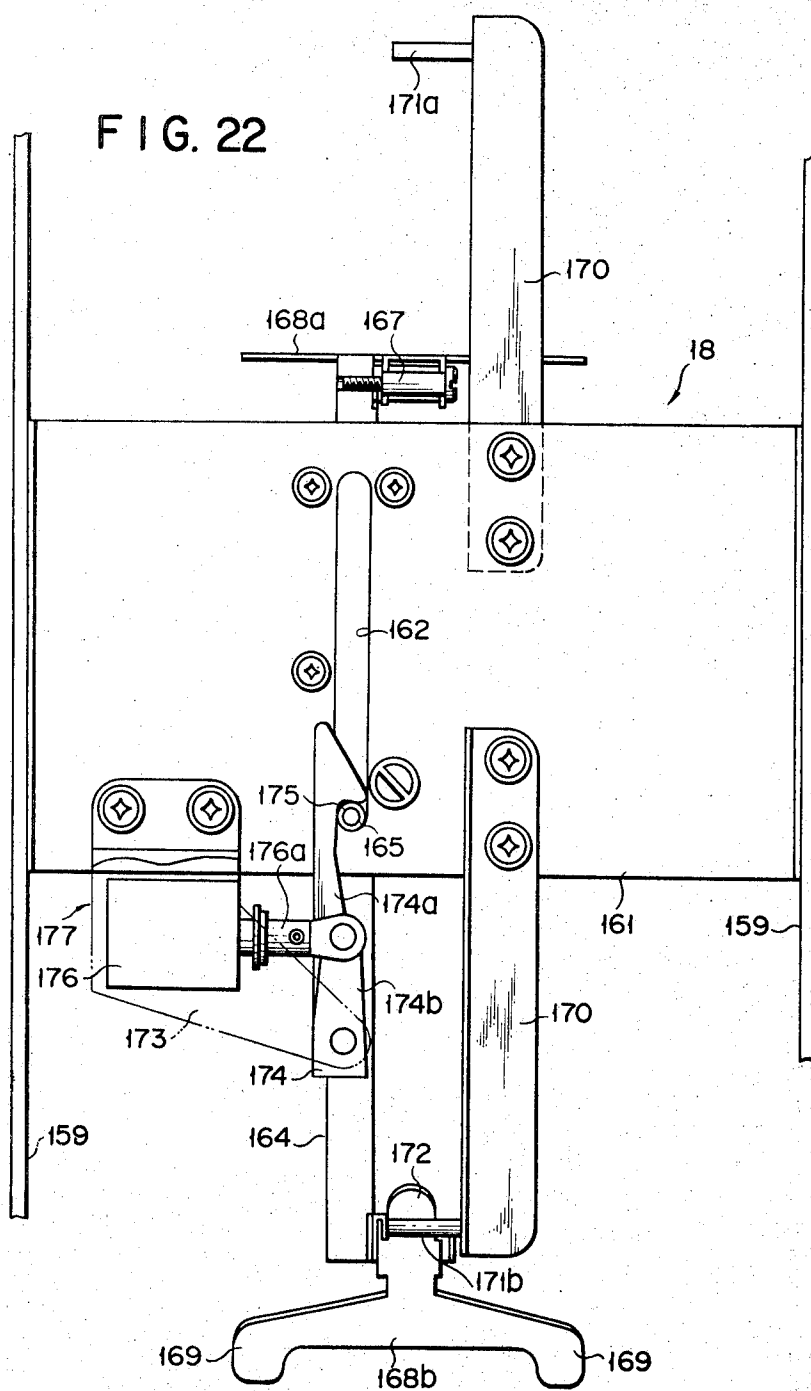


FIG. 23

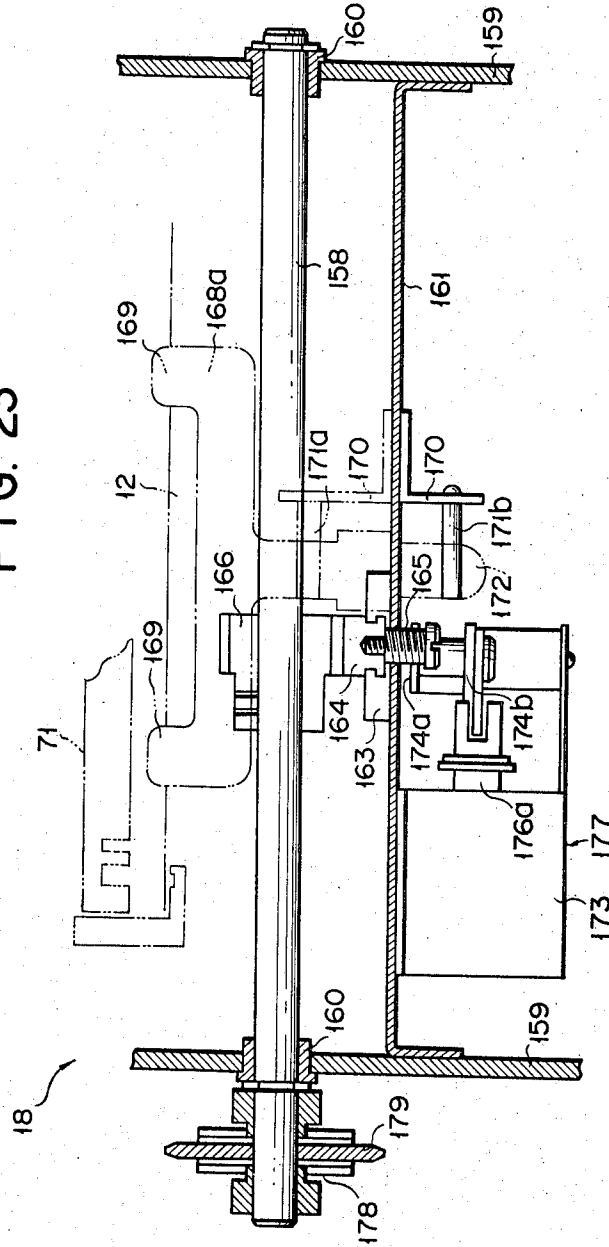


FIG. 24

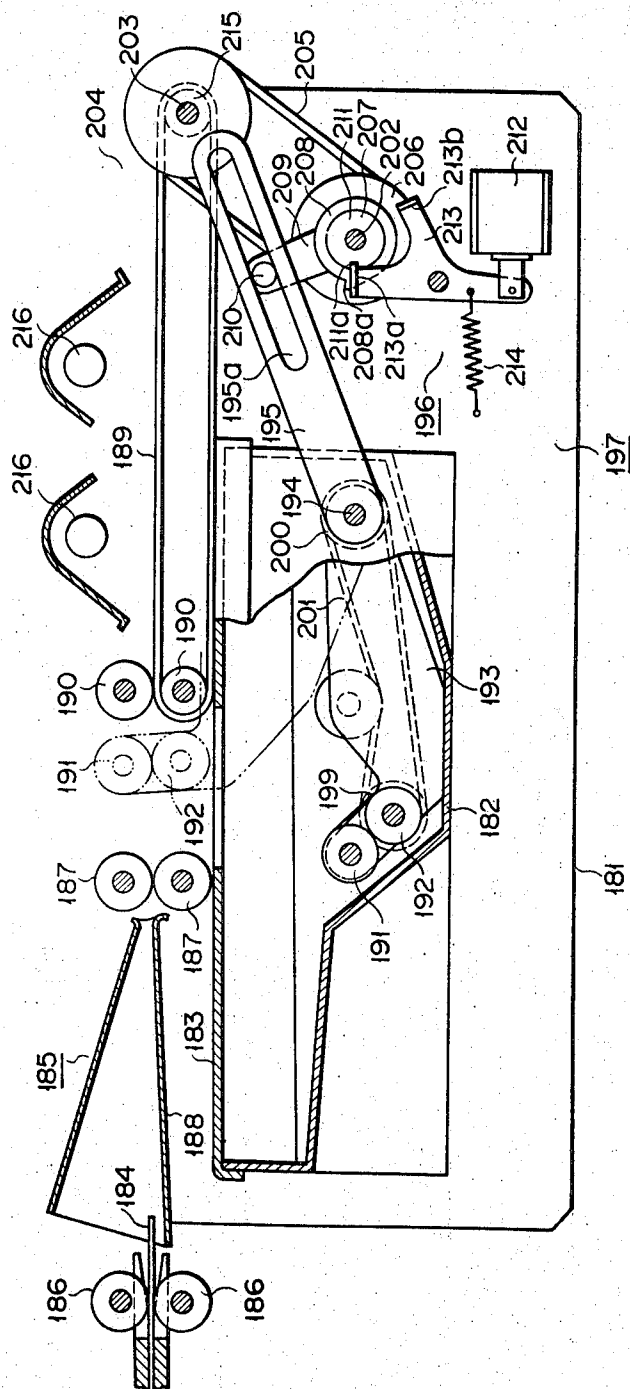


FIG. 25

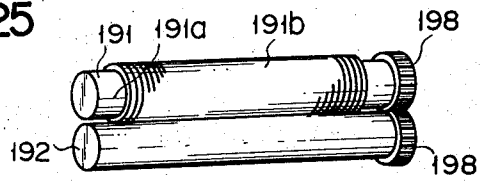


FIG. 26

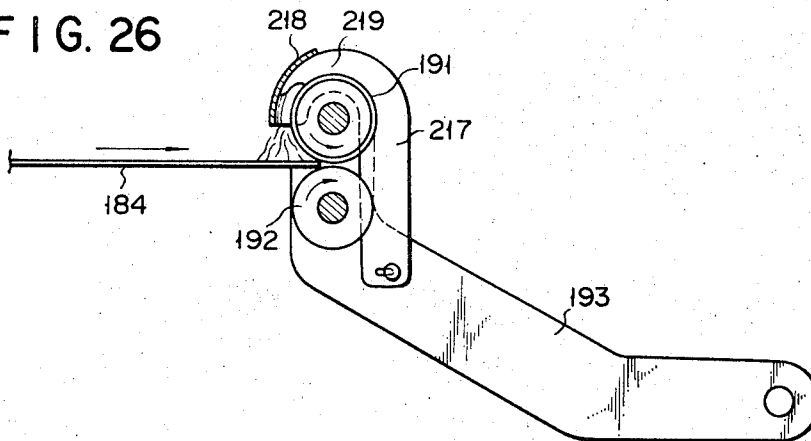
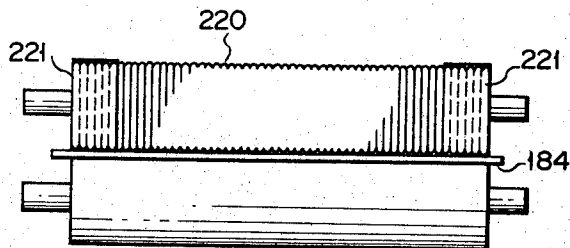


FIG. 27



COLOR ELECTROSTATIC COPYING APPARATUS

This invention relates to a color electrostatic copying apparatus. With such a copying apparatus known to date, a sheet of copying paper and optical system occupied an irregular relative position during several cycles of exposure and development, sometimes resulting in aberration of colours.

It is accordingly the object of this invention to provide a color electrostatic copying apparatus which enables several cycles of exposure and development to be effected quickly with the arrangement of a sheet of copying paper and optical system always fixed, thereby attaining colour recording free from aberration.

The present invention can be more fully understood from the following detailed description when taken in connection with the accompanying drawings, in which:

FIG. 1 is a schematic arrangement of a color electrostatic copying apparatus according to an embodiment of this invention;

FIG. 2 is a plan view of a film replacing mechanism;

FIG. 3 is a cross sectional view on line 3—3 of FIG. 2;

FIG. 4 is a fractional side view of the film feeder of FIG. 2;

FIGS. 5A and 5B illustrate the operating condition of the drive section of FIG. 4;

FIG. 6 is a perspective view of a weight placed on a heap of films in a film magazine;

FIGS. 7A and 7B are respectively perspective views of the upper and lower sections of a copying paper holding unit;

FIG. 8 is a front view of said copying paper holding unit;

FIG. 9 is a side view, partly in section, of said copying paper holding unit;

FIG. 10 is a cross sectional view on line 10—10 of FIG. 8;

FIG. 11 is a cross sectional view on line 11—11 of FIG. 8;

FIG. 12 is a side view of a copying paper feeding and withdrawing device;

FIG. 13 is a side view of the drive mechanism of the copying paper holding plate member of FIG. 12;

FIG. 14 is the top view of FIG. 13;

FIG. 15 is the rear view of FIG. 13;

FIG. 16 is a side view of a copying paper presser under an operating condition;

FIG. 17 is a side view of the copying paper presser of FIG. 16 under another operating condition;

FIG. 18 is a cross sectional view on line 18—18 of FIG. 17;

FIG. 19 indicates a clamp drive mechanism;

FIG. 20 is a side view of a copying paper feeder;

FIG. 21 is a fractional enlarged view of said feeder;

FIG. 22 is a front view of said feeder;

FIG. 23 is a bottom view of said feeder;

FIG. 24 is a side view, partly in section, of a finishing device;

FIG. 25 is a perspective view of a finishing liquid coating roller mechanism; and

FIGS. 26 and 27 jointly illustrate a modification of said finishing liquid coating roller mechanism.

Referring to FIG. 1, numeral 1 denotes a spline shaft penetrating an optical block or optical device 4 so disposed as to be rotatable, the optical block 4 being vertically slidable along the peripheral surface of the shaft 1. The optical block 4 includes a plurality of color original carrier units 300 each carrying a color original 5 (a positive color film in this embodiment). The optical block 4 includes a plurality of optical units 3 each corresponding to one of the film carrier units 300. Each optical unit 3 has a lens assembly 6 positioned at the intermediate position of the optical block 4 and a reflector 7 located at the bottom. A light projector 10 is disposed above the optical units with the film carrier units 300 between it and the optical units. The light projector 10 comprises a plurality of filters corresponding respectively to said optical units and at least one source of light 9. Around the optical block 4 are set a plurality of vertically movable copying paper holding units 11 facing the reflectors 7. To each of said holding units 11 is detachably fitted a sheet of copying paper 12. In the paths of said vertically movable holding units 11 are disposed chargers 13, respectively. At that lower part of the recorder which faces the respective copying paper holding unit 11 is placed a developing and washing device 14. Adjacent to this device 14 is located a dryer 15 ejecting hot air. The nozzle 16 of said dryer 15 is on the top edge of a tank. At the forward lower part of the recorder is set a copying paper feeding and withdrawing device 17 so as to interlock a copying paper feeder 18 and copying paper presser 19. At a location horizontally facing said copying paper feeding and withdrawing device 17 is disposed an electronic photograph finishing device 20. On a stationary table 2 positioned at the upper part of the recorder, on the rotation locus of the optical units, there is mounted a film replacing mechanism 21, which includes means for inserting positive films into film carriers facing the optical units 3 and withdrawing them therefrom.

There will now be described by reference to the appended drawings the constituent members of an electronic recorder according to an embodiment of this invention.

Film replacing mechanism 21 (FIGS. 2 to 6)

As shown in FIG. 5, a gear 24 is fitted to the shaft 23 of a motor 22. Said gear 24 engages a gear 26 on a rotary shaft 25, which is fitted with a spring clutch 27. To this spring clutch 27 is attached a cam 29 having a projection 28 formed on the periphery. There is provided an engagement member 30 engageable with the cam 29. Said engagement member 30 is rotatably supported by a pin 31 disposed at the intermediate part and connected at one end to a solenoid 32. The other end of said engagement member 30 is shaped into the form of a two-prong fork. Both ends of said forked end of the engagement member 30 constitute engagement pawls 33 and 34. This engagement member 30 is normally urged clockwise. Engagement of the pawl 33 with the projection 28 of the cam 29 releases the gear 26 from the rotary shaft 25. To the other end of the rotary shaft 25 is fixed, as shown in FIG. 2, an arm 36 having a roller 36a rotatably fitted to the outer end. This roller 36a engages the elongate slit 37a of a first lever rotatable at one end. Rotation of said arm 36 causes the first lever 37 to make reciprocations. The free end of the rotatable lever is fitted with a roller 37c, which abuts against a presser member 39 fitted to the end of a slider 38. Between the presser member 39 and rotatable lever

37 is stretched a coil spring 40. Where the slider 38 conducts a positive film 5 to a prescribed position, said coil spring 40 does not extend itself. Where the slider 38 fails to move due to, for example, the catch of the positive film 5, the coil spring 40 should be subject to a load sufficiently small to permit its extension and also save the positive film 5 from any damage. To the prescribed point on the slider 38 spatially facing a presser strip 37b fitted to the outer end of the first rotatable lever 37 there is attached a microswitch 41 electrically connected to the aforementioned motor 22. The slider 38 consists of a ribbon-shaped plate, both lateral sides of which are fitted with guide rollers 42 for guiding the linear reciprocations of said slider 38. At the intermediate point on the runway of the slider 38 is set up a box-shaped magazine 43, in which there are received a large number of positive films 5 in a superposed state. On the top of said heap of positive films 5 is placed a weight 44 to apply a constant load thereto. Said magazine 43 is provided at the bottom with an opening 45 extending in the direction in which the slider 38 passes through said magazine 43, said opening having a sufficient width and depth to permit the slider 38 and a single film jointly to pass therethrough. Adjacent to the forward side of the magazine 43 is set a positive film holding plate 46 in a position facing each optical unit 3. Adjacent to the forward side of said positive film holding plate 46 is disposed a collector 47 for collecting used positive films 5. Right above the film collector 47 is stretched a used film withdrawing bar 48 for conducting a used film into said film collector 47. This film withdrawing bar 48 is supported by a plurality of guide rollers 49 so as to make horizontal reciprocations together with the slider 38. The rear end of said bar 48 is fitted with a film catching pawl 50. To the intermediate part of said film withdrawing bar is connected the free end of a second rotatable lever 51 pivoted at one end. This second lever 51 is joined with the first rotatable lever 37 by means of a connection bar 52 (FIG. 4). There is further provided a discharge chute 53 for guiding a used positive film 5 drawn out by the aforesaid bar 48 into the film collector 47. To the stationary table 2 facing the positive film holding plate 46 is fitted a detector 54 consisting of a microswitch. There is also provided an actuator which extends up to the positive film holding plate 46 through a hole 56. The detector 54 electrically connected to the copying paper feeder 18 is so designed as to stop its operation, where required. The weight 44 contained in the magazine 43 has four projections 57 formed, as shown in FIG. 6, at the respective corners of its underside, the interspaces between the adjacent projections constituting clearance sections 58. Where the weight 44 is placed on the top of a heap of positive films 5, said projections 57 abut against the frame of the positive films 5, thereby preventing their surfaces from being damaged. Further, where all the positive films 5 are drawn out of the film magazine 43 and the weight 44 reaches its bottom, the slider 38 passes through the clearance sections 58 of the weight 44 and avoids its collision therewith. Further, the weight 44 is provided with a knob 59 and a chain 60 (FIG. 3) which is connected at one end to said knob 59 and at the other to the lug of the film magazine 43 so as to prevent the loss of the weight 4.

Copying paper holding unit 11 (FIGS. 7 to 11)

Referring to FIG. 7A, numeral 61 represents a stationary frame, which is fixed to the optical block 4 by

means of a fitting means 62. Each side wall 61a of the stationary frame 61 is fitted at the upper part with a first link 63a and at the lower part with a second link 63b, said first link 63a being pivoted at the center and said second link 63b at one end. These links 63a and 63b connect a movable frame 64 to the stationary frame 61 so as to render the former rockable about the latter. The first links 63a are joined together by a support shaft 65 disposed behind the side walls 61a of the stationary frame 61. The stationary frame 61 and movable frame 64 are drawn to each other by coil springs 66 stretched across both side walls thereof. Ahead of the movable frame 64 is positioned an exposure mask holding frame 67 normally at a prescribed interval, which is, however, adjustable, as need requires.

To both side walls of the movable frame 64 are fitted stops 68. The stops 68 have mutually facing bent portions formed at the center end. On the other hand, said exposure mask holding frame 67 has notches 67a cut out at the four corners with a depth equal to twice the thickness of the stops 68, said notches being engageable with said stops 68. Further between the exposure mask holding frame 67 and movable frame 64 is provided an urging member 69 comprised of a pair of plate springs 69a and 69b so fixed at both ends as to have the intermediate portions project outward for engagement with stop projections 64a on the movable frame 64 and similar projections 67b on the exposure mask holding frame 67. Said urging member 69 normally presses the exposure mask holding frame 67 toward the outside. The front side of the opening of said holding frame 67 is fitted with an exposure mask 70. Below the stationary frame 61 is disposed, as shown in FIG. 7B, a copying paper holding frame 71 which includes a rectangular back plate 72 and a pair of side members 73 with an L-shaped cross section fitted to both sides of said back plate 72. The inner walls of said side members 73 act as a copying paper clamping surface 73a in cooperation with a separate means. The back plate 72 has a lengthwise extending recess formed at the center. The lower half of said recess has notches 74 cut out on both sides. In the copying paper holding frame 71 constructed as described above is received a clamping device 75 illustrated in FIG. 10. At those parts of both end portions of the clamping device 75 which face the aforesaid copying paper clamping surfaces 73a of the side members 73, there are projectively provided flexible clamping members 76 made of elastic material such as rubber. Near said clamping members 76 are also projectively formed paper guides 77. Each clamping member 76 consists of a base 76a embedded in the body of the clamping device 75 and an elastic curved clamping pawl 76b integrally formed at the upper end of the base 76a. When the tips of both clamping pawls 76b abut against the clamping surfaces 73a of the side members 73, a sheet of copying paper is stretched in opposite directions. The clamping device 75 is elastically pressed, as shown in FIG. 11, to the back plate 72 by means of an elastic support 78, for example, a plate spring. On the inner wall of the back plate 72 is projectively provided a guide member 79 whose top has an arcuate surface. The upper end of said elastic support 78 slidably abuts against said arcuate surface. Substantially to the center of the backside of the clamping device 75 is fitted a hanger 80 as illustrated in FIG. 10. The outer end of said hanger 80 is so designed as to interlock the copying paper feeding and withdrawing de-

vice 17 by passing through the notch 74 to protrude out of the back plate 72. The inner wall of the back plate 72 is further fitted with a pair of trapezoidal attachments 81 for preventing the warp of said sheet of copying paper. Each attachment 81 includes a pair of legs 81a formed at both ends and a guide portion 81b extending between said legs 81a. The legs 81a are fixed to the upper and lower ends of the back plate 72 respectively, and the guide portion 81b faces the front side of the clamping device 75, and is also brought with a slight clearance opposite to the surface of a copying sheet of paper when it is placed in a normal position for recording. Inside of the copying paper holding frame 71 a stay 82 is horizontally mounted. The upper end of said holding frame 71 is fitted with a connection frame 83 which in turn is provided with a support arm 84. The arm 84 and in consequence the holding frame 71 are made to move vertically by drive means. During said movement a copying sheet of paper 12 is subjected to electrical charge, exposure, development, washing and drying.

Referring again to FIG. 1, the developing and washing device 14 positioned below said holding frame 11 consists of a tank 85, an inlet port 86 formed on the upper edge of the tank 85 so as to supply developing and washing liquids and an outlet port 87 bored at the bottom of the tank 85. On one side of the tank 85 are provided a downward pipe 88 and upward pipe 89 so as to supply the tank 85 with developing and washing liquids alternately through both pipes 88 and 89 each time by operation of a valve 90.

Copying paper feeding and withdrawing device 17 (FIGS. 12 to 15)

On the back side of the substantial longitudinal center of both walls of a copying paper holding frame 91 are provided a pair of support members 92a and 92b (FIG. 14). Said support members 92a and 92b are supported by shaft 94 stretched across a pair of support plates 93. The support member 92a is fitted with a guide plate 95 which is connected to the rotary shaft 94 through a friction clutch 96 (FIG. 15). The guide plate 95 has a sectorial shape, in the curved periphery of which there are cut out a first engagement groove 97 and a second engagement groove 98 (FIG. 13). Near the guide plate 95 is disposed a control mechanism 99 for allowing said guide plate 95 to rotate through an angle of 45° each time. This control mechanism 99 is rotatably supported at the intermediate part of a separate support shaft 100 and consists of a lever 102 provided at one end with a pin engageable with the engagement grooves 97 and 98 of said guide plate 95 and a solenoid 104 connected to the other end of said lever 102 so as to allow it to be rotated against the force of a spring 103 for disengagement from the groove 97 or 98.

The rotary shaft 94 is fitted at one end with a driven sprocket wheel 107a, which is connected by a chain (not shown) to a driving sprocket wheel 107b fitted to the drive shaft 106a of an electric motor 106 capable of normal and reverse rotations.

To the intermediate part of the rotary shaft 94 is fitted a pinion gear 110 through a friction clutch 109. Said pinion gear 110 engages the rock 112 of a conveying device 111 slidably fitted to the backside of said copying paper holding frame 91. Said conveying device 111 has a pair of pins 114 projecting forward through a pair of elongate guide holes 113 spatially bored in the

underside of the holding frame 91. Said conveying device 111 supports from below a sheet of copying paper held by the holding frame 91, and, where required, also acts as a feeder 115 for pushing up the copying paper 12. Near the inlet port 91a of the holding frame 91 is installed a drive means 116 capable of normal and reverse rotations so as to feed or draw out the copying paper 12. Across the underside of the upper part of the holding frame 91 is provided a driven shaft 118 by means of fitting members. Both ends of the driven shaft 118 are fitted with a pair of first rubber rollers 119 so as to face both edges of the copying paper 12. There are further provided a pair of second rubber rollers 120 rotatable in abutment against said first rubber rollers 119. These second rubber rollers 120 are normally urged toward the first rubber rollers 119 by a spring 121 (FIG. 14). The driven shaft 118 is fitted at one end with a pulley 122 and the rotary shaft 94 is also fitted at one end with a pulley 123 facing that of the driven shaft 118. Between these pulleys 122 and 123 is stretched a round belt 124 to allow the rotary shaft 94 and driven shaft 118 to rotate in the same direction (FIG. 14).

In the vertical and horizontal positions as well as in a position inclined 45° therefrom on the rotation locus of the copying paper holding frame 91 are set up the copying paper feeder 18, copying paper presser 19 and finishing device 20 respectively in a mutually facing relationship. There will now be described these devices by reference to the appended drawings.

Copying paper presser 19 (FIGS. 16 to 19)

To the hanger 80 of the copying paper holding frame 11 is connected a clamping device driving mechanism 125 for advancing and retracting the clamping device 75. To a base plate 127 is fitted the leg of a fitting member 126 channel-shaped in cross section. At the center of the front wall of said fitting member 126 are spatially formed a pair of upright cut out strips 126a (FIG. 17). To these upright cut out strips 126a are attached a pair of bearings 128, on which an actuating bar 129 is slidably mounted. This actuating bar 129 has an integral hook 129a formed at one end and is fitted at the other end with microswitch 130 having an actuating lever 130a spatially facing the end face of said actuating bar 129.

On the upper front wall of the channel-shaped fitting member 126 is projectively provided a support shaft 131 to which there are rotatably fitted actuating levers 132. The intermediate part of said actuating levers 132 intersects that of the actuating bar 129 such that the said actuating levers 132 clamp the actuating bar 129 by being connected thereto by a pin 133 penetrating both levers 132 and bar 129. The free ends of said actuating levers 132 are connected together by a stationary pin 134 with which there is rotatably engaged a cylindrical roller 135. This roller 135 rotatably abuts against an eccentric cam 136 for driving said levers 132. Said eccentric cam 136 is fitted to one end of a driven shaft 138 rotatably supported on bearings 137 provided on the fitting member 126 and base plate 127. To the intermediate part of the driven shaft 138 is fitted a driven gear 139 which engages a driving gear 142 on a driving shaft 141 disposed parallel with said driven shaft 138 and rotatably supported on bearings 140. These driving gear 142 and driven gear 139 have a gear ratio of one to two, namely, are so designed that when the driving gear 142 makes one rotation, the driven gear makes

half a rotation. To one end of the driving shaft 141, that is, the backside of the base plate 127, there are mounted through a spring clutch 143 a first gear 144 and a guide plate 145 coupled together as a unit. Near the first gear 144 is disposed a cylindrical member 147 which is rotatably fitted on a support shaft 146 fitted to the base plate 127. This cylindrical rotating member 147 is fitted at one end with a second gear 148 engaging the first gear 144 and at the other with a sprocket wheel 149. A chain 150 (FIG. 19) is stretched between said sprocket wheel 149 and another sprocket wheel (not shown) fitted to the motor shaft.

On the upper backside of the base plate 127 is provided a control mechanism 151 for adjusting the operation of the spring clutch 143. This control mechanism 151 consists of the guide plate 145 integrally coupled with the first gear 144 and also connected to the driving shaft 141 through said spring clutch 143, and an engagement pawl 153 detachably engaging an engagement groove 152 formed in the guide surface 145a of said guide plate 145.

This engagement pawl 153 is rotatably supported by a pivotal shaft 154 screwed at one end to the base plate 127, and also connected to a lever 155 rotatably fitted to said pivotal shaft 154. The free end of said lever 155 is connected to the sliding bar 156a of a solenoid 156 (FIG. 19), and normally so urged by a spring 157 as to cause the end of the engagement pawl 153 to be slidably pressed against the guide surface 145a of the guide plate 145.

Copying paper feeder 18 (FIGS. 20 to 23)

Ahead of the copying paper holding frame 11 facing the copying presser 19 is disposed the copying paper feeder 18 so as to permit a sheet of copying paper to be reliably supplied to, and drawn off from, the copying paper holding frame 71.

Referring to FIG. 23, numeral 158 represents a shaft rotatably supported by bearings 60 mounted on a pair of spatially set up base plates 159. Behind said rotary shaft 158 is positioned a fitting plate 161 connected at both ends to said spatially erected base plates 159. The fitting plate 161 is bored at the center with a vertically elongate guide hole 162 (FIG. 22). To the front side of the fitting plate 161 is attached a sliding member 164, for example, a rack so as to slide vertically through a fitting member 163. A guide pin 165 screwed to said rack 164 engages the vertically elongate hole 162 (FIG. 22). Further, the rack 164 engages a pinion gear 166 disposed at the intermediate part of the rotary shaft 158 so as to slide upward or downward according to the rotation of said rotary shaft 158. On the sides of both ends of the rack 164 are projectively provided support shafts 167. There are fitted engagement pawls 168a and 168b (FIG. 20) to the rack 164 so as to rotate about said support shafts 167. These engagement pawls 168a and 168b are urged by a spring (not shown) to take a horizontal position, that is, to cause the engagement tips 169 to face the upper and lower edges of the copying paper (FIGS. 22 and 23). Near the terminal of the travel of the rack 164 are disposed a pair of support members 170 fixed at one end to the fitting member 161. To said support members 170 are fitted actuating pins 171a and 171b (FIG. 23). The engagement pawls 168a and 168b are provided with projections 172, which restrict their movement when they are brought to a prescribed position. Accordingly, the engagement pawl 168a or 168b is made to rock against the force of

the aforesaid spring (not shown) to be prevented from abutting against a sheet of copying paper 12 held by the holding frame 67 and the feeding and withdrawing device 17, thereby opening the path of said paper.

The fitting plate 161 is further provided with a support plate 173, to which there is rotatably fitted a substantially channel-shaped engagement lever 179 consisting of a longer arm 174a and a shorter arm 174b. The longer arm 174a is provided at its free end with an engagement portion 175 which engages the guide pin 165 when it is brought to the lower end of the vertically elongate hole 162 (FIG. 22). The free end of the shorter lever arm 174b is connected to the actuating bar 176a of a solenoid 176 fitted to the support plate 173, causing, where necessary, the engagement lever 174 to rock so as to effect engagement or disengagement between said engagement portion 175 and guide pin 165. When there is supplied a sheet of copying paper for recording, the operation of the engagement pawl 168b is delayed from said supply to prevent the copying paper from abutting against it. The members associated with said delayed timing constitutes a control mechanism 177 (FIGS. 21, 22).

To one end of the rotary shaft 158 is connected a sprocket wheel 179 through a friction clutch 178 (FIG. 23). This sprocket wheel 179 is connected to the sprocket wheel and chain (neither shown) fitted to the drive shaft of a motor (not shown) capable of normal and reverse rotations.

Electronic photograph finishing device 20 (FIGS. 24 and 25)

A finishing solution tank 182 is filled with a surface finishing solution prepared by adding an interface active agent to an aqueous solution of, for example, polyvinyl alcohol. The upper opening of said finishing solution tank 182 is closed with a cap member 183. Above said finishing solution tank 182 is disposed a conveying device 185 for horizontally conducting an unfinished electronic photograph 184. This conveying device 185 comprises two forward and rear sections: the forward section consists of two pairs 186 and 187 of conveying rollers and a guide plate 188 disposed between these pairs 186 and 187; the rear section consists of a mechanism including a horizontal belt conveyor 189. A pair of feed rollers 190, over one of which there is stretched the forward end of said belt conveyor 189, are so designed as to move forward the conveyed electronic photograph 184 by pinching both of its lateral edges alone in cooperation with the belt conveyor 189.

In the finishing solution tank 182 are provided a rotatable arm 193 for supporting a coating roller 191 and complementary roller 192. The rotatable arm 193 jointly rotates with an actuating arm 195 about a rotary shaft 194 connecting both arms 193 and 195. Said actuating arm 195 is made to rotate by means of a rotation mechanism 196. Where the actuating arm 195 is rotated, for example, clockwise from its position indicated in solid lines in FIG. 24, then its end is lifted up to the height of the photograph conveying path. Namely, the coating roller 191 and complementary roller 192 are brought up by the coating roller driving mechanism 197 from their positions immersed in the finishing solution tank 182 to the photograph conveying path shown in phantom in FIG. 24. At this time the coating roller 191 is positioned above the complementary roller 192. The unfinished electronic photograph 184 pinched between said rollers 191 and 192 is deliv-

ered to the conveying path. Both rollers 191 and 192 have a pair of mutually engaging gears 198 disposed at the same end. Across said geared ends is stretched a pulley 199 (FIG. 24) which is driven by a pulley 200 provided concentrically with the rotary shaft 194 and a belt 201 stretched thereover. The coating roller 191 and complementary roller 192 are designed not only to abut against the surface of the conveyed electronic photograph 184 but also positively move it forward. The coating roller 191 has its periphery wound with a stainless steel wire 191a with an extremely narrow interval allowed between the turns (FIG. 25), whereas the complementary roller 192 simply consists of a round iron bar.

The actuating arm rotating mechanism 196 is constructed in the following way. Between a main pulley 204 fitted to a main shaft 203 normally rotated by a drive means (not shown) and a complementary pulley 206 fitted to a driven shaft 202 is stretched a belt 205. Said driven shaft 202 is normally made to rotate by the main pulley 204, and further fitted with a spring clutch 207. The driven cam 208 of said driven shaft 202 is connected to a lever 209 whose outer end is fitted with a projecting pin 210 which in turn engages an elongate hole 195a bored in the actuating arm 195. To the spring clutch 207 is attached a clutch actuating cam 211 which is operated by an actuating lever 213 interlocking a magnet 212. The engagement pawl 213a of the actuating lever 213 normally engages the engagement groove 211a of the clutch actuating cam 211, thereby preventing interlocking between the driven shaft 202 and driven cam 208. Energization of the magnet 212 causes the actuating lever 213 to rotate counterclockwise against the force of a spring 214, thereby releasing the clutch actuating cam 211. Accordingly, the driven cam 208 rotates clockwise jointly with the driven shaft 202, and in consequence the actuating arm 195 makes a clockwise rotation by the lever 209. Where, however, the stop 213a formed on the actuating lever 213 abuts against a projection 208a on the driven cam 208, the actuating arm 195 rotates no longer. This represents the condition where the coating roller 191 and complementary roller 192 are lifted.

On the main shaft 203 is provided a roller 215. Across this roller 215 and feed roller 190 is stretched a belt conveyor 189, which normally makes an endless run. On the rear section of the conveying device 185 are provided driers 216 to dry an electronic photograph 184 coated with a finishing solution.

There will now be described the operation of an electronic recorder arranged according to the aforementioned embodiment of this invention. Referring to FIG. 1, the optical block 4 has a neutral position. Where, under this condition, the spline shaft 1 rotates through an angle of 90°, the optical units 3 rotate jointly therewith. Said optical block 4 is lifted up to the point where a sheet of copying paper 12 faces the charger 13 to cause the surface of the paper 12 to be electrically charged by the charger 13. When the charger 13 fully passes over the exposed surface of the copying paper, it faces the exposure mask 7. Where, under this condition, the light source 9 of the light projector 10 gives forth light, the light passes through the positive film 5 and lens 6 to project the image of said film is refracted by the reflector 7 and projected on the copying paper 12 with a prescribed colour.

Upon completion of said exposure the optical block 4 is brought down the spline shaft 1. While the optical block 4 is in an upper position to effect exposure, a used positive film 5 is replaced with a fresh one in another section of the electronic recorder. There will now be described by reference to FIGS. 3 to 6 the operation of the film replacing mechanism 21. Where the solenoid 32 is energized with the positive film 5 brought to the underside of the withdrawing bar 48, then the engagement member 30 makes a counterclockwise rotation against the righting moment of the spring 35. Upon said counterclockwise rotation, the engagement pawl 33 which engaged the projection 28 of the cam 29 up to this point, is removed outward and conversely the other engagement pawl 34 approaches the cam 29. When the cam 29 is disengaged, the spring clutch 27 is operated, causing the drive shaft 23 of the normally rotating motor 22 to operate the rotary shaft 25 through the gears 24 and 26. Accordingly, the cam 29 rotates clockwise and is brought to rest when its projection 28 abuts against the engagement pawl 34. Rotation of the cam 29 is transmitted to the arm 36 through the rotary shaft 25, resulting in the clockwise rotation of the first rotatable lever 37. Rotation of this first rotatable lever 37 is transmitted through the spring 40 to cause the slider 38 to move in its axial direction, and in consequence the second rotatable lever 51 to rotate through the connection bar 52. The forward end of the slider 38 which travels to the right in FIG. 3 passes through the openings of the film magazine 43 to insert the lowermost one of the superposed positive films 5 into the positive film holding member 46. Where, under this condition, the forward end of the positive film 5a abuts against the actuator 55 for its rotation, then the detector 54 detects the travel of the positive film 5a and supplies the copying paper feeding and withdrawing device 17 with a signal instructing the feeding of copying paper. Conversely where the actuator 55 does not rotate, namely, the positive film 5a is not inserted into said positive film holding member 46, said detector 54 supplies the copying paper feeding and withdrawing device 17 with a signal instructing the stop of said feeding. At this time, rotation of the second rotatable lever 51 causes the withdrawing bar 48 to slide in the same direction as the slider 41, namely, to the right of FIG. 3. The used positive film 5b already placed in the positive film holding member 46 is caught by the engagement pawl 50 just before the succeeding film 5a is inserted into said holding member 46 by the slider 38, and drawn out to the right. The positive film 5b thus drawn out passes through the discharge chute 53 to be collected into the collector 47. Even where the slider fails to move due to the positive film 5 being caught in the magazine 43 or the erroneous insertion of the positive film into said holding member 46, the resultant increased tension of the spring 40 restricts the rotation of the first lever 37. If said first rotatable lever 37 tends to make any further rotation, the presser member 37b is pressed against the actuator 41a of the microswitch 41, to cut off power supply to the drive mechanism 21 (FIG. 1). When said drive mechanism 21 stops, the first rotatable lever 37 is brought back to its original position by the righting moment of the spring 40, thereby saving the positive film from damage.

The above-mentioned insertion of the positive film 5 is completed while exposure is made in another section. When exposure is finished, the optical block is

brought down, followed by development and fixing. At this time, the solenoid 32 is deenergized and the engagement member 30 rotates counterclockwise by the righting moment of the spring 35, namely, the engagement pawl 34 is detached from the cam 29 and the other engagement pawl 33 approaches it. Due to the resultant release of the cam 29, the rotary shaft 25 rotates by the action of the spring clutch 27, resulting in the counterclockwise rotation of the first and second levers 37 and 51 through the arm 36 (FIG. 2). When the projection 28 of the cam 29 abuts against the engagement pawl 33, the rotary shaft 25 stops again by the action of the spring clutch 27. Rotation of the first and second levers 37 and 51 causes the slider 38 and withdrawing bar 48 to travel to the left of FIG. 3, ready for the insertion and withdrawal of the succeeding positive film. When the slider 38 retracts from the magazine 43 the following positive film 5 is brought down under the pressure of the weight 44 to face the openings 45. Repetition of the aforementioned cycle of operation allows the positive films 5 in the magazine 43 to be inserted into the positive film holding member 46 one after another with the used film drawn out of said holding member 46 into the collector 47.

Upon completion of the exposure of a positive film 5 and its replacement with a fresh one, a sheet of copying paper 12 is taken into a tank 85 (FIG. 1) below while being held by the holding frame 11. At this time, a developing solution is taken into the tank 85 at the inlet port 86, passes through the downward path 88, flows up from the bottom of the tank 85 and fills the upward path 89. After the exposed surface of the copying paper 12 is developed, the developing solution is drawn off from the tank 85 through the outlet port 87. Thereafter, a washing solution is supplied through the inlet port 86 to wash the developed surface of the copying paper for fixation. Like the developing solution, the washing solution is discharged through the outlet port 87. Then the optical block 4 is slowly lifted, and a finished copying paper 12 is dried by hot air ejected from the nozzle 16 of the driers 15.

While being held during development and washing in the holding frame 11 facing the feeding and withdrawing device 17, a sheet of copying paper 12 is recorded initially in single colour and thereafter multicolours to produce the so-called electronic photograph. After this photograph is withdrawn from the electronic recorder, a fresh sheet of copying paper is supplied thereto. There still now be described the operation of a device for feeding and withdrawing the copying paper 12. Where the hanger 80 of the holding frame 71 and the hook 129a of the clamping device actuating mechanism 125 engage each other, the cylindrical roller 135 abuts against the least displacement portion of the eccentric cam, so that the hook 129a and hanger 80 are in a free or in operative state. Accordingly, the copying paper 12 is pinched between the surface of the clamping device 75 and the clamping surface 73a.

Where, under this condition, supplied with an input signal, the solenoid 156 of the clamping device actuating mechanism 125 operates for a prescribed length of time, and the lever 155 rocks against the force of the spring 157 and the integral engagement pawl 153 is released from the engagement groove 152 of the guide plate 145 to operate the spring clutch 143. Rotation of the first gear 144 driven by a motor (not shown) is transmitted to the driving shaft 141 through the spring

clutch 143. Said driving shaft 141 continues rotation until the engagement pawl 153 again engages the engagement groove 152 of the guide plate 145. At this time the driven gear 138 makes half a rotation which is provided with a driven gear 139 bearing a gear ratio of 1:2 to a driving gear fitted to the driving shaft 141. The eccentric cam 136 also makes half a rotation with its maximum displacement portion brought opposite to the cylindrical roller 135. As the result, the actuating bar 129 slides to a position indicated in two dots-dash lines in FIG. 17, and the clamping device 75 of the holding frame 67 is drawn outward, so that the clamping surface 73a and the surface of the clamping device 75 are separated from each other to set the copying paper 12 free (FIG. 10). When brought to such a free state, the copying paper is pulled down by the copying paper feeder 18 on to the feeding and withdrawing device 17. After rotated to a horizontal position by said device 17, the paper is conducted to the finishing device 20.

The copying paper 12 brought from the feeding and withdrawing device 17 is again inserted between the holding bar 71 and clamping device 75 by the copying paper feeder 18. After lapse of sufficient time for the feeding and withdrawal of the copying paper, that is, in a prescribed time after the actuating bar 129 depresses the actuating lever 130a of the position detecting microswitch 130, then solenoid 156 of the clamping device actuating mechanism 125 is put into operation to disengage the engagement pawl 153 from the engagement groove 152 and cause the eccentric cam 136 to make half a rotation again. When the actuating lever 132 is brought back to its original position, that is, when the actuating bar 129 and the hook 129a are set free, then the copying paper 12 is held between the holding frame 71 and the surface of the clamping device 75.

Where, in the copying paper presser 19, the holding frame 71 is removed from the clamping device 75 to set the copying paper 12 free, then the motor drives the sprocket wheel 179, causing the pinion gear 166 on the rotary shaft 158 to rotate counterclockwise. As the result, the rack 164 engaging said pinion gear 166 is brought down, so that the engagement tips 169 of the engagement pawl 168a provided at the upper part of the rack 164 are pressed against the upper surface of the copying paper 12, thereby inserting the lower end of the copying paper 12 between the rollers 119 and 120 (FIG. 20) of the feeding and withdrawing device 18 which are already displaced from each other. The copying paper 12 held by the feeding and withdrawing device 18 is brought to a horizontal position thereby and conducted to the later described finishing device 20.

At this time, the rack 164 stops at a point where the guide pin 165 reaches the lower end of the vertically elongate hole 162. The projection 172 of the engagement pawl 168b provided at the lower end of the rack 164 rotates by abutting against the actuating member 171b, thereby opening the travelling path of the copying paper held by the feeding and withdrawing device 18. At this time, the engagement member 175 of the engagement lever 174 remains engaged with the guide pin 165.

The copying paper conveyed by the feeding and withdrawing device 18 passes between the holding frame 71 and clamping device 75 and is held between the rollers

119 and 120. Where, under this condition, the solenoid 176 of the control mechanism 177 is energized, the engagement member 175 of the engagement bar 174 is released from the guide pin 165.

The rotating moment of the already clockwise rotating sprocket wheel 179 is transmitted through the friction clutch 178 to cause the rack 164 to be lifted and the projection 172 of the engagement pawl 168b to be removed from the actuator 171b, bringing said engagement pawl 168b to a horizontal position.

The lower end of the copying paper 12 is kept pushed by roller until the guide pin 165 abuts against the upper end of the vertically elongate guide hole 162 and in consequence the friction clutch 178 slips away. At this time, the engagement pawl 168a disposed at the upper end of the rack 164 rotates to a position indicated in two-dots-dash lines in FIG. 20 so as to be pressed against the actuating member 171a.

The moment the rack 164 ceases to move, the motor stops. After lapse of sufficient time for the feeding and withdrawal of the copying paper 12, the solenoid 156 of the clamping device actuating mechanism 125 is energized to release the hanger 80 and hook 129a, causing the copying paper 12 to be held between the holding frame 71 and clamping device 75.

There will now be described the interaction of the copying paper feeder 18, copying paper presser and copying paper feeding and withdrawing device 17. While the drive shaft 106a of the motor 106 rotates counterclockwise, the rotary shaft 108 and the first rubber rollers 119 fitted to the driven shaft 118 also rotate counterclockwise.

At this time, the guide plate 95 connected to the rotary shaft 108 through the friction clutch 95 similarly makes counterclockwise rotations. Since, however, the pin 101 of the control mechanism 99 engages the second engagement groove 98 of said guide plate 95, the friction clutch 96 slips away to keep the copying paper 12 in a vertical position. Therefore, the pinion gear 110 fitted to the rotary shaft 108 through the friction clutch 109 also rotates to cause the pins 114 of the conveying member 111 to abut against the lower end of the guide holes 113 respectively.

Under this condition, the developed copying paper 12 attached to the presser 19 is drawn out by the feeding and withdrawing device 18 to have its bottom end inserted into the copying paper insertion opening 91a (FIG. 13) and then pinched between the first and second rubber rollers 119 and 120. Thus the copying paper 12 is further conveyed by the side members of the holding frame 91 with its lateral sides and underside supported by the pins 114.

After lapse of sufficient time for the copying paper 12 to be securely held in place, the drive shaft 106a of the motor 106 rotates clockwise and the solenoid 104 of the control mechanism 99 is energized to cause the lever 102 to continue rotation for a prescribed length of time against the force of the spring 103. Accordingly, the engagement pin 101 is released from the second engagement groove 98 and the guide plate 95 rotates through an angle of 90°. At this time, the engagement pin 101 is pressed against one end of the first engagement groove 98 to limit the movement of said guide plate 95, thereby keeping the copying paper holding frame 91 in a horizontal position.

Rotation of the pinion gear 110 causes the pins 114 of the conveying member 111 to move on until they

abut against the upper end of the guide holes 113. Accordingly, the copying paper 12 has its upper end inserted between the first and second rubber rollers 119 and 120 and, after being developed, is delivered to the later described finishing device 20. Thereafter, the drive shaft 106a of the motor 106 rotates counterclockwise. Accordingly, the copying paper holding frame 91 stops after rotating through an angle of 45 degrees until the engagement pin 101 is pressed against the other end of the first engagement groove 97 of the guide plate 95. At this time, the pins 114 are brought down to the lower end of the guide holes 113.

The copying paper delivered in the copying paper holding frame 91 from a rolled copying paper by a feeder is cut in a properly size with a cutter and the cut copying paper is further conveyed into the holding frame 91 by being clamped between the first and second rubber roller 119 and 120.

After a prescribed period of time, the solenoid 104 is again energized to cause the engagement pin 101 to be released from the first engagement groove 97. Accordingly, the guide plate 95 continues to rotate until said pin 101 engages the second engagement groove 98, thereby keeping the copying paper holding frame 91 in a vertical position.

Where, under this condition, the drive shaft 106a of the motor 106 rotates clockwise, the copying paper 12 is moved forward and inserted between the holding frame 71 and clamping device 75 which are separated in advance. The hanger 80 and hook 129a are disengaged free each other, thereby allowing the copying paper 12 to be securely set in place.

When the copying paper holding device 91 is brought to a horizontal position, a copying paper 12 delivered to the finishing device 20, or an electronic photograph 184 is conducted from the conveying mechanism 185, that is, the conveying rollers to the guide plate 188. The travel of said electronic photograph 184 is detected by a detecting device (not shown). An electric signal transmitted from the detecting device energizes the magnet 212 to actuate the rotation mechanism 196. Namely, the actuating lever 213 rotates counterclockwise to release the clutch actuating cam 211. Accordingly, the spring clutch is operated to effect rotation of the lever 209, causing the pin 210 to slide through the elongate hole 195a with the resultant rotation of the actuating arm 195. The rotary shaft 194 rotates to lift the rotatable arm 193 from the finishing tank 182. The projection 208a (FIG. 24) abuts against the stop 213b to bring the lever 209 to rest. At this time, the coating roller 191 and complementary roller 192 clamp the electronic photograph 184 delivered from the conveying rollers 187 through the guide plate 188. While said electronic photograph 184 passes between the coating roller 191 and complementary roller 191, the finishing solution attached to the closely wound stainless wire 191a is coated only on that part of the surface of said electronic photograph 184 which bears an image. Even if both sides and backside of said photograph 184 are perchance coated with a finishing solution, the coating roller 191 and complementary roller 192 strongly abut against all these sides under pressure to scrape off the finishing solution. The electronic photograph 184 thus properly coated is delivered to the conveying rollers 190 and then transferred on to the belt conveyor 189, and after dried in the driers 216, is received in a collector (FIG. 24).

When the electronic photograph 184 is drawn out from between the coating roller 191 and complementary roller 192, the detecting device is actuated to de-energize the magnet 212. Accordingly, the actuating lever 213 rotates clockwise and the stop 213b is disengaged from the projection 208a. The spring clutch 207 is operated again and the clutch actuating cam 211 begins rotation. The pin 210 of the lever 209 slides through the elongate hole 195a to lift the actuating arm 195. The rotary shaft 194 rotates a clockwise and the rotatable arm 193 is brought down to be immersed again in the finishing solution tank 182. At this time, the engagement pawl 213a again engages the engagement groove 211a to release the spring clutch 207 and in consequence stop the rotation of the clutch actuating cam 207. Hereafter, the aforesaid cycle of producing an electronic photograph 184 is repeated.

According to the above-mentioned embodiment, the coating roller 191 of the electronic photograph finishing device 20 was made simply to abut against the complementary roller 192 while rolling. However, it is possible to use a different arrangement illustrated in FIG. 26. Namely, a support plate 217 is movably fitted to the rotatable arm 193. To the upper end of said support plate 217 is fitted a cover plate 218 so as to extend partly along the periphery of the coating roller 191. Between the coating roller 191 and cover plate 218 is provided a receptacle 219 for holding the finishing solution, thereby enabling the finishing solution to be fully applied to the electronic photograph 184 according to its length.

Throughout the foregoing description, the coating roller 191 was prepared by winding a stainless steel wire 191b about a round iron bar 191a with an extremely narrow interval allowed between the turns. However, it is possible to use a modification shown in FIG. 27. Namely, that part of the periphery of the coating roller 191 which is to be coated with the finishing solution is made into a roughened plane 220 and the noncoated peripheral portion of said roller 191 into a smooth plane 221. This arrangement prevents the blank portion of the electronic photograph 184 from being unnecessarily coated with the finishing solution.

Further according to the above-mentioned embodiment, the cycle of producing an electronic photograph was effected in four steps, using three filters bearing blue, red and yellow colours respectively. However, this invention is also applicable to the case where said cycle is carried out in a larger number of steps than four, using filters bearing any desired colours.

What we claim is:

1. A color electrostatic copying apparatus comprising a rotatable and vertically movable optical device including a plurality of color original carrier units, a plurality of optical units and a plurality of copying paper holding units, these three groups of units being arranged in optically facing relationship; at least one light projector including a plurality of filters and light source means disposed optically opposite to said color

original carriers; a plurality of charging units provided in the travelling paths of the copying paper holding units vertically movable jointly with said optical device; a plurality of developing units positioned at the lower part of the copying apparatus opposite to said copying paper holding units; a copying paper feeding and withdrawing device for conducting a developed sheet of paper to a sheet carrying device and supplying the copying paper holding units with a fresh blank sheet of paper; and a means for exchanging color originals automatically, wherein colour recording is effected by a required number of operating cycles including charging, exposure, and development with each color original, optical units and copying paper fixed in the prescribed positions.

2. Apparatus according to claim 1 wherein the copying paper holding device comprises an exposure assembly including a holding frame member having a fixed frame, a movable frame and a holding frame bearing an exposure mask which are all arranged in upright position in the order mentioned, first and second links bridging both fixed and movable frames at the upper and lower parts thereof so as to permit said movable frame to make vertical movements, a plurality of springs stretched between said fixed and movable frames so as to urge the movable frame toward the fixed frame and compression springs stretched between the movable frame and holding frame bearing an exposure mask so as to urge the latter outward; and copying paper holding units positioned below said exposure assembly.

3. Apparatus according to claim 2 wherein each copying paper holding unit includes a back plate, frames with L-shaped cross section fitted to both sides of said back plate and a clamping plate disposed opposite to the inner wall of said back plate, thereby holding the copying paper between said clamping plate and the lower bent portions of said L-shaped frames.

4. Apparatus according to claim 1 wherein the copying paper feeding and withdrawing device comprises a copying paper guide plate rotatable to vertical and horizontal positions and a position displaced through an angle of 45 degrees therefrom; a cam disposed below said guide plate to shift it stepwise to said three positions; a control device for adjusting the operation of said cam; and a pair of rollers provided ahead of said guide plate to facilitate the advance and retraction of the copying paper.

5. Apparatus according to claim 1 which further comprises electronic photograph finishing device consisting of a tank filled with a finishing solution; a conveying device positioned above the finishing solution tank to conduct the copying paper in the horizontal direction; and a finishing solution coating roller device normally immersed in the finishing solution tank and, when the developed and washed copying paper is conveyed to a proper point on its path, moved up to said path to apply the finishing solution to the developed and washed surface of the copying paper.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,810,693 Dated May 14, 1974

Inventor(s) Yushi MATSUMOTO et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 16, lines 50 and 51, change "consisting of"
to --comprising--.

Signed and sealed this 29th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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