

June 30, 1970

M. A. LEEDOM

3,517,994

ELECTROPHOTOGRAPHIC APPARATUS

Filed April 25, 1968

9 Sheets-Sheet 1

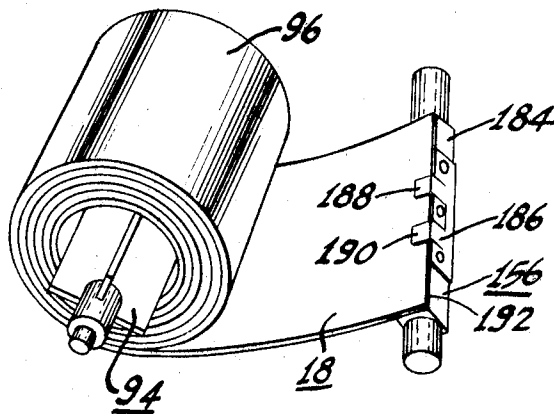
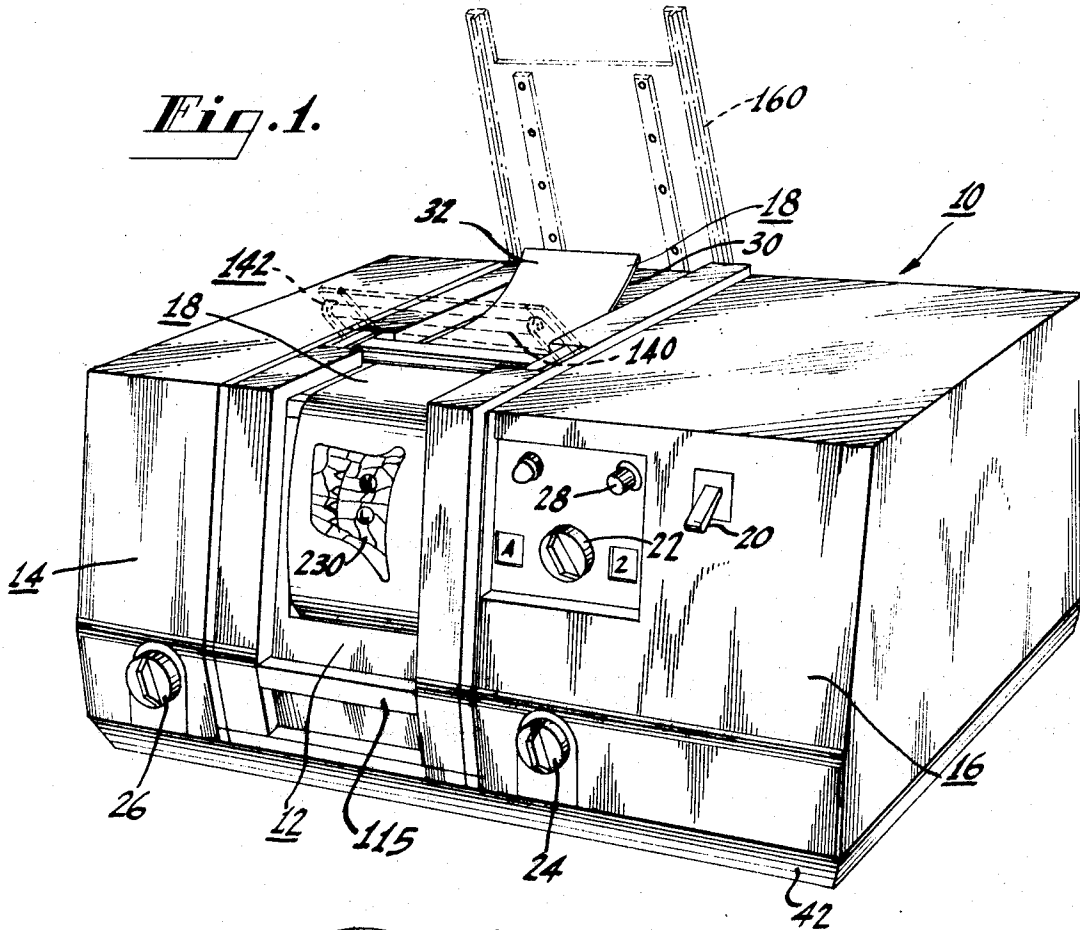


Fig. 8.

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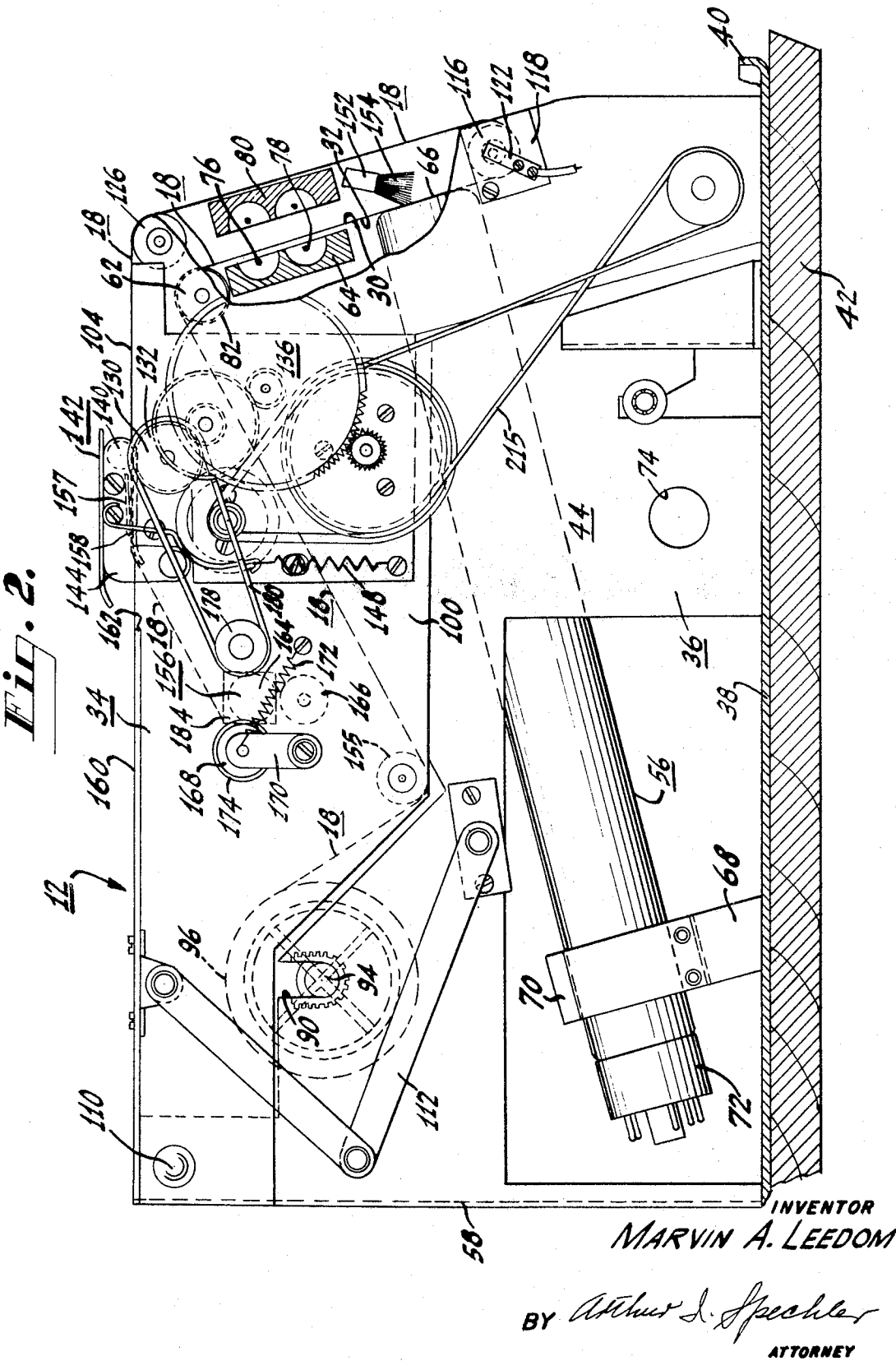
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9 Sheets-Sheet 2



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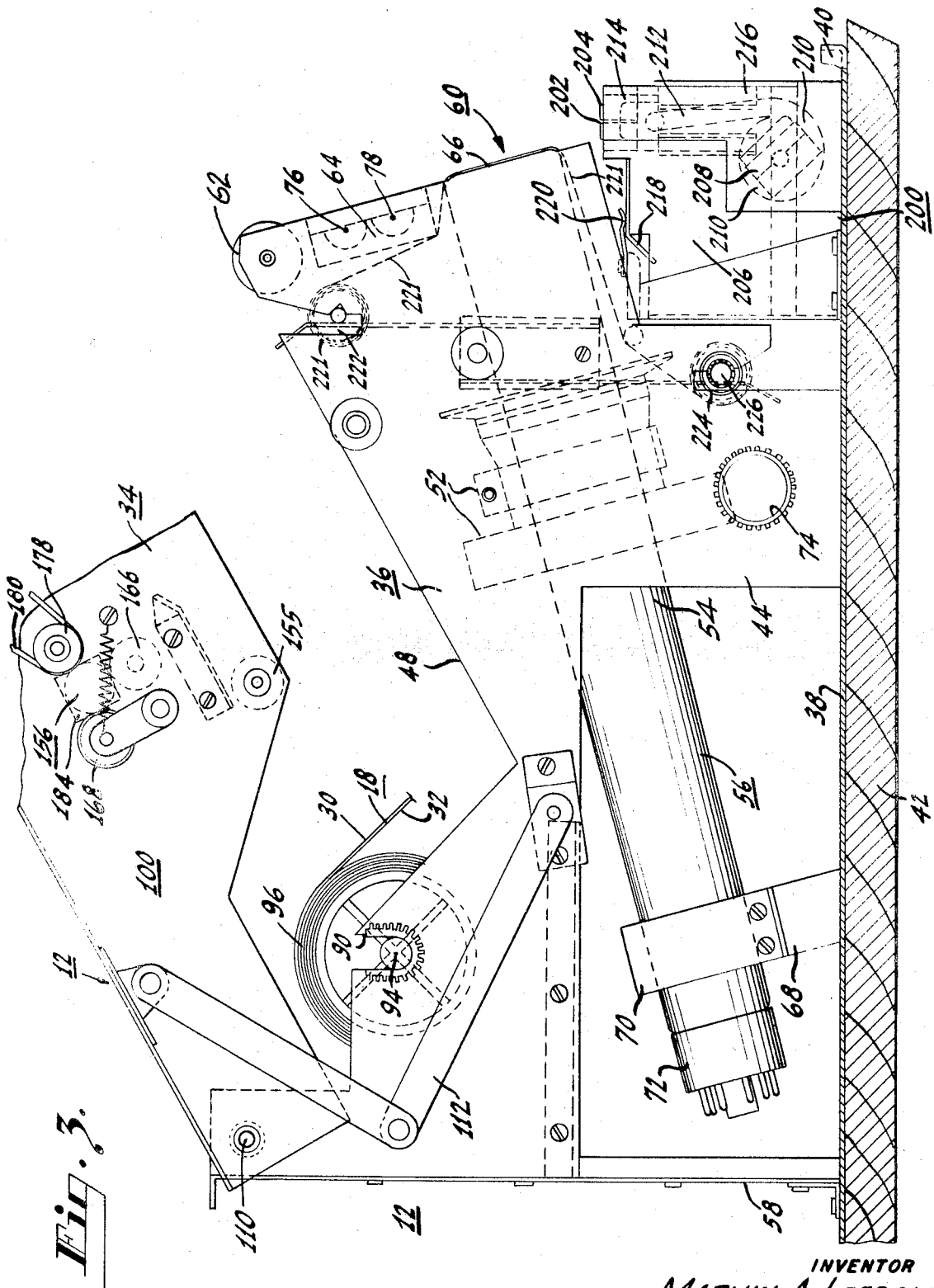
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9 Sheets-Sheet 3



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9 Sheets-Sheet 4

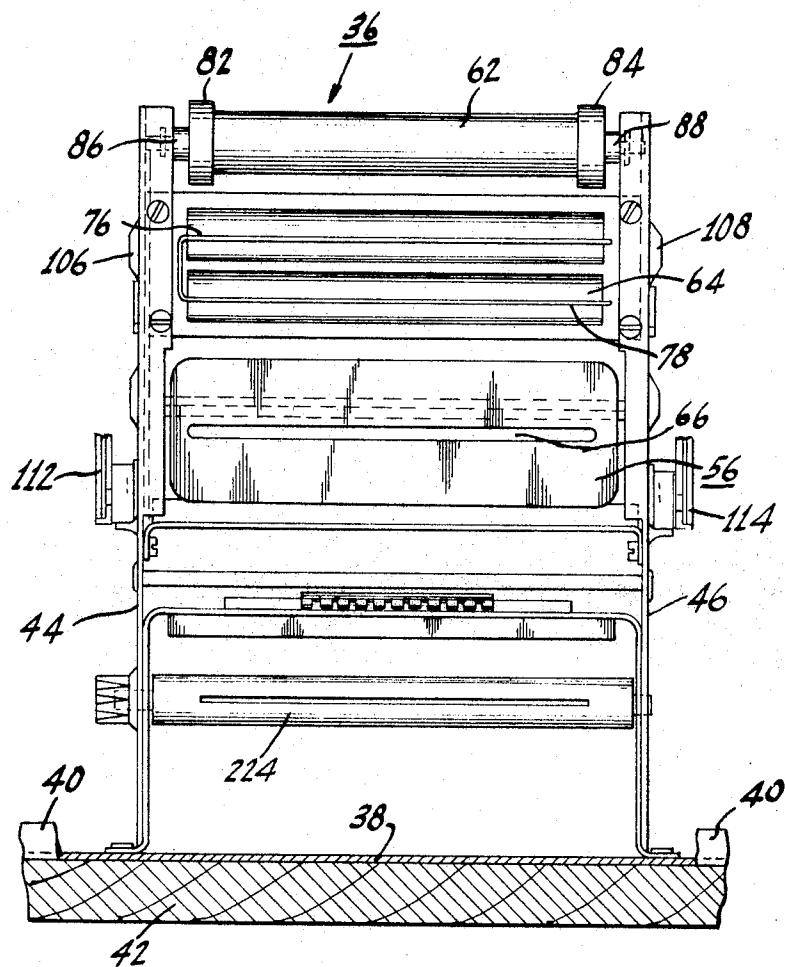


Fig. 4.

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9 Sheets-Sheet 5

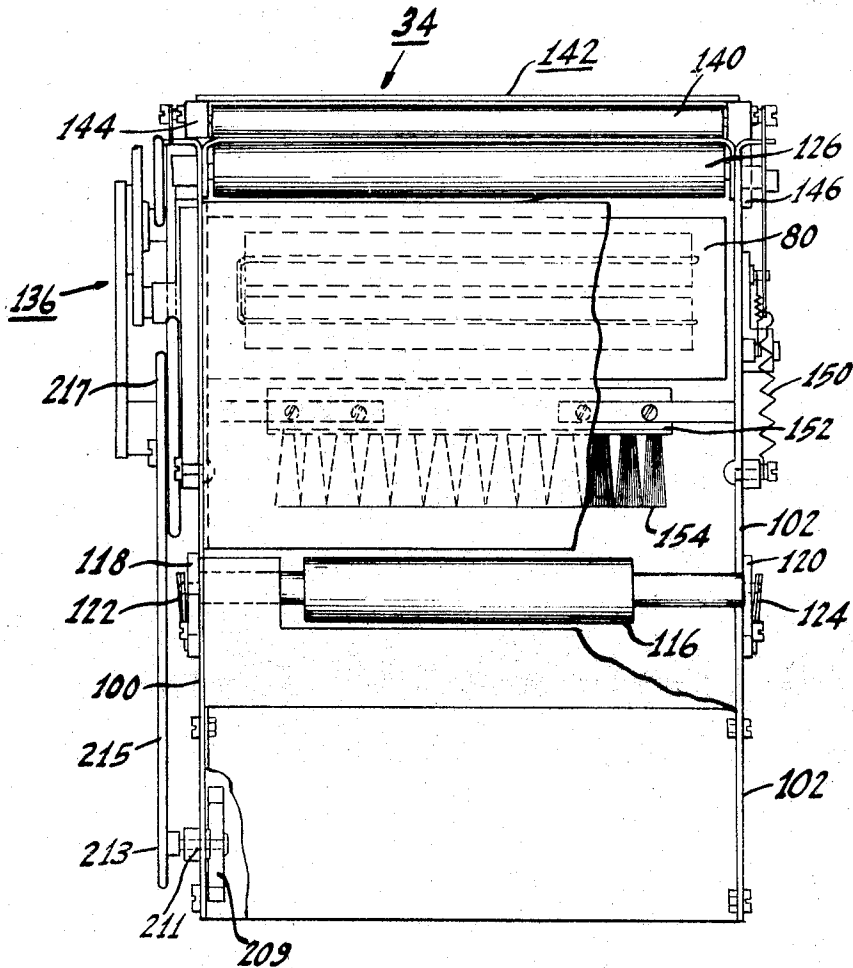


Fig. 5.

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ELECTROPHOTOGRAPHIC APPARATUS

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9 Sheets-Sheet 6

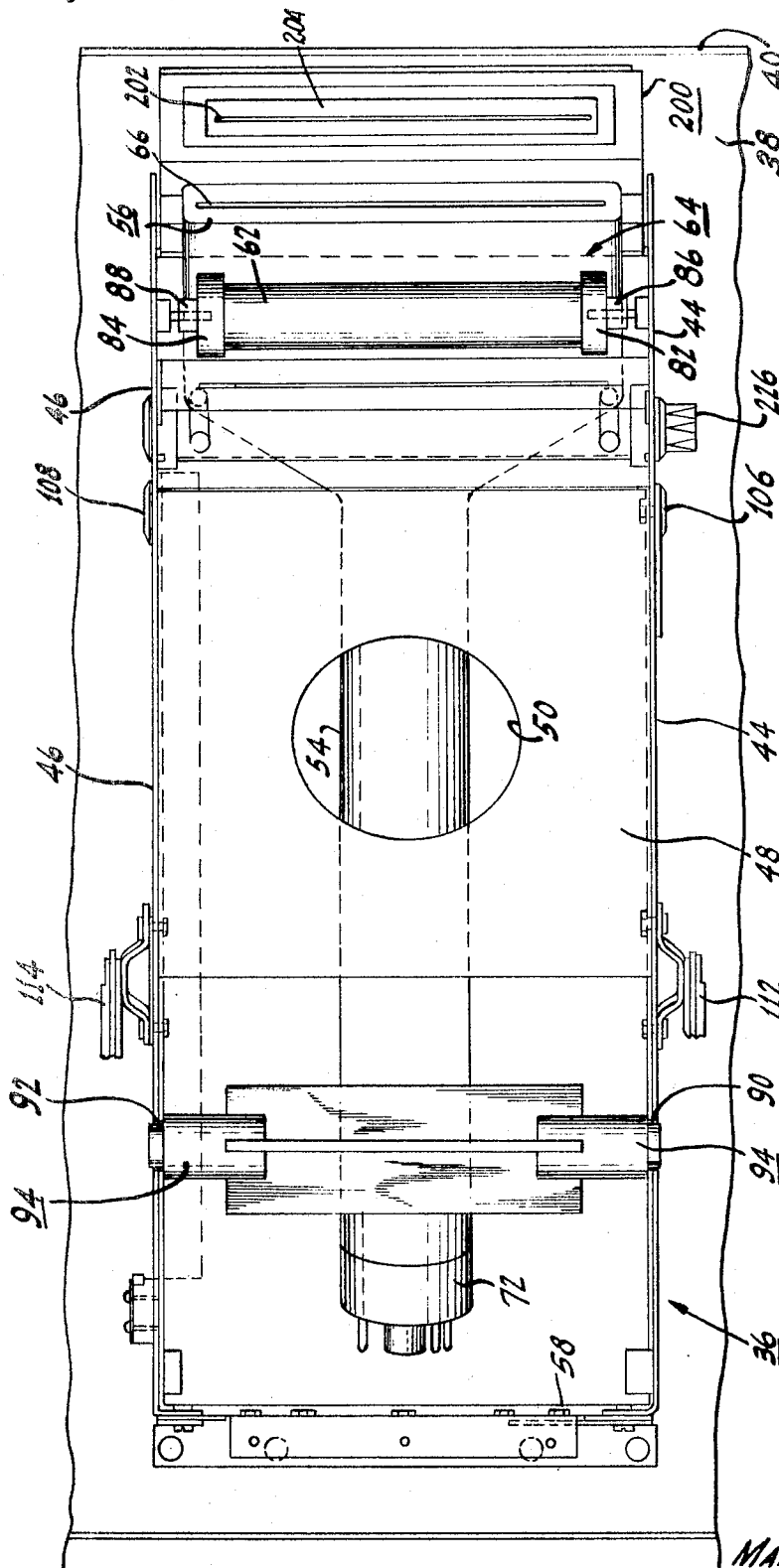


Fig. 6.

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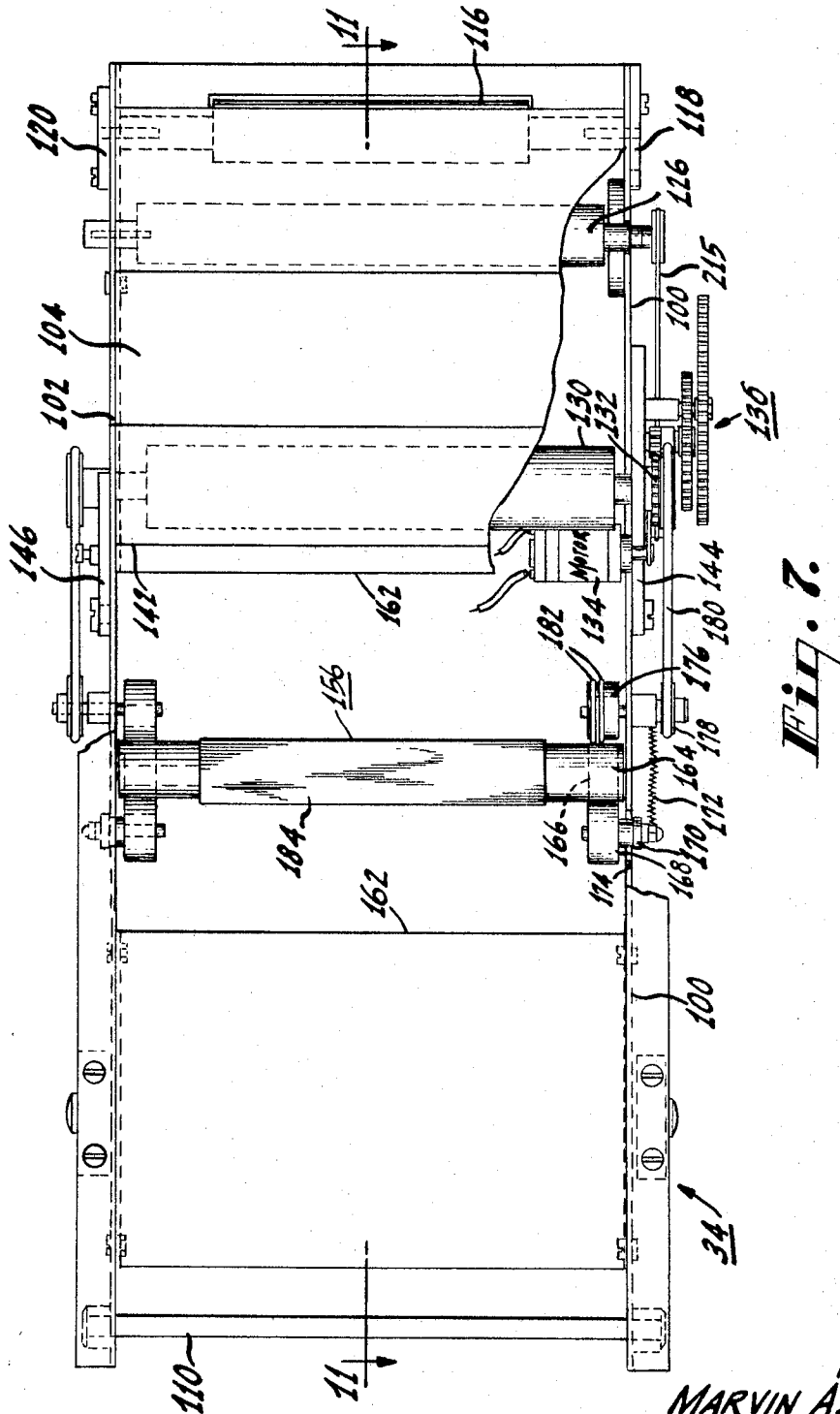
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ELECTROPHOTOGRAPHIC APPARATUS

Filed April 25, 1968

9 Sheets-Sheet 7



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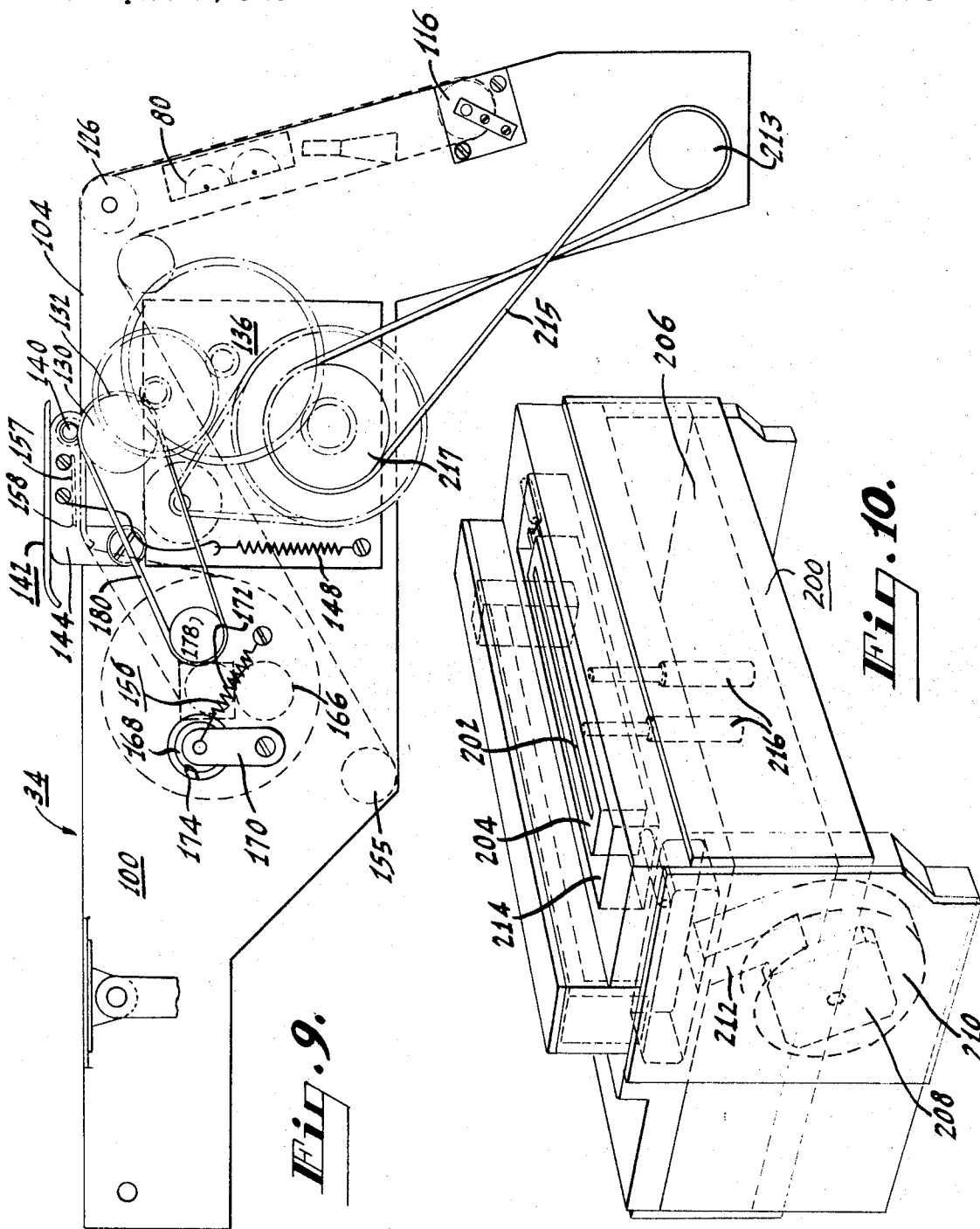
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ELECTROPHOTOGRAPHIC APPARATUS

Filed April 25, 1968

9 Sheets-Sheet 8



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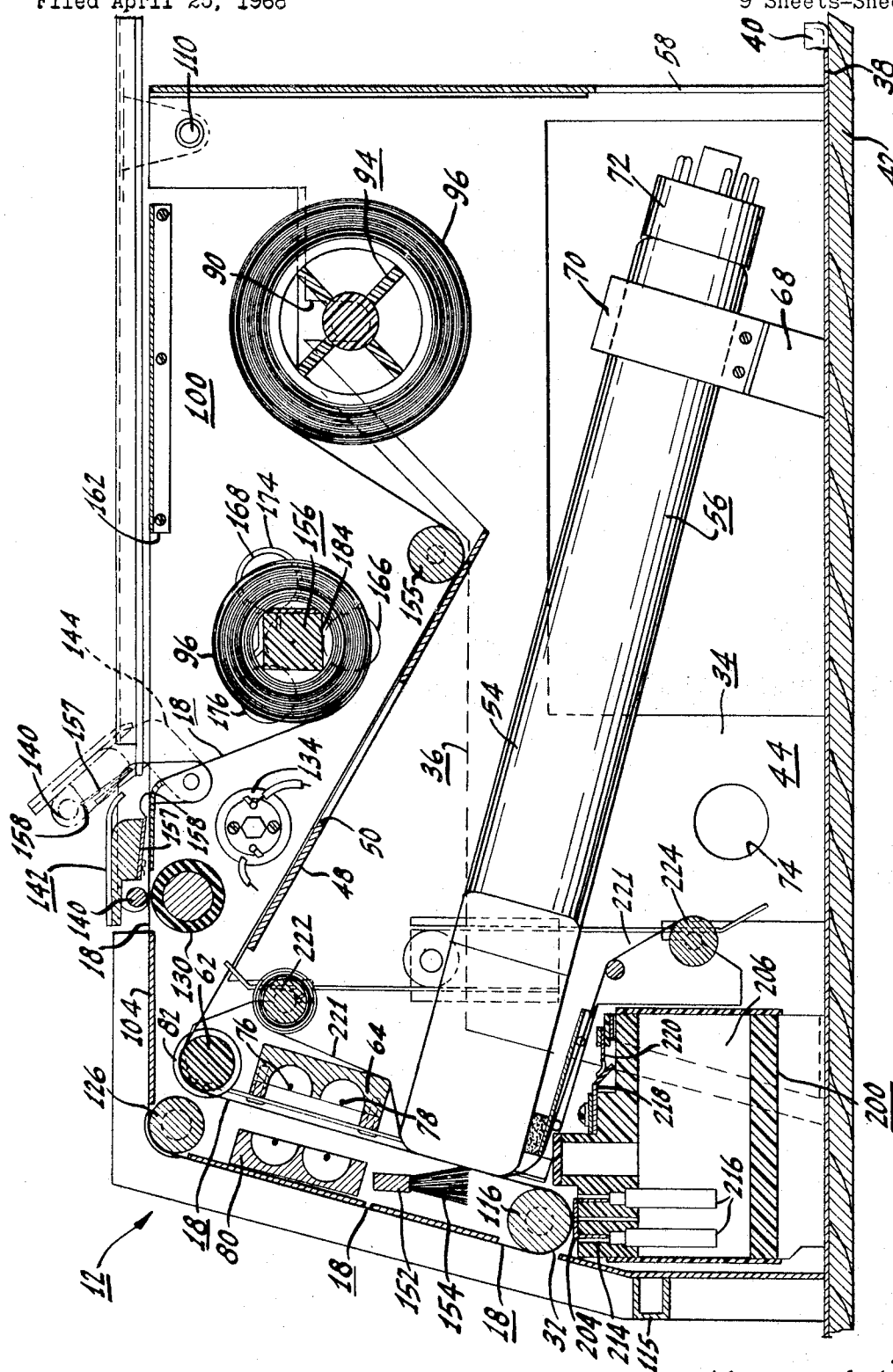
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ELECTROPHOTOGRAPHIC APPARATUS

Filed April 25, 1968

9 Sheets-Sheet 9



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3,517, 994

ELECTROPHOTOGRAPHIC APPARATUS
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Filed Apr. 25, 1968, Ser. No. 724,148
Int. Cl. G03g 15/00
U.S. Cl. 355—16

16 Claims

ABSTRACT OF THE DISCLOSURE

Electrophotographic apparatus, adapted to expose an electrostatically charged web of a recording element with images derived from the face of a cathode ray tube, comprises upper and lower component compartments pivotally hinged together so that the compartments may be either moved apart into a web-loading position or telescoped together into a closed operating position. Rollers on the compartments, which are disengaged from the web of the recording element when the compartments are in the web-loading position, engage and guide the web along a path adjacent electrostatic charging, exposure, and developing stations when the compartments are in the closed operating position.

BACKGROUND OF THE INVENTION

This invention relates generally to electrophotographic apparatus, and more particularly to improved electrophotographic apparatus adapted to expose and develop an electrostatically charged recording element with images derived from the face of a cathode ray tube. The improved electrophotographic apparatus is particularly useful for providing a convenient, low-cost printer for the home, utilizing facsimile information transmitted by television signals.

Several facsimile systems from the home have been proposed in the past, but none of these systems has met with enthusiastic public acceptance because the output printers were relatively complex, expensive, and inconvenient for the operator to use. The improved electrophotographic apparatus differs from the prior art proposals in several important aspects. Firstly, the improved electrophotographic apparatus is relatively simple and inexpensive, bringing the cost of a home instrument within the reach of a mass consumer market. Secondly, the improved electrophotographic apparatus is a natural adjunct to existing television service. The improved apparatus can be used, for example, to supply printed material in conjunction with televised educational programs for the home, or printed recipes in conjunction with a televised cooking program. Thirdly, the improved apparatus is easy to load and substantially self-threading so that it can be operated efficiently by the average home owner.

SUMMARY OF INVENTION

The improved electrophotographic apparatus comprises upper and lower component compartments pivotally hinged together so that one of the compartments may be moved with respect to the other between a closed operating position and an open web-loading position. Guide means on the upper and lower compartments, which are disengaged from a web of a recording element when the compartments are in the web-loading position, engage and guide the web along a path adjacent charging, exposure, and developing stations when the compartments are in the closed operating position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a television signal receiver-printer utilizing the improved electrophotographic apparatus, a hinged top wall and a toggle assembly of the

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improved apparatus being shown in phantom in their raised positions;

FIG. 2 is a side view of the electrophotographic apparatus, with some parts cut away and some parts in cross-section, showing pivotally hinged upper and lower component compartments in their closed operating position;

FIG. 3 is a side view of the electrophotographic apparatus, with some parts cut away, showing the upper and lower compartments separated into their open web-loading position, the upper compartment being a fragmentary view;

FIG. 4 is a front view of the lower compartment, with parts cut away and a developing tank removed to show details of the components therein;

FIG. 5 is a front view of the upper compartment, with parts cut away to show details of components therein;

FIG. 6 is a plan view of the lower compartment;

FIG. 7 is a plan view of the electrophotographic apparatus with parts cut away to show details of the components therein;

FIG. 8 is a perspective view of a web of a recording element, the roll of the web being on a supply mandrel and the free end of the web being attached to a take-up mandrel;

FIG. 9 is a side elevational view of the upper compartment;

FIG. 10 is a perspective view of the developing tank; and

FIG. 11 is a cross-sectional view of the electrophotographic apparatus taken along the line 11—11 of FIG. 7 and viewed in the direction indicated by the arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now particularly to FIG. 1 of the drawings, there is shown one embodiment of a low-cost receiver/printer 10 for use in a home television facsimile system, utilizing an improved electrophotographic apparatus 12 as the printer. The receiver/printer 10 comprises signal-receiving portions 14 and 16 on opposite sides of the printer 12 for receiving electrical signals that are translated into light images on the face of a cathode ray tube in the electrophotographic apparatus 12. The electrophotographic apparatus 12 reproduces these images on a web 18 of a recording element in a manner to be explained hereinafter in detail.

The signal-receiving portions 14 and 16 of the receiver/printer 10 form no part of the present invention other than to provide signal-receiving means for forming images on the face of a cathode ray tube in the electrophotographic apparatus 12. Since many embodiments of such signal-receiving means are known in the art, these portions 14 and 16 will not be described herein. While the signal-receiving portions 14 and 16 comprise circuitry, including an on-off switch 20, signal selecting knobs 22 and 24, and a signal adjusting (contrast) knob 26, for example, similar to those utilized in the television art, the signal-receiving portions 14 and 16 may also comprise circuitry for receiving any signals that can be displayed on the face of a cathode ray tube, not necessarily conventional television type signals. A start-stop button 28 for the electrophotographic apparatus 12 is also conveniently disposed on the receiver/printer 10.

The web 18 of the recording element comprises a substrate of paper 30 with a thin, flexible, white coating, or layer 32, of photoconductive zinc oxide in a resin binder on the paper 30. The electrophotographic apparatus 12 utilizes the web 18 of the recording element in an "Electrofax" process. In this process, the layer 32 of the web 18 is uniformly electrostatically charged, at a charging station, by applying a negative electrostatic charge to it in the dark. The electrostatically charged layer 32 is ex-

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posed, at an exposure station, to light emitted from the face of a cathode ray tube. The layer 32 is preferably dy-sensitized to respond to the color of the light emitted from the cathode ray tube. The uniform electrostatic charge is lost or reduced in the light exposed areas and retained in the unexposed areas to form a latent electrostatic charge image on the layer 32 of the web 18. The latent image is developed by applying electroscopic pigmented particles at a developing station. Details of the "Electrofax" process, well known in the art, are described in an article "Electrofax Direct Electrophotographic Printing on Paper," by C. J. Young and H. G. Greig, in the RCA Review, December 1954, vol. XV, No. 4.

Referring now to FIG. 2, there is shown the electrophotographic apparatus 12 comprising upper and lower component compartments 34 and 36, respectively, the upper compartment 34 being somewhat telescoped over the lower compartment 36. In this position of the compartments 34 and 36, as shown in FIG. 2, the improved apparatus 12 is in its closed operating position.

The lower compartment 36 is disposed on a horizontal metal sheet 38 which has a peripheral upwardly extending flange 40, forming a tray, to contain any liquids that may fall accidentally onto the sheet 38. The sheet 38 is supported, and fixed to, a flat wooden base 42 by any suitable means.

The lower compartment 36 (FIGS. 4 and 6) comprises a pair of parallel spaced-apart side walls 44 and 46 fixed to, and extending upwardly from, the sheet 38. A partial top wall 48 (FIG. 6) of the compartment 36 is fixed to the side walls 44 and 46, as by screws, and serves to fix the side walls 44 and 46 a predetermined distance apart. The top wall 48 is formed with an opening 50 through which adjustments in an electron beam deflection yoke 52 (FIG. 3), around the neck 54 of a cathode ray tube 56, can be made. A partial rear wall 58 (FIG. 2) is fixed between the side walls 44 and 46 by any suitable means, such as screws.

The front end 60 of the lower compartment 36 is defined by an idler roller 62, a corona discharge device 64, and a face 66 of the cathode ray tube 56, as shown in FIGS. 3 and 4. The cathode ray tube 56 is disposed within the lower compartment 36, as by a bracket 68 (FIG. 3) and strap 70 fixed to the neck 54 of the tube 56 adjacent its base 72. Electrical connections from the signal-receiving portions 14 and 16 of the receiver/printer 10 are adapted to be connected to the base 72 of the tube to provide signals on the face 66 of the tube 56. The yoke 52 for the tube 56 is energized from the signal-receiving portions 14 and 16 by means of a cable (not shown) extending through an opening 74 (FIG. 3), lined with a "nylon" grommet, in the side wall 44.

The tube 56 is a thin-window cathode ray tube whose face 66 is in the form of an elongated slit-like area coated with a suitable phosphor, as shown in FIG. 4. The face 66 of the tube 56 is the exposure station of the electrophotographic apparatus 12.

As shown in FIGS. 2 and 4, the corona discharge device 64 comprises two thin wires 76 and 78 disposed in, and insulated from, an insulating plastic frame having a separate concave portion about each of the wires 76 and 78. The concave portions of the corona discharge device 64 are painted with a metallic paint that can be grounded to provide an electrically conductive shield. The wires 76 and 78 of the corona discharge device 64 are adapted to be connected to a source (not shown) of unidirectional negative voltage of about at least 6000 volts with respect to a reference potential, such as ground. The source of voltage may be derived from the portions 14 and 16 of the receiver/printer 10. An additional corona discharge device 80, shown in FIGS. 2 and 11, is substantially similar to the corona discharge device 64 and forms a double corona discharge unit with the corona discharge device 64, as described in U.S. Pat. No. 2,922,883, issued to E. C. Giaimo, Jr. on Jan. 26, 1960.

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The idler roller 62 is rotatably disposed between the side walls 44 and 46 and is formed with collars 82 and 84 adjacent its ends 86 and 88, respectively, to serve as guide means for centering the web 18 adapted to move thereover.

A pair of slots 90 and 92, lined with "nylon" grommets, are formed in the upper edges of the side walls 44 and 46, respectively, intermediate the front and rear ends thereof. The ends of a supply mandrel 94, for holding a roll 96 of the web 18 are adapted to be placed in the slots 90 and 92, respectively, for rotation therein, as shown in FIG. 6.

The upper component compartment 34 comprises a pair of side walls 100 and 102 spaced a predetermined distance apart by a partial top wall 104, as shown in FIG. 7. The side walls 100 and 102 of the upper compartment 34 are spaced a greater distance apart than the side walls 44 and 46 of the lower compartment 36 so that the upper compartment 34 may be telescoped over the lower compartment 36, as shown in FIGS. 2 and 11. The side walls 100 and 102 of the upper compartment 34 and spaced from the side walls 44 and 46 of the lower compartment 36 by tapered plastic spacers, such as "nylon" spacers 106 and 108 fixed to the walls 44 and 46, respectively, when the compartments 34 and 36 are telescoped together.

The upper compartment 34 is pivotally hinged to the lower compartment by hinge means. To this end, a pivot rod 110 (FIG. 2) is disposed through holes in the side walls 44, 100, 102, and 46 adjacent the rear ends of the upper and lower compartments 34 and 36. With this arrangement, the upper compartment 34 can be rotated about the pivot rod 110 from a closed operating position, as shown in FIG. 2, to an open web-loading position, as shown in FIG. 3. The ends of a pair of friction-loaded hinges 112 and 114 are fastened between the upper and lower compartments 34 and 36 to maintain them selectively in either the open web-loading position or the closed operating position. A handle grip 115 (FIG. 1) fixed to the front of the upper compartment 34 provides means to rotate the upper compartment 34 about the lower compartment 36.

A metal idler roller 116 is rotatably disposed between the side walls 100 and 102 of the upper compartment 34 adjacent the front end thereof, and is electrically insulated from the side walls 100 and 102 by plastic insulators 118 and 120, respectively, as shown in FIG. 7. A leaf spring 122 (FIGS. 2 and 5) is fixed to the plastic insulator 118 and in electrical contact with the roller 116 to provide means to apply a unidirectional bias voltage to the roller 116 so that the latter may function as a developing electrode, in a manner known in the art. The bias voltage may be provided from the portions 14 and 16.

An idler roller 126 (FIGS. 7, 9 and 11) is rotatably mounted between the side walls 100 and 102 of the upper compartment 34, above the metal idler roller 116, to provide guide means for the web 18.

A rubber-covered drive roller 130 is also rotatably mounted between the side walls 100 and 102 of the upper compartment 34. One end of the drive roller 130, adjacent the side wall 100 (FIG. 7) is fixed to a gear 132 so that the drive roller 130 can be driven from an electric motor 134 through a reduction gear train 136. The motor 134 is mounted on the side wall 100 and energized through the start-stop button 28 from suitable circuitry in the portions 14 and 16.

A freely rotating pinch roller 140 (FIGS. 9 and 11) is mounted on a toggle assembly 142 in a manner whereby the pinch roller 140 can be brought into contact with, and parallel to, the drive roller 130 for pulling the web 18 therebetween when the motor 134 is energized. To this end, the toggle assembly 142 comprises a pair of L-shaped brackets 144 and 146 (FIGS. 7, 9, and 11), proximal ends of which are pivotally attached to the side walls 100 and 102, respectively, of the upper compartment 34. The pinch roller 140 is rotatably mounted between the distal

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ends of the L-shaped brackets 144 and 146. A spring 148, anchored between the side wall 100 and a point intermediate the ends of the L-shaped bracket 144, permits the bracket 144 to be positioned in either of two positions, that is, in a "down" position for driving the web 18, or in an "up" position (shown in phantom in FIGS. 1 and 11) for inserting the web 18 between the pinch roller 140 and the driven roller 130. A spring 150 (FIG. 5) cooperates with the L-shaped bracket 146 in a manner similar to that of the spring 148 with the L-shaped bracket 144.

The corona discharge device 80 (FIG. 11) is disposed between the side walls 100 and 102 of the upper compartment 36 adjacent the front end thereof. The device 80 is disposed between the upper idler roller 126 and the lower metal idler roller 116 and directly opposite, and slightly spaced from, the corona discharge device 64. The device 80 forms a double corona discharge device with the device 64 and is adapted to be energized from a source of unidirectional positive potential of about 6000 volts, with respect to a negative reference potential, available from the signal-receiving portions 14 and 16.

A brush 152 (FIGS. 2, 5, and 11) is also disposed between the side walls 100 and 102 of the upper compartment 34, adjacent the front end thereof, between the device 80 and the metal idler roller 116. The bristles 154 of the brush 152 are adjacent the face 66 of the cathode ray tube 56 and serve to press the web 18 of the recording element against the face 66 of the cathode ray tube 56, the face 66 being the exposure station.

An idler roller 155 is disposed between the lower edges of the walls 100 and 102 of the upper compartment 34, intermediate the front and rear ends thereof, to provide guide means for the web 18 of the recording element when the upper and lower compartments 34 and 36 are disposed in the operating position, as shown in FIGS. 2 and 11.

Means are provided either to dispense portions of the developed web 18 directly or to roll the developed web 18 onto a take-up mandrel 156 (FIGS. 7 and 11). If portions of the developed web 18 are to be discarded, that is, not saved, the toggle assembly 142 is provided with a knife 157 (FIG. 11) fixed by any suitable means, between the L-shaped brackets 144 and 146 and provided with a sharp tear edge 158. Thus, any portion of the web 18 that has been pulled beyond the tear edge 158 can be torn from the remainder of the web 18 by pulling the portion of the web to be discarded against the tear edge 158, and thereby severing it from the bulk of the web.

The apparatus 12 comprises a top wall 160 (FIG. 1) which has a rear edge that is pivotally attached to the pivot rod 110. In its "down" position, as shown in FIGS. 2 and 11, the top wall 160 covers an opening 162 in the upper component compartment 34 through which the take-up mandrel 158 is inserted. Thus, with the top wall 160 in its "down" position, the free end of the web 18 can pass over the opening 162 so that portions of the web 18 can be torn from the remainder of the web 18, as desired.

In the "up" position, as shown in phantom in FIG. 1, the top wall 160 exposes the opening 162 through which the take-up mandrel 156 is inserted into the upper compartment 34. If the developed web 18 of the recording element is to be saved, it is wound about the take-up mandrel 156. The top wall 160 may be moved to the "down" position after the web 18 is fixed to the take-up mandrel 156.

Each of the opposite ends of the take-up mandrel 156 is of circular cross-section supported peripherally at three points by three roller wheels. Since each end of the take-up mandrel 156 is supported in a similar manner, the support of one end 164 only, as shown in FIGS. 7, 9 and 11 will be described. An idler wheel 166 is supported for rotation about a pin fixed to the wall 100. The idler wheel 166 is disposed to contact the end 164 of the take-up roller 156 tangentially at the bottom thereof. A pinch

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wheel 168 is mounted for rotation about a pin fixed to one end of a lever 170, the other end of lever 170 being mounted for rotation about a pin fixed to the wall 100. The lever 170 is spring biased by a spring 172 that urges it into contact with the end 164 of the take-up mandrel 156. The rotation of the lever 170 about its pin is limited by portions of the side wall 100 that define the periphery of a hole 174 in the side wall 100. The pinch wheel 168 is disposed to contact the end 164 of the take-up mandrel 156 slightly above the horizontal diameter of the end 164. A drive wheel 176 is fixed to one end of a pin and is adapted to rotate therewith. The pin extends through the wall 100 and a pulley 178 is fastened to the other end of the pin. The pulley 178 is driven by a belt 180 which, in turn, is connected to a pulley driven by one of the gears of the gear train 136.

In operation, the take-up mandrel 156 is inserted between the pinch wheel 168 and the drive wheel 176 and pushed downwardly until its ends touch the idler wheel 166. One or more rubber O-rings 182 are disposed about the drive wheel 176 to provide friction for driving the take-up mandrel 156. The drive wheel 176 drives the take-up mandrel 156 faster than necessary to wind up the web 18. Hence, the web 18 is wound tightly about the take-up mandrel 156 because of slippage between the ends of the take-up mandrel 156 and the drive wheels.

The body 184 (FIG. 8) of the take-up mandrel 156, between its rounded ends, is of square cross-section and is provided with a spring biased clip 186. The clip 186 has a pair of resilient tabs 188 and 190 adapted to hold the web 18 resiliently against the body 184. When the rear of the clip 186 is pressed against the body 184, the tabs 188 and 190 are lifted away from the body 184 so that the free 192 of the web 18 can be inserted thereunder for loading.

Means are provided to develop charge patterns, that is, electrostatic latent images produced on the web 18 of the recording element. To this end, a tank 200 (FIGS. 3 and 10) for a liquid developer, comprising electroscopic pigmented particles in an insulating carrier liquid, is provided. The tank 200 comprises both means to hold a quantity of the liquid developer and means to dispense the liquid developer through an exit slit 202 in a metal electrode 204 slightly spaced from the metal roller 116 in the upper compartment 34 when the compartments 34 and 36 are in the closed operating position, as shown in FIGS. 2 and 11. The liquid developer is stored primarily in a reservoir 206 of the tank. A magnetic member, a pump impeller 208, is rotatably mounted within the tank 200 within a chamber 210 that communicates with the reservoir 206. When the impeller 208 is rotated, as by a magnetic member 209 (FIG. 5) magnetically coupled to the impeller 208, the impeller 208 functions as a pump to force the liquid developer upwardly from the reservoir 206 through a channel 212, the wall of the tank 200, that communicates through other channel means with the exit slit 202. The liquid developer emerging from the exit slit 202 impinges upon the nearby coated layer 32 of the web 18 of the recording element to develop any latent electrostatic images thereon, in a manner known in the art. Excess liquid developer spills over into a channel 214 that surrounds the metal electrode 204 and is returned to the reservoir 206 through one or more tubes 216.

The magnetic member 209 (FIG. 5) is fixed to one end of a pin 211 and is adapted to rotate therewith. The pin 211 extends through a bushing in the wall 100. The magnetic member 209 is fixed to one end of the pin 211, adjacent the impeller 208 in the tank 200 when the tank 200 is in place, and a pulley 213 is fixed to the other end of the pin 211. A belt 215, connected between the pulley 213 and a driven pulley 217 on the gear train 136, rotates the magnetic member 209 when the motor 134 is energized. The impeller 208 in the tank 200 is magnetically coupled to the magnetic member 209 and rotates therewith.

The developing tank 200 is separable from the apparatus 12 so that it can be replaced by another similar tank when the liquid developer is exhausted. The tank 200 is constructed so that it can be pulled away from the lower front end 60 of the lower compartment 36 when the compartments 34 and 36 are in the open web-loading position. A metal contact 218 (FIG. 11) on the top wall of the tank 200 is disposed to engage spring contact fingers 220 positioned between the side walls 46 and 48 of the lower compartment 36. The contact fingers 220 are connected in the circuit with the portions 14 and 16 of the receiver/printer 10. The metal electrode 204, formed with the exit slit 202 therein, is adapted to be energized, through suitable connections, by a bias voltage of suitable amplitude from the fingers 220.

Since the web 18 of the recording element is adapted to move over the face 66 of the cathode ray tube 56, with the bristles 154 of the brush 152 pressing the web 18 against the face 66 of the tube 56, means are provided to prevent the web 18 from causing excessive frictional wear on the face 66. To this end, two slotted rollers for holding a web 221 of transparent plastic material, such as the plastic "Mylar," are provided. A slotted supply roller 222 is rotatably disposed between the side walls 100 and 102 of the upper compartment 34, above and behind the face 66 of the cathode ray tube, as shown in FIGS. 3 and 11. A slotted take-up roller 224 is also rotatably disposed between the side walls 44 and 46 of the lower compartment 36, below and behind the face 66 of the cathode ray tube. A knob 226 (FIG. 6) is fixed to one end of the take-up roller 224 so that the web 221 of transparent plastic material can be wound manually on the take-up roller 224. The web 221 extends from the supply roller 222 to the take-up roller 224 in a path whereby it is disposed across the face 66 of the cathode ray tube 56, as shown in FIG. 11. Thus, the web 18 of the recording element need not come in contact with the face 66 of the cathode ray tube 56. The web 18 of the recording element can slide over the web 221 of transparent plastic material at the face 66. The web 221 of the plastic material need be moved only occasionally, by turning the knob 226 slightly when the plastic material, adjacent the face 66, begins to show evidence of frictional wear.

In operation, the electrophotographic apparatus 12 is loaded by gripping the handle grip 115 and moving the upper compartment 34 about the pivot rod 110, separating the upper and lower compartments 34 and 36 so that they are in the open web-loading position. The supply mandrel 94 is inserted into the center opening of a roll 96 of the web 18, and the ends of the supply mandrel 94 are disposed in the slots 90 and 92 in the side walls 44 and 46. The free end 192 of the web 18 of the recording element is pulled under the metal roller 116 in the upper compartment 34 and held there. The free end 192 of the web 18 may also be pulled over the idler roller 126 and clamped between the driven roller 130 and the pinch roller 140 on the toggle assembly 142, if desired. When the upper component compartment 34 is telescoped over the lower component compartment 36, in the closed operating position, shown in FIG. 2, the web 18 is automatically threaded through the electrophotographic apparatus 12, and the web 18 assumes the threaded position, shown in FIG. 11. Thus, the web 18 of the recording element is threaded under the idler roller 155, over the idler roller 62, under the metal roller 116, over the idler roller 126, and between the driven roller 130 and the pinch roller 140. If it is desired to save the developed web 18, the free end 192 of the web 18 is inserted between the clip 186 and the body 184 of the take-up mandrel 156, and the web 18 will be rolled up on the take-up mandrel 156 as the web 18 is used.

When the motor 134 is energized, as by pushing the on-off button 28, and the cathode ray tube 56 is connected to the signal-receiving circuitry of the signal re-

ceiving portions 14 and 16, the photoconductive layer 32 of the web 18 passes through the charging station, between the corona discharge devices 64 and 80, where the layer 32 receives a uniform negative charge. The uniformly charged layer 32 is exposed to light images on the face 66 of the cathode ray tube, the developing station, and portions of the uniformly charged layer 32 are discharged in proportion to the intensity of the light impinging thereon to provide electrostatic latent (charge) images. The electrostatic latent images are developed at the developing station by a liquid toner that is pumped through the exit slit 202 of the tank 200, and the developed images, such as the image 230 in FIG. 1, can be seen on the layer 32 as the web 18 of the recording element moves between the metal roller 116 and the idler roller 126. The portions of the developed web 18 can either be torn from the web or saved on the take-up mandrel 156, as described previously.

In the embodiment of the receiver/printer 10, it has been found that facsimile information can be transmitted and received on the face 66 of the cathode ray tube 56 at the rate of 60 scan lines per second. Where copy consists of printed matter, a minimum of about 10 scan lines is required per line of 8-point type. A liquid developer of the reversal type in a highly volatile nonflammable liquid carrier substantially eliminates the need for heat-fixing of the developed image. If the length of the face 66 is 4 inches, and the web 18 is moved past the face 66 at the rate of 0.6 inch per second, a 4 by 6 inch message can be printed in 10 seconds, using a cathode ray beam spot of about 10 mils.

I claim:

1. In electrophotographic apparatus of the type wherein a web of a recording element is moved along a path adjacent a charging station, an exposure station, and a developing station, the improvement comprising:

upper and lower component compartments, each of said compartments having a front end and a rear end, hinge means joining said compartments together, whereby one of said compartments can be moved pivotally, with respect to the other of said compartments, between a closed operating position and an open web-loading position,

a supply mandrel for holding a roll of said web of recording element rotatably disposed in said lower compartment, and

guide means cooperatively associated with said upper and lower compartments to engage and guide said web along said path when said compartments are in said closed operating position, said web being disengaged from said guide means when said compartments are in said open web-loading position.

2. In electrophotographic apparatus of the type described in claim 1,

a first corona discharge device disposed in said lower compartment adjacent said front end thereof,

a second corona discharge device disposed in said upper compartment adjacent said front end thereof and slightly spaced from said first corona discharge device and comprising a double corona charging arrangement therewith when said compartments are in said closed operating position,

said charging station being between said first and said second corona discharge devices.

3. In electrophotographic apparatus of the type described in claim 1,

a cathode ray tube disposed in said lower compartment with its face adjacent said front end thereof, said exposure station being adjacent said face of said cathode ray tube, and

resilient means disposed in said upper compartment and adjacent said face of said cathode ray tube when said compartments are in said closed operating position, whereby said web of recording element

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is urged against said face for good contact therewith at said exposure station.

4. In electrophotographic apparatus of the type described in claim 3,

a web of transparent plastic material, and means disposing said web of said transparent plastic material between said face and said web of recording element, whereby to prevent friction between said face and said web of recording element.

5. In electrophotographic apparatus of the type described in claim 1,

a tank for a liquid toner, said tank having a reservoir for said liquid toner, an exit slit, and means to pump said liquid toner from said reservoir through said exit slit, and

said guide means comprises a roller rotatably disposed in said upper compartment adjacent said front end thereof, said roller being slightly spaced from said exit slit and disposed parallel thereto when said compartments are in said closed operating position, whereby to dispose said web of recording element at said developing station for development by said liquid toner.

6. In electrophotographic apparatus of the type described in claim 5,

said roller is metal, and said exit slit is defined by a metal member, whereby said liquid toner may be biased electrically with respect to said roller.

7. In electrophotographic apparatus of the type described in claim 5,

said means to pump said liquid toner comprises an impeller of magnetic material disposed for rotation within said tank,

a magnetic member is rotatably mounted in said upper compartment and disposed adjacent, and slightly spaced from, said impeller when said compartments are in said closed operating position, and

means to rotate said magnetic member are coupled to said magnetic member, whereby said impeller can be rotated through magnetic coupling with said magnetic member to pump said liquid toner.

8. In electrophotographic apparatus of the type described in claim 1,

drive means for pulling said web of recording element along said path disposed in said upper compartment, said drive means comprising a driven roller and a pinch roller,

a toggle assembly disposed on said upper compartment and adapted to be positioned in either an "up" or a "down" position,

means rotatably mounting said pinch roller on said toggle assembly for movement therewith,

said pinch roller being resiliently pressed against said driven roller when said toggle assembly is in said "down" position, whereby said web may be disposed between said driven roller and said pinch roller for pulling said web along said path.

9. In electrophotographic apparatus of the type described in claim 1,

a take-up mandrel having clip means to engage the free end of said web of a recording element and a pair of opposite ends of circular cross-section,

means to rotatably dispose and rotate said take-up mandrel in said upper compartment comprising an idler wheel, a spring biased pinch wheel, and a driven wheel for each of said opposite ends of said take-up mandrel,

said idler wheels being disposed to support said opposite ends, respectively, at the bottoms thereof, and said pinch wheels and said driven wheels being disposed to contact said opposite ends, respectively, above horizontal diameters of said circular cross section thereof.

10. Electrophotographic apparatus adapted to expose

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an electrostatically charged recording element with light images on the face of a cathode ray tube, said apparatus comprising:

an upper component compartment and a lower component compartment, each of said compartments having a front end and a rear end,

pivot means cooperatively associated with said compartments to join them together adjacent said rear ends thereof, whereby one of said compartments may be moved about said pivot means, with respect to the other of said compartments, either to a separated web-loading position or to a closed operating position,

said front end of said lower compartment comprising a first roller rotatively mounted in said lower compartment, a first corona discharge device mounted in said lower compartment below said first roller, and said face of said cathode ray tube disposed below said first corona discharge device, said cathode ray tube being mounted within said lower compartment,

a developing station below said face of said cathode ray tube,

a second roller rotatively disposed in said upper compartment, adjacent said front end thereof, and positioned adjacent said developing station when said compartments are in said closed operating position, and

a supply mandrel for holding a roll of a web of said recording element rotatively disposed in said lower compartment, intermediate the ends thereof, whereby the free end of the web of said recording element can be held under said second roller when said compartments are in said separated web-loading position, and said web automatically defines a path over said first roller and adjacent (1) said first corona discharge device, (2) said face of said cathode ray tube, and (3) said developing station when said compartments are subsequently moved to said closed operating position.

11. Electrophotographic apparatus as described in claim 10, wherein

a tank for a liquid toner is removably disposed in said lower compartment adjacent the front end thereof,

said tank having a reservoir for said liquid toner, an exit slit, and means to pump said liquid toner from said reservoir through said exit slit, and

said tank being disposed with said exit slit at said developing station.

12. Electrophotographic apparatus as defined in claim 11, wherein

said means to pump said liquid toner comprises a magnetic impeller rotatably disposed in said tank,

a magnetic member is rotatably disposed in said upper compartment adjacent, and magnetically coupled to, said magnetic impeller when said compartments are in said closed operating position, and

means coupled to said magnetic member to rotate said magnetic member, whereby to rotate said magnetic impeller in said tank to pump said liquid toner through said exit slit.

13. Electrophotographic apparatus as described in claim 10, wherein

a spring-biased toggle assembly is mounted on said upper compartment and adapted to be positioned in either an "up" position or a "down" position,

a pinch roller is rotatably mounted on said toggle assembly,

a driven roller is rotatably mounted in said upper compartment adjacent said toggle assembly, said pinch roller being disposed parallel to, and resiliently in contact with, said driven roller when said toggle assembly is in said "down" position, whereby said web can be disposed between said driven roller and said pinch roller when said toggle assembly is

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in said "up" position, and said web can be pulled between said driven roller and said pinch roller when said toggle assembly is in said "down" position

14. Electrophotographic apparatus as described in claim 13, wherein said toggle assembly comprises a knife having a tear edge, whereby a portion of said web of recording element that passed between said driven and pinch rollers can be torn from the remainder of said web when said toggle assembly is in said "down" position.

15. Electrophotographic apparatus as described in claim 10, wherein

a take-up mandrel having a pair of opposite ends of circular cross-section is rotatably mounted in said upper compartment between said front and rear ends thereof,

an idler wheel, a spring-biased pinch wheel, and a driven wheel are disposed about each of said opposite ends of said take-up mandrel, respectively, to support and to rotate said take-up mandrel, and

a resilient clip is on said take-up mandrel adapted to receive the free end of said web to said take-up mandrel.

16. Electrophotographic apparatus adapted to expose an electrostatically charged recording element with images on the face of a cathode ray tube, said apparatus comprising:

an upper component compartment and a lower component compartment,

said lower compartment comprising a base, a first pair of spaced-apart side walls fixed to said base and extending upwardly therefrom, each of said side walls having a front end and a rear end, means disposing said cathode ray tube between said side walls with said face thereof disposed between said front ends of said side walls, a first corona discharge device disposed between said side walls, adjacent said front ends thereof, and above said face, a supply mandrel for holding a roll of a web of said recording element, and means disposing opposite ends of said supply mandrel rotatably between said side walls, a toner tank for holding a liquid toner, said tank having an exit slit for dispensing said toner therethrough and means, including a magnetic impeller rotatably mounted in said tank, to pump said liquid from said container through said exit slit,

said upper compartment being adapted to fit over said lower compartment and comprising a second pair of spaced-apart side walls, each of said second pair of side walls having a front end and a rear end.

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hinge means pivotally joining said upper and lower compartments together adjacent said rear ends of said side walls, whereby said upper and lower compartments can be either partly telescoped together to a closed operating position or partly separated from each other to an open web-loading position, a second idler roller disposed between said second pair of side walls intermediate said front and rear ends thereof,

a drive roller disposed between said second pair of side walls intermediate the front and rear ends thereof,

a pinch roller,

spring-loaded toggle means disposed between said second pair of side walls and capable of being positioned in either an "up" or "down" position,

means rotatably mounting said pinch roller on said toggle means, parallel to said drive roller and for engagement therewith when said toggle means are in said "down" position,

a motor disposed on at least one of said side walls of said second pair of side walls,

means coupled to said motor to rotate said drive roller, a take-up mandrel,

means rotatably mounting said take-up mandrel between said second pair of parallel walls, intermediate the front and rear ends thereof,

means coupled to said motor to rotate said take-up mandrel,

a magnetic member disposed adjacent the lower front end of one of said side walls of said second pair of said walls, and

means coupled to said motor to rotate said magnetic member, said magnetic member being magnetically coupled to said magnetic impeller in said tank, whereby to pump said liquid toner through said exit slit to dispense said toner.

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