

[54] **AUTOMATIC PHOTOSTUDIO COMPRISING
AUTOMATIC FILM CASSETTE CHANGING
APPARATUS**

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354/174**

[51] Int. Cl. **G03b 17/50**

[58] Field of Search **75/14, 89 R; 250/468, 470,
250/471**

[56]

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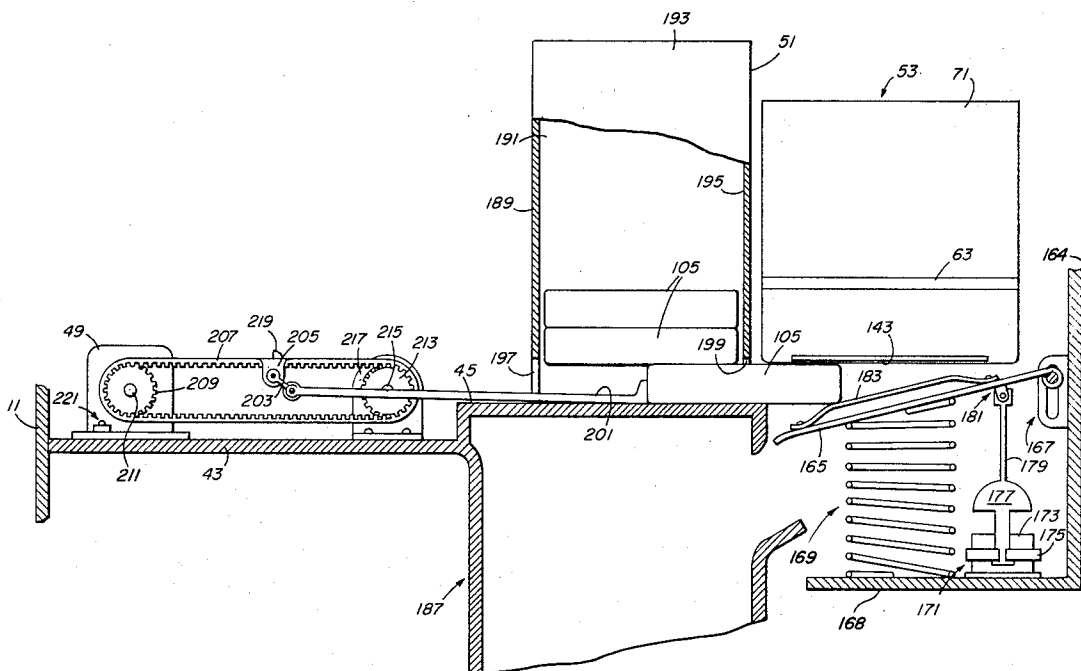
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[57]

ABSTRACT

An automatic photostudio for taking self-portraits under studio lighting conditions and delivering a finished processed print to the user immediately after exposure.

6 Claims, 9 Drawing Figures



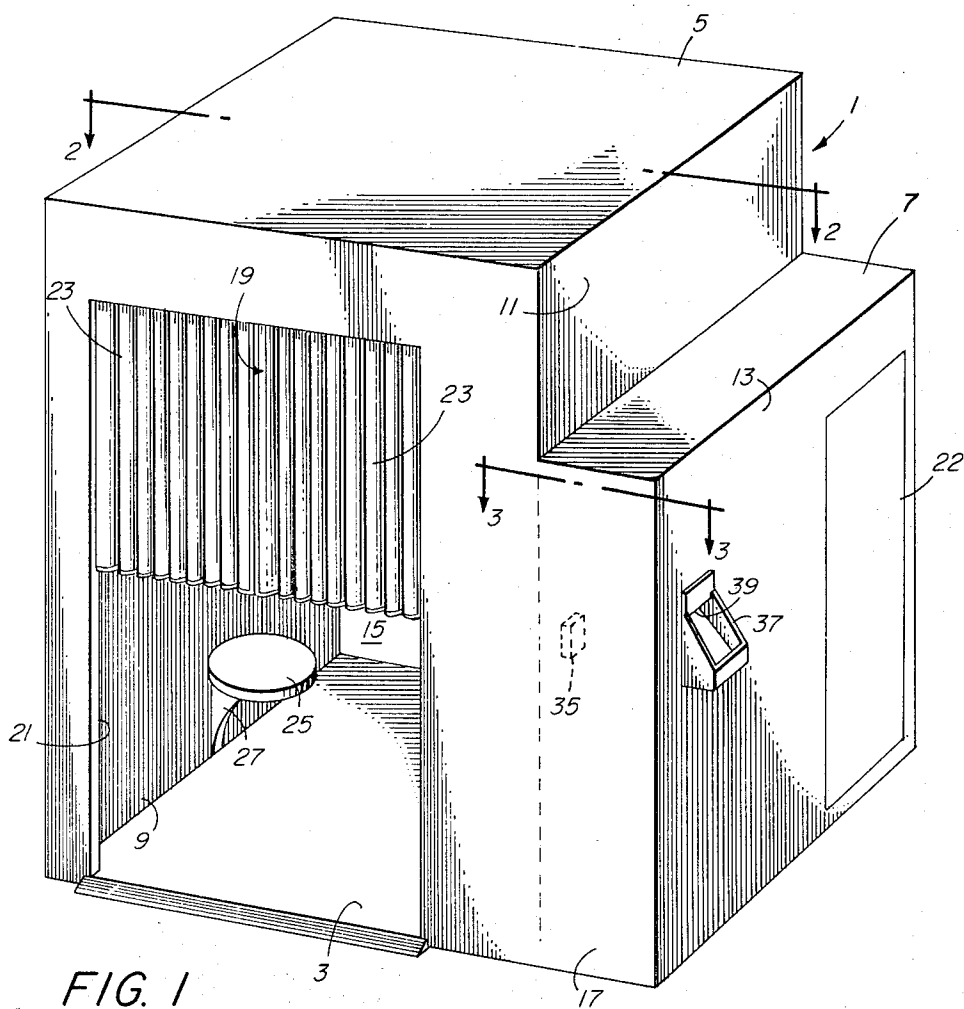


FIG. 1

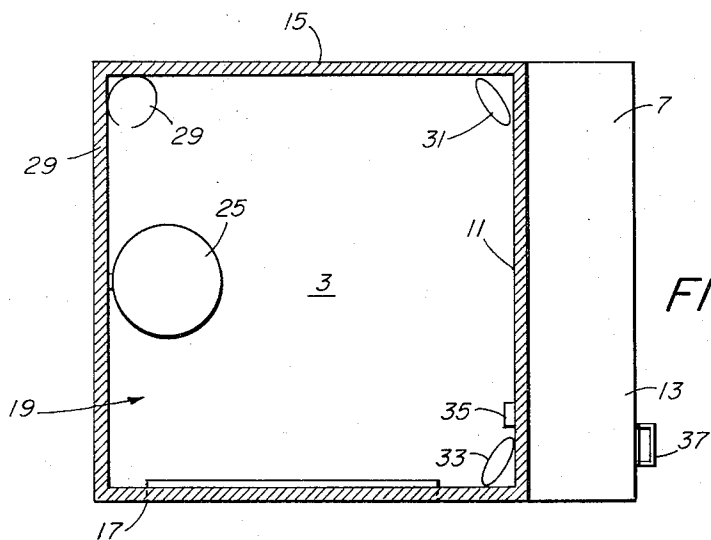
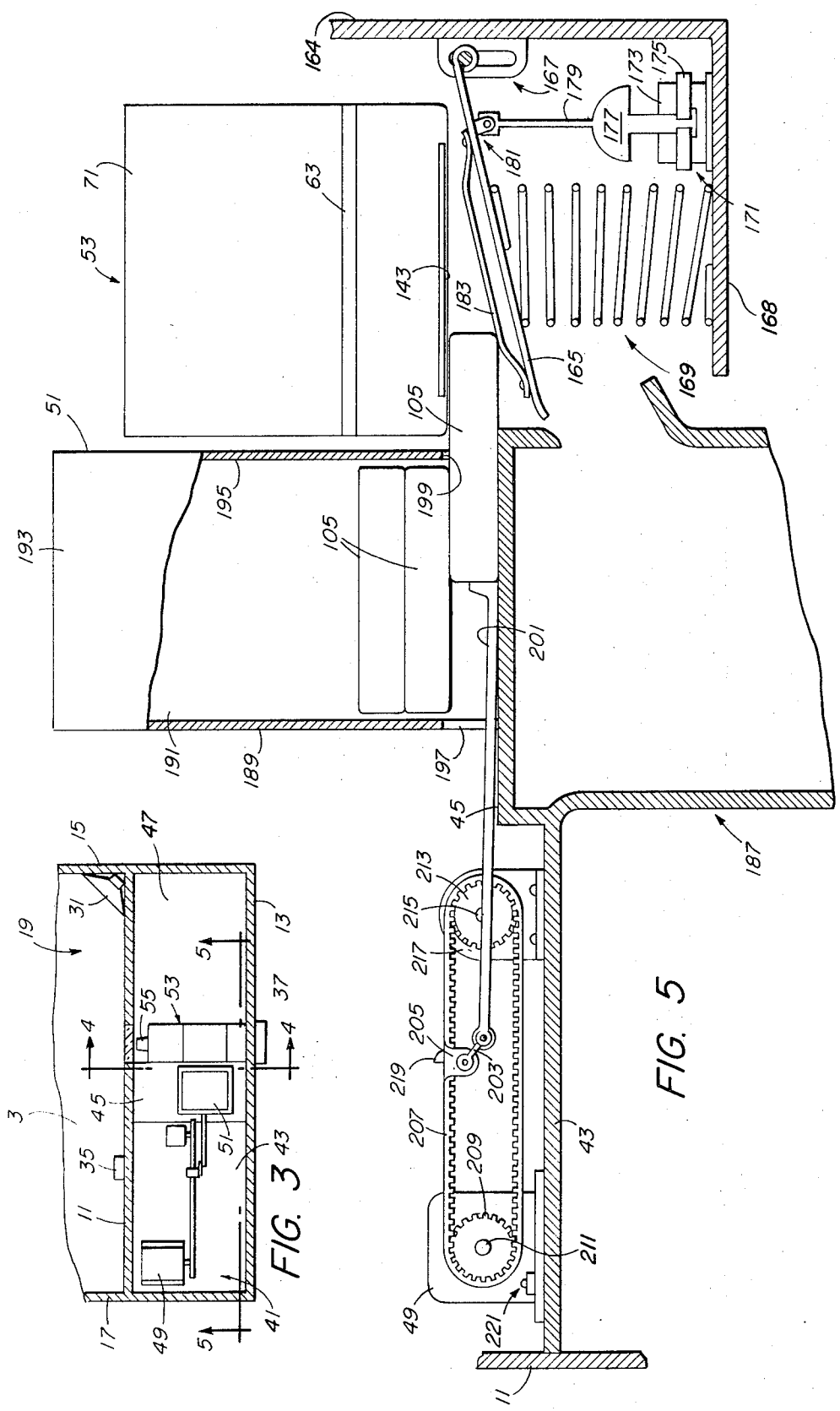
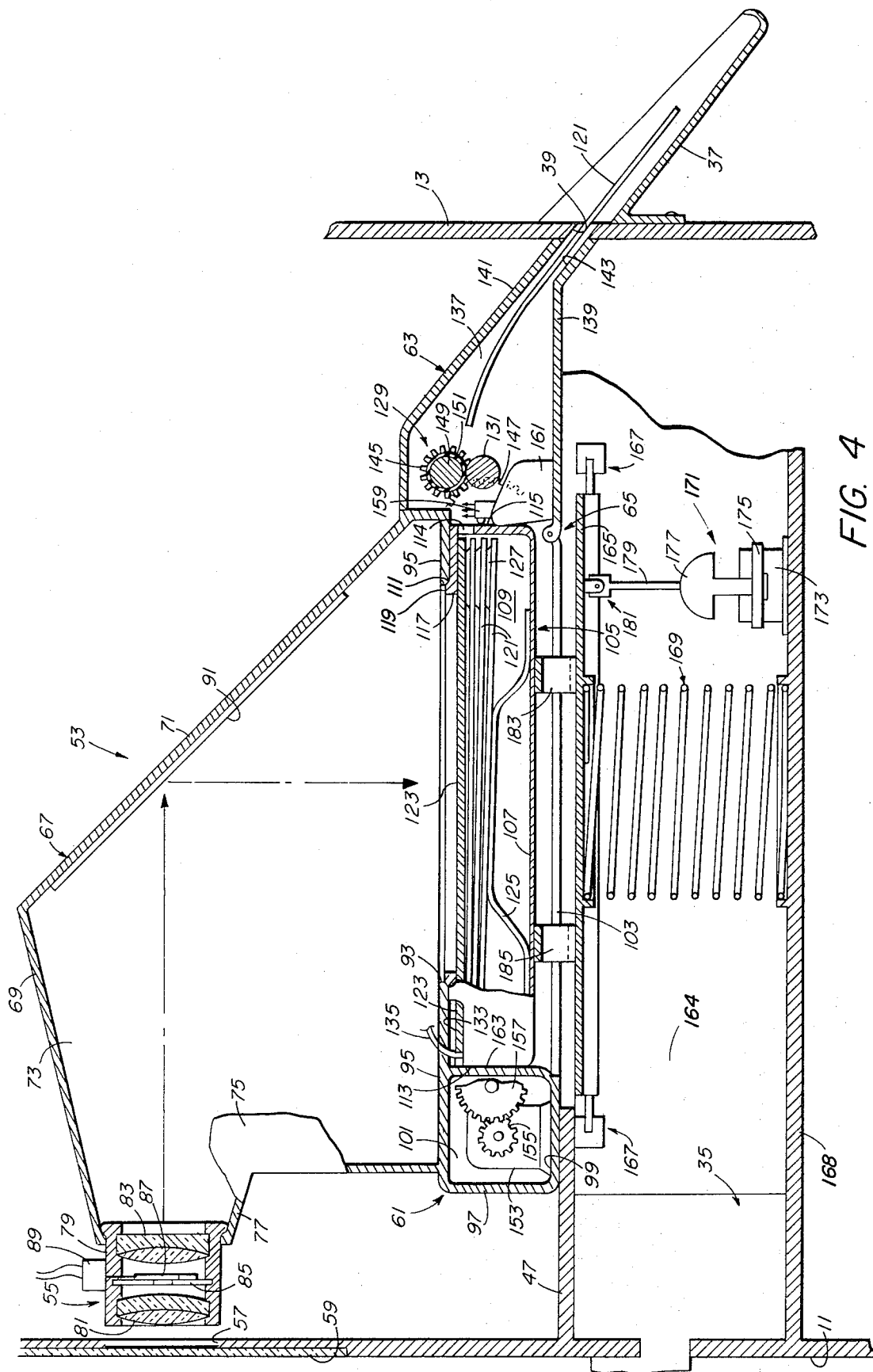
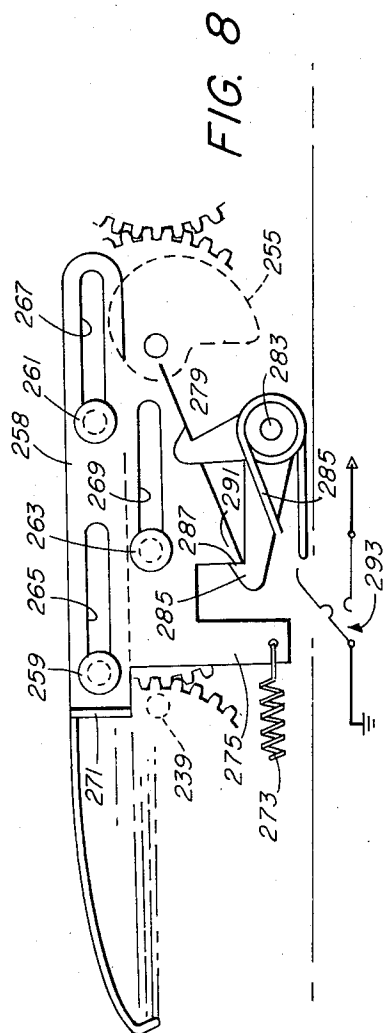
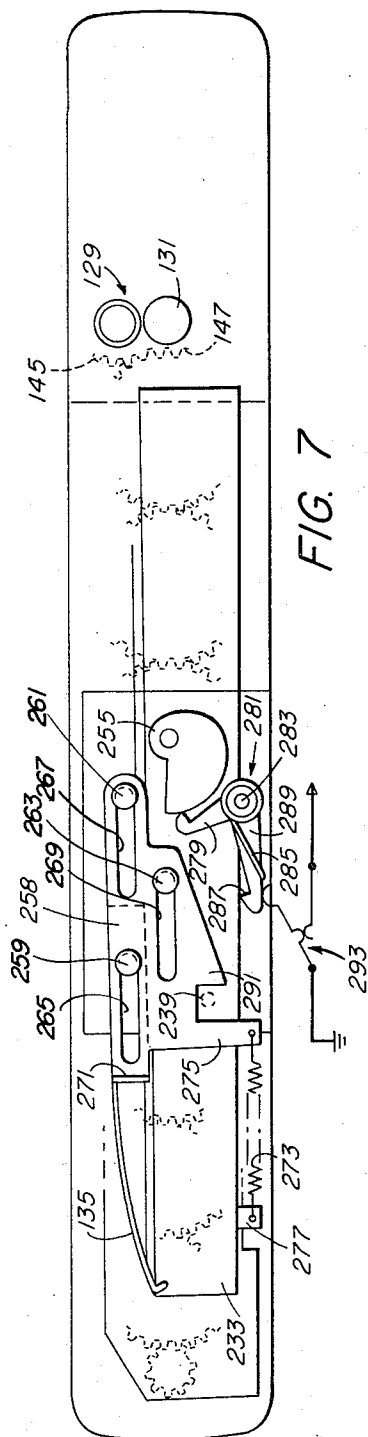
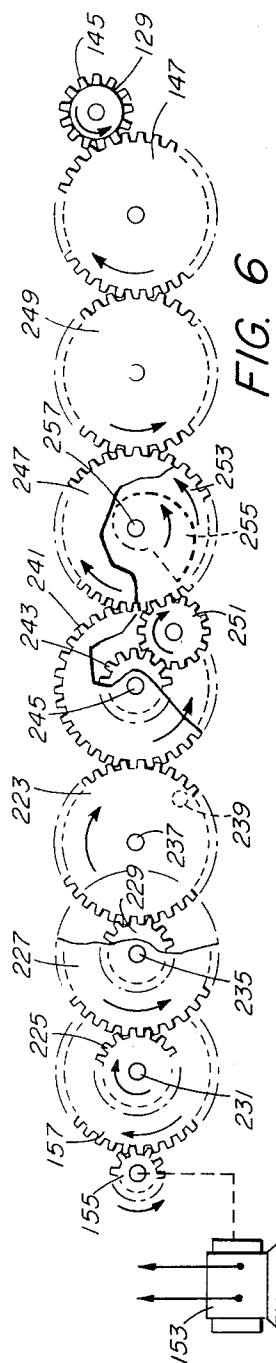
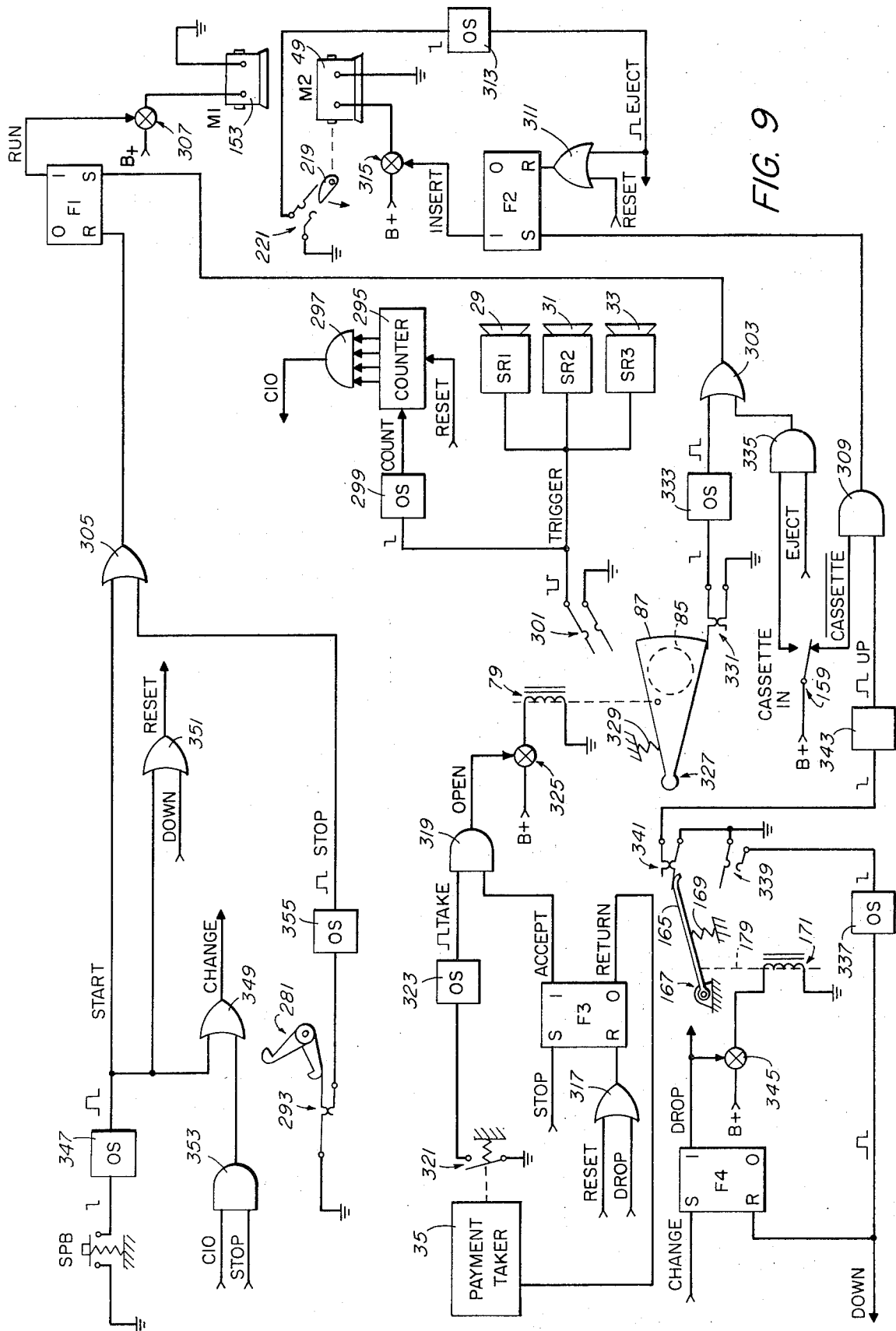


FIG. 2









AUTOMATIC PHOTOSTUDIO COMPRISING AUTOMATIC FILM CASSETTE CHANGING APPARATUS

This invention relates to photography, and particularly to a novel photostudio for taking self portraits with studio lighting.

User operated photostudios are highly desirable, because they bring to the public the advantages of professional lighting arrangements and processing facilities without requiring the attendance of a skilled and talented photographer. The objects of this invention are to facilitate the construction and simplify the maintenance of such photostudios.

Photostudios of the kind to which the invention is directed are conveniently made in the form of a booth open to the public, and provided with a coin or currency operated mechanism. When payment is deposited by the user, the photographic apparatus is enabled to take a photograph and deliver a finished print.

Such a studio must be attended at sufficient intervals to insure that the coin or currency receptacle does not overflow before the contents are collected. Another schedule of attendance is established by the needs to replenish the supply of photosensitive material, to maintain the processing system and replenish any processing fluids that may be employed, and to service the apparatus.

It is not difficult to synchronize the capacity of the payment-taking device with the capacity of the photosensitive material supply, or to limit either to the life of the processing fluids that may be employed. However, it has generally been necessary to design the photographic system with a constant capacity, resulting in an over-capacity for most locations and periods of use, to accommodate locations or seasons of use in which extensive use can be anticipated. For example, if photostudios are established at two locations, one of which receives a run of business on September 14th and the other on December 24th, at times the installation at each location will either run out of photosensitive material, or carry an extensive inventory of unused material. A particular object of the invention is to facilitate inventory control of user-operated photostudios.

Briefly, the above and other objects of the invention are attained by a novel self-operated photostudio which comprises a housing divided into a studio compartment and an adjacent accessory apparatus compartment. The studio compartment comprises a booth which the subject can enter, and be seated for a portrait. The apparatus compartment contains the photographic and processing apparatus required to produce a finished photograph of the subject, taken through a window between the compartments.

The need for differential maintenance of processing chemicals and photosensitive material is eliminated by employing film units of a self-processing type, each containing its own processing composition, such as those commercially available in cassettes of 10 for use in the Polaroid SX-70 Land Camera. The apparatus is arranged to accept a stack of such cassettes, and to sequentially load them into a camera forming a part of the apparatus so that the film units located therein can be successively exposed.

By the use of cassettes in this manner, the operator of the photostudio can schedule reloading at desired intervals in units of multiples of ten exposures, so that

a small number of cassettes can be supplied for use at a location in an interval when low utilization is contemplated, and a considerably larger number of cassettes can be loaded for use during an interval in which a higher utilization rate is contemplated. In this manner, the operating capacity of each photostudio can be maintained at an optimum level without carrying an excessive inventory at any location, and without requiring any particular skill on the part of the attendant. Maintenance of the apparatus is considerably simplified by enclosing most of the delicate apparatus which transports and positions the film units for exposure and processing in a compact camera housing, which can be removed and changed out if found to require maintenance. By that arrangement, the studio can quickly be put back into operation without field maintenance other than required to change the camera housing.

The manner in which the apparatus of the invention is constructed, and its mode of operation, will best be understood in the light of the following detailed description, together with the accompanying drawings, of a preferred embodiment thereof.

In the drawings,

FIG. 1 is a schematic perspective sketch of a self-operated photostudio in accordance with the invention;

FIG. 2 is a schematic plan sketch of the apparatus of FIG. 1, with parts shown in cross-section, taken substantially along the lines 2—2 in FIG. 1;

FIG. 3 is another schematic cross-sectional plan view of the apparatus of FIG. 1, on a different scale, taken substantially along the lines 3—3 in FIG. 1;

FIG. 4 is a schematic fragmentary elevational sketch, with parts shown in cross-section and parts broken away, and on an enlarged scale, of a portion of the apparatus of FIG. 3, taken substantially along the lines 4—4 in FIG. 3;

FIG. 5 is a schematic fragmentary elevational sketch, with parts omitted, parts shown in cross-section, and parts broken away, showing a portion of the apparatus of FIG. 3 and taken substantially along the lines 5—5 in FIG. 3;

FIG. 6 is a fragmentary elevational sketch, with parts omitted and parts broken away, of a film transport motor and drive train forming a part of the apparatus of FIG. 4;

FIG. 7 is a schematic elevational view, with parts broken away, showing a portion of the film transport mechanism of FIGS. 4 and 6 in more detail;

FIG. 8 is a fragmentary schematic elevational view, with parts broken away, showing a portion of the apparatus of FIG. 7 on an enlarged scale and with parts in a different position; and

FIG. 9 is a schematic block and wiring diagram of a control system forming a part of the apparatus of FIGS. 1—8.

Referring to FIG. 1, a self-operated photostudio is shown to comprise an outer housing generally designated 1 made up of a floor panel 3, ceiling panels 5 and 7, wall panels 9, 11 and 13, a back wall panel 15 and a front wall panel 17. These panels may be made of glass reinforced polyester or phenolin resin, or of wood, sheet metal, or the like.

A studio compartment 19 is formed in the housing 1 by the walls 9, 11, 15 and 17. A doorway 21 is formed in the front wall 17 to allow admission to the studio compartment 19, and suitable means, shown as a pair

of drapes 23, are provided to shield the compartment 19 from ambient external light, when in use. An access door 22 is provided in the wall 13, to admit an attendant for maintenance and service.

A stool 25, on which the user can be seated, is mounted in the studio compartment 19 in any convenient position. For that purpose, the stool 25 may be fixed to the side wall 9 by a suitable support, as indicated at 27.

As best shown in FIG. 2, three strobe lights in reflectors 29, 31 and 33 are arranged to light a subject seated on the stool 25. The reflector 29 may be mounted in the ceiling panel 5, to serve as a top light. The reflector 31 may be mounted in the corner formed by the walls 11 and 15 to serve as a front light. The reflector 33 may be mounted adjacent the corner of the walls 17 and 11 to form a fill light.

A payment taker 35 is mounted anywhere in the studio compartment 19 where it will be convenient for access by the user seated on the stool 25, as on the wall 11 as indicated. The payment taker 35 may be a conventional coin operated device, or a paper currency responsive mechanism of any conventional design, or it may respond to the insertion of a token, ticket, punch card, or the like. Alternatively, it may be a simple push-button, if admission and use of the apparatus is not charged for, or if payment is externally collected.

A print delivery tray 37 is mounted on the side wall 13 of the housing 1, and is provided with a slot 39 through which a finished print may be delivered to the subject after his photograph is taken.

Referring to FIG. 3, an apparatus compartment 41 is formed by the walls 15, 13, 17 and 11. A shelf member having three levels 43, 45 and 47 extends across this compartment and supports the various elements of the photographic apparatus to be described.

On the shelf 43 there is mounted a cassette changer including a drive motor 49 to be described in more detail below. On the shelf 45 is mounted a cassette magazine comprising a hopper 51 adapted to receive a stack of cassettes, each containing a number of film units, to be described below.

On the shelf 47 is mounted a camera generally designated 53. The camera 53 has a lens 55 confronting a port 57 in the wall 11 through which the subject can be photographed. Surrounding and over the port 57 is a half-silvered mirror 59, which serves to allow the subject seated on the stool 25 to see himself as his portrait will be taken, and also allows light to be admitted to the lens 55 for the purpose of exposing the film unit.

Referring to FIG. 4, the camera 53 comprises a body including a front housing portion generally designated 61, a rear housing portion generally designated 63 hinged to the front housing portion 61 as indicated at 65, and a lighttight upper housing portion 67. The housing portion 67 comprises top walls 69 and 71, side walls 73 and 75, and a bottom wall 77. The upper housing portion 67 connects the body comprising the front housing 61 and the rear housing 63 to the lens 55.

The lens 55 is provided with a barrel 79 in which a compound front element 81 and a compound rear element 83 are mounted in a conventional manner. Between the front and rear elements of the lens are an aperture plate 85, and a movable shutter blade 87. The aperture plate 85 determines the effective f-stop at which the film units will be exposed. The shutter blade 87 operates under the influence of a solenoid schemati-

cally indicated at 89. The solenoid 89 serves, in a manner to be described, to open the shutter, and to provide a trigger signal for operating the strobe lights when the shutter is open to expose the aperture in the plate 85.

A mirror 91 is mounted inside the upper housing 67 and attached in a conventional manner to the wall 71. The mirror 91 is disposed at 45° to the optical axis of the lens 55, and serves to direct light coming through the lens downward onto an image plane exposed through a framing aperture 93 formed as a rectangular opening in the top wall 95 of the front housing 61.

The front housing 61 is of generally rectangular configuration, and comprises, in addition to the top wall 95, a front wall 97, a bottom wall 99, and side walls such as 101. An opening 103 in the bottom wall 99 serves to admit a cassette such as 105.

The cassettes 105 each comprise a housing, of plastic or the like, and having a bottom wall 107, side walls such as 109, a top wall such as 111, and end walls 113 and 115. The top wall 111 is formed with a rectangular recess 117 surrounded by a rim 119 that mates with the framing aperture 93 in the camera and serves to define the limiting aperture in which the uppermost of a series of film units 121 is exposed. The film units 121 may comprise a set of, for example, ten units initially disposed between a cardboard dark slide 123 and a resilient spring 125 that urges the film units upwardly into registry with the framing aperture 117.

The film units 121 in the cassette 105 may be of the type shown and described in U.S. Pat. No. 3,415,644, issued on Dec. 10, 1968 to Edwin H. Land for Novel Photographic Products and Processes, and in U.S. application for Letters Patent Ser. No. 194,407, filed on Nov. 1, 1971 by Edwin H. Land for Novel Products and Processes, copending with, and assigned to the assignee of, this application.

Generally, as is more fully disclosed in those references, the film units comprise a number of photosensitive layers in which latent color images can be formed, and other layers which cooperate with the photosensitive layers. A supply of processing composition is contained in a pod 127 at the end of each film unit 121. When the film unit is compressed between a pair of spreader rolls 129 and 131, in a manner to be described, the processing composition in the pod 127 is forced between selected layers of the film unit, thereby initiating a diffusion transfer process which develops and fixes the image. Since the final image is formed on the emulsion side of each film unit, the mirror 91 serves to record the image in correct left-to-right orientation.

A slot 133 formed in one corner of a top wall 111 of the cassette 105 receives a picker finger 135. The picker finger operates in a manner to be described to advance the dark slide 123, or the uppermost one of the film units 121, into the bite of the spreader rolls 129 and 131.

The rear housing portion 63 comprises side walls such as 137, and a bottom wall 139 in which a portion of the entrance aperture 103 of the cassette 105 is formed. The bottom wall 139 is hinged to the bottom wall 99 of the front housing portion as indicated at 65. A tapering front wall 141 serves to cooperate with the spreader rolls 129 and 131 to guide a film unit 121 down through an exit slot 143 formed in the bottom wall 139 and thence through the exit slot 39 into the collecting tray 37.

The spreader rolls 129 and 131 are rotatably supported by the side walls 137 of the rear housing 63 in any conventional manner, not shown, and are in frictional engagement, so that when one of the rolls is driven, the other follows. For that purpose, a gear 145 fixed to the spreader roll 129 is arranged to be driven by a gear 147, in a manner to be described below, and thereby drives the roll 131. The roll 129 may have a stainless steel core 149, and a resilient covering 151 thereon of polyurethane or the like. The roll 131 may be of stainless steel.

A film unit, introduced into the bite of the rolls by the picker finger 135 in a manner to appear, will be driven by the rolls toward the exit slot 143.

A DC motor 153 is secured to the bottom wall 99 of the front housing portion 61, and drives a gear 155. The gear 155 drives a dual gear train, to be described, beginning with a gear 157 and continuing through, in a manner to appear, to the gears 147 and 145.

The front housing portion 63 is normally held in the position shown in FIG. 4 by conventional latch means, not shown. The latch is arranged to be released to allow the housing portion 63 to swing downwardly, as seen in FIG. 4, to allow access to the spreader rolls for cleaning.

In the position of the rear housing 63 shown, a micro-switch 159 is engaged by a cassette 105, when the cassette is in position in the housing as shown, to provide a signal for purposes to be described. The switch 159 is mounted at the top of a support 161 secured to the bottom wall 139 of the rear housing. The support 161 cooperates with a wall portion 163, extending between the bottom wall 99 and the top wall 95 of the front housing portion, and with side walls such as 101 of the housing, to guide the cassette 105 into registry with the framing aperture 93.

The cassette 105 is held in the position shown in FIG. 4 by a bed plate 165 that is pivotally secured to a wall 164 formed integrally with the shelf 47, as schematically indicated at 167, for movement between the position shown in FIG. 4, and a lower position shown in FIG. 5, being urged toward the position shown in FIG. 4 by a spring 169. The spring 169 engages a bracket 168 formed integrally with the wall 164 as suggested in FIG. 5.

The bed 165 is at times dropped against the force of the spring 169 by a solenoid generally designated 171. The solenoid 171 has a core 173 secured to the wall 164, windings 175, and an armature 177 having an output shaft 179 that is pivotally connected to the bed plate 165 as suggested at 181.

A pair of springs 183 and 185 connected to the bed plate 165 serve to guide the cassette 105 up into the camera body, and to resiliently hold it in engagement with the framing aperture in the top plate 95 in the camera when it is in position. When the solenoid 171 is actuated, the bed plate 165 comes down, as shown in FIG. 5, to allow the cassette to fall out and into a bin 187. That occurs when all the film units in the cassette have been exposed and processed, as will appear. Dropping the bed plate allows disposal of the cassette housing, and the introduction of a new cassette into the camera, by operation of the cassette changing mechanism, next to be described in connection with FIG. 5.

As shown in FIG. 5, the hopper 51 comprises a generally rectangular bin open at the top and formed from

interconnected walls 189, 191, 193 and 195. A slot 197 is formed at the base of the wall 189, and a corresponding slot 199 is formed in the base of the wall 195, to permit each of a stack of cassettes 105 in the hopper 51 to be ejected by means of a ram 201.

When the ram 201 is moved to the right, as seen in FIG. 5, a cassette moved by the ram forces the bed 165 down against the spring 169, into a position in which the cassette can enter the camera 53 through the opening 103 in the bottom walls of the front and rear housing portions 63 and 61. As the cassette 105 enters the housing in this manner, the bed 165 swings upwardly under the influence of the spring 169 to hold the cassette in the position shown in FIG. 4. The ram 201 is then moved back through the slot 197 to allow the next cassette 105 to fall into loading position.

The ram 201 is pivotally connected to a link 203 that is in turn pivotally connected to a dog 205 secured to a timing belt 207. The belt 207 is driven by a sprocket 209 fixed to the output shaft 211 of the motor 49.

The belt 207 extends from the sprocket 209 over a second idler sprocket 213 secured to a shaft 215 that is journaled in a suitable support 217 secured to the shelf 43. A cam 219 is secured to the belt 207, and is adapted to engage and momentarily close a switch 221 secured to the motor 49 so that a signal indicating the completion of one revolution of the timing belt will be produced, for purposes to be described below.

In general, it will be apparent that during each rotation of the belt 207, the ram 201 moves to the right in FIG. 5 to move the cassette 105 into the camera 53, and then moves back to the position in which the next cassette can drop down into position for loading. In overall operation, when a cassette 105 is placed in the camera 53, all of the film units in it are exposed, processed and ejected, and the solenoid 171 is then actuated to pull down the bed 165 and allow the empty cassette housing to be dropped into the bin 187. The motor 49 is then operated to load a new cassette into the camera.

FIGS. 6, 7 and 8 show the essential operating elements of the film transport and timing mechanism operated by the DC motor 153 in the camera housing. As shown in FIG. 6, and as described above, the motor 153 drives the gear 155. The gear 155 drives a first timing gear 223 through reduction gears 157, 225, 227 and 229.

The gears 157 and 225 are fixed together, and fixed on a shaft 231 that is journaled in suitable bearings, not shown, mounted on a plate such as 233, FIG. 7, that is secured in the housing 61 in a conventional manner along-side the bay in which the cassettes 105 are received. The plate 233 may serve as one of the walls guiding the cassettes 105 into operative position.

The gears 227 and 229 are secured together, and to a shaft 235 journaled in bearings mounted on the plate 233. The gear 223 similarly has a shaft 237 journaled in bearings fixed to the plate 233.

A pin 239, on the rear side of the gear 223, as seen in FIGS. 6 and 7, is at times adapted to operate the picker finger 135 in a manner to appear. The gear 223 drives a gear 241. The gear 241 is fixed to another gear 243, and to a shaft 245 that is rotatably supported by the plate 233.

The gear 241 drives a power train for the spreader rolls 129 and 131 that comprises intermediate gears 247, 249 and 147. The gear 147 engages the gear 145

when the front portion 63 of the housing of the camera 53 is closed as shown in FIG. 4.

A second train of gears is operated at a reduced speed by the gear 243. This second train includes a pinion gear 251 and a timing gear 253 on which there is affixed a cam 255. The gear 247 is rotatably mounted on a shaft 257, to which the gear 253 and the cam 255 are fixed, so that the gears 247 and 253 can rotate independently at different speeds. The shaft 257 may be journaled in suitable bearings supported by the plate 233, and the other gears 251, 249, 247 and 147 may be similarly supported.

As best shown in FIGS. 7 and 8, the picker arm 135 is connected to a slide 258 that is guideably mounted for sliding movement on the plate 233 by pins having enlarged heads 259, 261 and 263 extending through cooperating slots 265, 267 and 269 formed in the slide 258. An outstanding ear 271 on the slide 258 is adapted to cooperate with the pin 239 in a range of angular positions of the gear 223.

The slide 258 is urged to the position shown in FIG. 7 by a tension spring 273 connected between an arm 275 formed on the slide 258 and an arm 277 formed on the plate 233. In the position of the parts shown in FIG. 7, the cam 255 engages one arm 279 of a bell crank generally designated 281.

The bell crank 281 is journaled for rotation on a shaft 283 that is supported by the plate 233. The bell crank 281 is urged in a clockwise direction, as seen in FIG. 7, by a spring 285 that tends to bring the bell crank 283 to a rest position in which a tooth 287 formed on an arm 289 of the bell crank 281 will interfere with a corresponding tooth 291 formed on the slide 258.

In the position of the parts shown in FIG. 7, the arm 289 closes a switch 293 to produce a ground level current sink, for purposes to appear. When the cam 255 is rotated counterclockwise as seen in FIG. 7, the bell crank 281 is released. The switch 293 is then opened, and remains open while the cam rotates, through a position shown in dotted lines in FIG. 8, and until the cam returns to substantially the position shown in FIG. 7 in which the switch is again closed. The negative going transition produced by the switch 293 when it is again reclosed is used in a manner to be described below to control the operation of the apparatus.

The operation of the apparatus of FIGS. 6, 7 and 8 will next be briefly described, and later related to the operation of the other elements of the system. Assuming that the parts are initially in the position shown in FIG. 7, when the motor 153 is first energized, the gear 145 will begin to drive the spreader rolls 129 and 131. The cam 255 will be rotated counterclockwise, as seen in FIG. 6, opening the switch 293. The bell crank, which opens the switch 293 as the cam 255 revolves, will be released to rotate to a rest position, in which the tooth 287 formed on the bell crank arm 289 will be in a position to engage the cooperating tooth 291 formed on the slide 258.

As the motor 153 continues to operate, the pin 239 formed on the cam 223 will engage the ear 271 formed on the slide 258 and drive the slide to the right in FIG. 7, moving the picker arm 135 to carry either the dark slide, or the uppermost one of the film units 121, in the cassette 105, out through a slot 114 formed in the front wall 115 of the cassette 105 and into the bite of the spreader rolls 129 and 131, which continue to rotate.

The slide 258 will move until the tooth 291 rides up over the arm 289 of the bell crank 281 and engages the tooth 287. The pin 239 will then ride off of the ear 271, and the slide 258 will be locked in the position shown in FIG. 8 as the gear train continues to be driven. The gear 223 makes a number of revolutions during each cycle of operation of the gear train, but successive passages of the pin 239 past the ear 271 will have no effect on the position of the slide 258 once it has been moved to its latched position.

As the gear train continues to be driven, the film unit or dark slide will be carried out by the spreader rolls 129 and 131 into engagement with the front panel 141, and thence be guided down through the exit slot 143 to the slot 39 formed in the wall 13, FIG. 4, and thence to the output tray 37 where it can be removed by the user.

Toward the end of this process, the cam 255 will again come around and engage the bell crank arm 279, driving the bell crank counterclockwise to the position shown in FIG. 7, and releasing the slide 258 to return to the position shown in FIG. 7 under the influence of the spring 273. The switch 293 will again close, causing a ground going transition to be produced that will terminate operation of the motor 153 in a manner to be described below.

FIG. 9 shows the control system for the apparatus of FIGS. 1-8. Three strobe units SR1, SR2 and SR3, diagrammatically shown in FIG. 9, are provided for supplying light to be directed by reflectors 29, 31 and 33 when an exposure is to be made. These units may conveniently be powered from an alternating current line, such as a 120 volt, 60 Hz line.

The direct current voltage required to operate the rest of the apparatus may be derived from the same source through conventional power supply circuits. This DC source is connected between the terminals labelled B+ and a reference ground terminal. Alternatively, if the cassettes 105 are of the type sold for use in the Polaroid SX-70 Land Camera, which include a battery that would be located between the spring 125 and the back 107 of the cassette housing as seen in FIG. 4, such batteries may be used to supply power to the DC control circuits to be described.

The state of the system of FIG. 9 is determined by the conditions of four conventional flip-flops F1, F2, F3 and F4, and by a conventional four-stage binary counter 295. Four selected terminals from each of the stages of the counter 295 are connected to a conventional AND gate 297, to produce a logic 1 signal (positive with respect to ground) labelled C10, each time ten count pulses are applied to the counter 295.

A count pulse is provided to the counter each time a conventional one-shot multivibrator 299 is triggered by the ground going transition produced when a switch 301 is momentarily closed. The ground level pulse produced when the switch 301 is closed, labelled TRIGGER, triggers the strobe units SR1, SR2 and SR3 simultaneously to produce an exposing flash from the reflectors 29, 31 and 33. The switch 301 is arranged to be opened by the shutter blade 87 when the shutter is opened to expose the aperture in the aperture plate 85, as will be described.

The flip-flop F1 is arranged to be set, and thereby product a logic 1 signal at its logic 1 output terminal, labelled RUN, when a conventional OR gate 303 produces a logic 1 output signal. The flip-flop F1 is reset

when a conventional OR gate 305 produces a logic 1 output signal, that is applied to the reset input terminal R of the flip-flop F1.

When set, the flip-flop F1 applies the RUN signal to the control terminal of a conventional electronic switch 307, such as a transistor or the like. The RUN signal closes the switch 307 to supply load current from the supply terminal at B+ through the windings of the motor 153 and thence to ground, causing the motor to operate as long as the switch 307 is closed by the presence of the RUN signal. When the flip-flop F1 is reset, the RUN signal is absent, the switch 307 is open, and the motor 153 is stopped.

The flip-flop F2 is arranged to be set, producing a logic 1 signal labelled INSERT at its logic 1 output terminal, when a logic 1 input signal is supplied to its set input terminal S by a conventional AND gate 309. The flip-flop F2 is reset by a logic 1 signal applied to its input terminal R when a conventional OR gate 311 produces a logic 1 output signal.

The gate 311 has two input terminals, one receiving a signal labelled RESET that is produced in a manner to be described, and a second which receives a positive EJECT pulse produced when a one-shot multivibrator 313 is triggered. The multivibrator 313 is triggered by a ground-going transition produced when the switch 221 is momentarily closed by the cam 219 in response to rotation of the motor 49 through a full revolution, as described above in connection with FIG. 5.

When the flip-flop F2 is set, the signal labelled INSERT closes a conventional electronic switch 315 to supply operating current to the motor 49. When the flip-flop F2 is reset, the switch 315 is open and the motor 49 is stopped.

The flip-flop F3 is arranged to be set by a logic 1 signal labelled STOP applied to its set input terminal S. The flip-flop F3 is reset when a conventional OR gate 317 receives either the signal RESET or a signal DROP, produced in a manner to be described.

When set, the flip-flop F3 produces a logic 1 signal labelled ACCEPT, at its logic 1 output terminal, and when reset, the flip-flop F3 produces a logic 1 signal labelled RETURN at its logic 0 output terminal. The ACCEPT signal is supplied to one input terminal of a conventional AND gate 319.

The RETURN signal may be employed to disable the payment taker 35 in a conventional manner, as by lighting a lamp behind a sign indicating that the apparatus is not ready for use, by inserting a stop in a coin slot or a bill accepting tray, or otherwise making it apparent to the user that insertion of payment will not result in the taking of a picture because the apparatus is not ready for it. When the RETURN signal is absent, the payment taker 35 responds to the desired input by the user by momentarily closing a switch 321 to produce a ground level transition that triggers a conventional one-shot multivibrator 323.

When triggered, the multivibrator 323 produces a positive output signal labelled TAKE. When both the signals TAKE and ACCEPT are present, the gate 319 produces a positive signal labelled OPEN that closes a conventional electronic switch 325 to supply energizing current to the solenoid 79.

As schematically indicated, the solenoid 79 has an armature connected to the shutter blade 87. The blade 87 is pivoted, as suggested at 327, to the stop blade 85 in FIG. 4, and resiliently biased by a spring 329 toward

a position in which it closes the aperture in the aperture plate 85.

In the closed position of the shutter blade 87, a switch 331 is closed. When the shutter blade 87 is opened by energization of the solenoid 79, the switch 331 is opened.

When the blade 87 has fully opened the aperture in the aperture blade 85, the switch 301 is momentarily closed to produce the TRIGGER signal, firing the strobe units, and triggering the multivibrator 299 to produce a COUNT pulse. When the shutter 87 again closes after the solenoid 79 is released, which occurs at the end of the TAKE pulse, the switch 331 is momentarily closed to produce a ground going transition that triggers a conventional multivibrator 333 to produce an output pulse. The output pulse from the multivibrator 333 sets the flip-flop F1 through the gate 303.

The presence of a cassette in the camera is registered by the switch 159, as described above in connection with FIG. 4. When no cassette 105 is in the camera, the cassette switch 159 is in the position shown in FIG. 9, in which the DC supply voltage at B+ is supplied, as a signal labelled CASSETTE, to one input terminal of the AND gate 309. When a cassette is in the camera, the switch 159 engages the upper contact in FIG. 9, and supplies a logic 1 signal at B+ to one input terminal of a conventional AND gate 335. A second input terminal of the gate 335 receives the EJECT pulse produced by the multivibrator 313 as described above. Thus, when a cassette is in the camera and the EJECT pulse is produced, the gate 335 will produce a logic 1 output signal that will set the flip-flop F1 through the OR gate 303.

The flip-flop F4 is arranged to be set by a logic 1 signal labelled CHANGE applied to its set input terminal S. The flip-flop F4 is reset by a positive pulse labelled DOWN supplied when a conventional one-shot multivibrator 337 is triggered by momentary closure of a switch 339. The switch 339 is arranged to be momentarily closed when the bed 165 is moved by the solenoid 171 down into its lower position against the force of the spring 169, to allow an empty cassette in the camera to be dropped into the bin 187 in FIG. 5.

When the bed 165 returns to its upper position, it closes a switch 341. Closing the switch 341 causes a ground level transition to trigger a conventional one-shot multivibrator 343, causing the multivibrator 343 to produce a positive pulse labelled UP.

The UP pulse is supplied to the second input terminal of the gate 309, causing the gate 309 to set the flip-flop F2 when a cassette is not present in the camera, but not affecting the flip-flop F2 if the UP pulse is produced when a cassette is in the camera, as it will be after a cassette has been ejected from the camera and the bed has again been lowered and raised as a new cassette is loaded.

When the flip-flop F4 is set, it produces a logic 1 signal labelled DROP at its logic 1 output terminal, closing an electronic switch 345 of any conventional design to supply operating current to the solenoid 171. When the flip-flop F4 is reset, the signal DROP disappears, and the switch 345 is opened.

It will be apparent that when a CHANGE signal is produced, the flip-flop F4 is to be set to produce the DROP signal, energizing the solenoid 171. The bed 165 is then pulled down to the position in which the switch

335 closes to trigger the multivibrator 337. That produces the DOWN pulse to reset the flip-flop F4.

A spring-returned, manually operable pushbutton SPB is provided which is used to begin operations when the camera 53 has no cassette in it and a stack of cassettes 105 has just been loaded into the hopper 51. When momentarily depressed, the pushbutton SPB produces a ground level transition that triggers a conventional multivibrator 347 to cause it to produce an output pulse labelled START. The START pulse resets the flip-flop F1 through the OR gate 305. It is also applied to an OR gate 349 to produce the signal labelled CHANGE referred to above. The START pulse is also applied to an OR gate 351 to produce the RESET pulse described above. The RESET pulse is also produced by the DOWN pulse supplied to the gate 351 when the one-shot multivibrator 337 is triggered, by the bed 165 reaching its down position and closing the switch 339.

The gate 349 also produces a CHANGE signal in response to the signals C10 and STOP applied to an AND gate 353. The gate 353 has an output terminal connected to a second input terminal of the gate 349. The signal C10 is produced by a gate 297 as described above, when the counter 295 has counted ten exposures and thus indicates that the last film unit in the cassette of ten film units has been used, making it necessary to change the cassette. Of course, different numbers of film units in the cassette would require the counter gate 297 to detect correspondingly different counts at which the cassettes would be changed.

The STOP pulse applied to the gate 353 is produced by a conventional one-shot multivibrator 355. The multivibrator 355 is triggered each time the bell crank 281, described above in connection with FIGS. 7 and 8, closes the switch 293 to produce a ground going current transition.

Having described the construction of the apparatus of the invention, its operation will next be described with reference to FIGS. 1-9. Referring first to FIG. 9, operation will be discussed on the assumption that the apparatus is energized by the power supply, that the bed 165 is in its upper position, the shutter blade 287 is in its closed position as shown, the flip-flops F1, F2, F3 and F4 are reset, the counter 295 is in its count 0 state, and the bell crank 281 is in the position shown in which the switch 293 is closed.

Referring to FIG. 5, assume that the bed 165 is in its upper position, that there is no cassette in the camera 53, and that the ram 201 is in its extreme left position in FIG. 5 in which it is outside of the hopper 51. Assume next that a stack of cassettes 105 is loaded into the hopper 51.

No operation will occur until the start pushbutton SPB in FIG. 9 is momentarily depressed. When that happens, the multivibrator 347 will be triggered to produce a START pulse. The START pulse will reset the flip-flop F1 through the gate 305. The RESET pulse will be produced by the gate 351, resetting the counter 295 to insure that it is in its count 0 state, and resetting the flip-flops F3 and F2.

The START pulse will also cause the gate 349 to produce a CHANGE pulse, setting the flip-flop F4 to produce the DROP signal. The DROP signal will close the switch 345. That will apply current from B+ through the winding of the solenoid 171 to ground, energizing the solenoid and causing its armature 179 to bring

down the bed 165 against the force of the spring 169.

The switch 341 will be opened at this time, and the switch 339 will be closed as soon as the bed reaches its lower position. When the switch 339 is closed, the multivibrator 337 will be triggered to produce a DOWN pulse, resetting the flip-flop F4 and again producing the RESET pulse. This RESET pulse will produce no further effect this time.

Next, the bed 165 will swing up under the influence of the spring 169, because the solenoid 171 is de-energized as soon as the flip-flop F4 is reset by opening the switch 345. When the bed 165 reaches its upper position, the switch 341 will close to trigger the multivibrator 343 and produce the UP pulse.

With no cassette in the camera, the switch 159 will supply the signal CASSETTE to the gate 309, and the flip-flop F2 will be set. That will produce the INSERT signal to close the switch 315 and cause the motor 49 to run.

Referring to FIG. 5, the ram 201 will move the first cassette 105 into engagement with the springs such as 103 on the bed 165, driving the bed 165 downward against the spring 169 enough to allow the cassette 105 to enter the camera and reach the position shown in FIG. 4. The bed will follow the cassette up into the camera and hold it there.

The ram 209 will be retracted toward the end of the stroke, until the cam 219 closes the switch 221. Referring again to FIG. 9, that will trigger the multivibrator 313 to produce the EJECT pulse. The EJECT pulse will reset the flip-flop F2 through the gate 311, causing the switch 315 to be opened and stopping the motor 49.

The EJECT pulse will also be applied to the AND gate 335. With a cassette 105 now in the camera, the switch 159 will engage the upper contact in FIG. 9, and the gate 335 will set the flip-flop F1 through the gate 303. The flip-flop F1 now produces a RUN signal to close the switch 307 and cause the motor 153 to operate.

Referring to FIGS. 4 and 7, as the motor begins to run, the picker arm 135 will be advanced in the manner described above, causing the dark slide 123 to be moved out through the slot 114 in the cassette 105 and into the bite of the spreader rolls 129 and 131. The dark slide will then be ejected out the slots 143 and 39, where it can be removed from the tray 37 by the attendant. Referring to FIG. 9, as soon as the dark slide has been completely ejected, the bell crank 281 will return to the position shown in FIG. 9 in which the switch 293 will be closed. Closure of the switch will trigger the multivibrator 355 to produce a STOP pulse. That will reset the flip-flop F1 through the gate 305 and remove the RUN signal, opening the switch 307 and causing the motor 153 to stop with the parts in the position shown in FIG. 7.

The STOP pulse produced by the multivibrator 355 will also set the flip-flop F3. The signal ACCEPT will now be produced, and the signal RETURN will be removed, enabling the payment taker 35 to receive a coin, dollar bill, ticket, token or simply a user's closure of a switch such as 321, to initiate the taking of a picture. Referring to FIG. 1, with the apparatus in the standby position just described, a user can enter the studio compartment 19, be seated on the stool 25, and view his image in the half-silvered mirror 59 shown in FIG. 4.

When satisfied with the picture that will be taken, the subject deposits payment in the payment taker 35. Referring again to FIG. 9, when that occurs, the switch 321 will be momentarily closed to trigger the multivibrator 323 and produce a TAKE pulse. With the ACCEPT signal now present, the gate 319 will produce the OPEN signal, closing the switch 325. The shutter solenoid 79 will now be energized.

The shutter blade 87 will begin to open, opening the switch 331. When the aperture in the aperture plate 85 is fully exposed, the blade 87 will momentarily close the switch 301, triggering the multivibrator 299 to produce a COUNT signal and advance the counter to count 1. At the same time, the strobe units SR1, SR2 and SR3 will be triggered to produce flashes that will illuminate the subject and expose the film unit then in position in the camera.

At the end of the TAKE pulse, which is merely of sufficient duration to make sure that the shutter 87 is fully opened, the signal OPEN will disappear and the switch 325 will be opened. That will de-energize the solenoid 79, allowing the shutter blade 87 to return to its closed position under the influence of the spring 329. The switch 301 will then open.

When the shutter blade reaches its closed position, the switch 331 will be closed to trigger the multivibrator 333. That will set the flip-flop F1 through the gate 303. The RUN signal will be produced, causing the motor 153 to operate as before. This time, the first exposed film unit will be advanced by movement of the picker arm, and then by engagement with the spreader rolls, so that its pod 127 will be broken and fluid dispersed throughout the film unit to cause it to be processed as it moves through the spreader rolls 131. The film unit will then be deposited in the tray 37, where it can be picked up by the user.

At the end of the eject and process cycle for the first film unit, the bell crank 281 will again close the switch 293, triggering the multivibrator 355 to produce a STOP pulse. That will reset the flip-flop F1 and turn off the motor 153. The apparatus will now wait for the next user to come along.

As the 10th user deposits payment in the payment taker 35, closure of the switch 321 will trigger the multivibrator 323 to produce a TAKE pulse as before. That will open the shutter, with the flip-flop F3 still in its set state and producing the ACCEPT signal. When the shutter 87 is fully open, the switch 301 will close.

Closure of the switch 301 will cause the multivibrator 299 to produce the 10th COUNT pulse. That will advance the counter to count 10, and the gate 297 will now produce the signal labelled C10. The strobe units SR1, SR2 and SR3 will be triggered to make the 10th exposure.

When the shutter blade 87 closes, closing of the switch 331 will trigger the multivibrator 333 to set the flip-flop F1 through the gate 303 as before. The motor 153 will be run to eject and process the tenth film unit, until the bell crank 281 closes the switch 293 at the end of the eject and process cycle. That will trigger the multivibrator 355 to produce a STOP pulse as before, resetting the flip-flop F1.

At the same time, the gate 353 will respond to the stop pulse in the presence of the signal C10 to cause the gate 349 to produce a signal labelled CHANGE. The CHANGE signal will set the flip-flop F4, causing it to produce the DROP signal. The DROP signal will reset

the flip-flop F3 through the gate 317, causing the level ACCEPT to be removed and the level RETURN to be present, disabling the payment taker 35.

The DROP signal will also close the switch 345 to energize the solenoid 171 and drop the bed 165 to cause the empty cassette housing to be ejected. As the bed returns to the upper position, the switch 341 will be closed to trigger the multivibrator 343 to produce the UP pulse. Since there is not now a cassette in the camera, the switch 159 will be in the position shown in FIG. 9 in which the level CASSETTE will be produced to enable the gate 309. The gate 309 will now respond to the UP pulse by setting the flip-flop F2 to produce the signal INSERT. That will close the switch 315 and cause the motor 49 to go through the cassette changing cycle, described above, causing a new cassette to be inserted from the hopper 51 into the camera 53.

As before, the EJECT pulse produced at the end of the cassette changing cycle will cause the gate 335 to set the flip-flop F1 through the gate 303, because the cassette is now in the camera and a switch 159 engages its upper contact as shown in FIG. 9. That will result in the dark slide ejection cycle first described above.

The DOWN signal produced when the first cassette was ejected by lowering the bed 165 caused the gate 351 to produce a RESET pulse, the pertinent effect of which at this point in the operation is to reset the counter 295 to count 0. It again begins to count 10 for the film units of the second cassette as they are exposed.

When the last of the set of cassettes supplied to the hopper 51 has been loaded into the camera 53 and ejected as described above, the motor 49 will be run through a changing cycle as before, but no cassette will be loaded into the camera because none is in the hopper. When the EJECT pulse is produced by the multivibrator 313 at the end of this changing cycle, without a cassette in the camera, the gate 335 will not respond. The apparatus will then remain in the state first described above, with the flip-flops F1, F2, F3 and F4 reset and the counter at count 0, until a new stack of cassettes 105 is loaded into the hopper 51 and the pushbutton SPB is again momentarily depressed.

It will be apparent that the system is quite flexible in the film unit inventory required for operation. Any number of cassettes 105 can be loaded into the bin 51 within the limits of the capacity of the bin. Thus, the bin 51 may accommodate enough cassettes for the most extensive use intended between visits by the attendant, and yet loaded with only one or a few cassettes for use in less frequently patronized installations, or during periods when lower use is anticipated. The number of film units in each cassette can also be modified, simply by changing the code at which the counter 295 actuates the gate 297 to produce the signal equivalent to the signal C10.

While the invention has been described with reference to the details of a particular embodiment, many changes and variations will occur to those skilled in the art upon reading this description. Such can obviously be made without departing from the scope of the invention.

Having thus described the invention, what is claimed is:

1. A photostudio, comprising a first housing, wall means dividing said first housing into a studio compartment and an apparatus compartment, means forming

an entrance aperture in said wall means through which a subject in said studio compartment can be seen from said apparatus compartment, a camera mounted in said apparatus compartment, said camera comprising a second housing, means forming a receptacle in said second housing adapted to receive a cassette containing a stack of film units, means forming a rectangular framing aperture in a first side of said receptacle to facilitate the exposure of a film unit in a cassette in said receptacle, means forming an opening in a second side of said receptacle opposite said first side to admit a cassette into said receptacle, bed means adapted to close said opening, means mounting said bed means adjacent said housing for movement between a first position closing said opening to hold a cassette in said receptacle and a second position removed from said opening sufficiently to allow a cassette to be inserted in or removed from said receptacle, resilient means biasing said bed means toward its first position, optical means mounted in said second housing and confronting said entrance aperture for focusing an image of a subject in said studio compartment through said framing aperture onto a film unit in a cassette in said receptacle, said optical means comprising shutter means operable to expose a film unit in a cassette in said receptacle, means mounted in said second housing and responsive to the operation of said shutter means for ejecting and processing the exposed film unit, magazine means for containing a stack of cassettes containing film units, means for detecting the absence of a film unit in a cassette in said receptacle, electromagnetic means connected to said bed means and responsive to said detecting means for moving said bed means to its second position to remove a cassette from said receptacle when the last film unit in that cassette has been exposed and ejected, and reciprocating means controlled by said detecting means for moving a cassette from said magazine means into engagement with said bed means to move said bed means toward its first position and thereby load the cassette into said receptacle when a cassette has been ejected by said electromagnetic means.

2. The apparatus of claim 1, further comprising illuminating means mounted in said studio compartment and responsive to an applied signal to produce light illuminating a subject in said studio compartment, and control means responsive to the operation of said shutter means for applying a signal to said illuminating means.

3. The apparatus of claim 2, in which said illuminating means comprises a set of strobe lights each responsive to an applied trigger signal to produce an illuminating flash of light, and in which said control means comprises synchronizing means operative when a film unit is exposed by said shutter means for simultaneously applying a trigger signal to each of said strobe lights.

4. The apparatus of claim 1, further comprising

means forming an exit slot from said apparatus compartment in said wall means, and means mounted in said apparatus compartment for conveying a film unit ejected from said second housing to said exit slot.

5. The apparatus of claim 1, in which said means for ejecting and processing film units comprises a pair of spread rolls journaled for rotation in said housing about adjacent axes and adapted to compress and advance a film unit presented between them when a first of said rolls is rotated in a predetermined sense, motor means mounted in said housing and connected to said first roll to rotate it in said predetermined sense when energized, and means responsive to the operation of said shutter means for advancing a film unit exposed by said shutter means to said rolls while energizing said motor means.

6. Cassette changing apparatus for a camera having a cassette receiving receptacle comprising a top wall in which a rectangular framing aperture is formed and side walls forming a guide to direct a cassette into registry with said framing aperture to facilitate the exposure of a film unit in the cassette, said receptacle being open at the bottom to admit a cassette, bed plate means adapted to close said receptacle at the bottom and hold a cassette in said receptacle in registry with said framing aperture, hinge means mounting said bed plate means adjacent said camera for movement between a first position closing said receptacle at the bottom and a second position removed from said receptacle by an amount sufficient to permit a cassette in said receptacle to fall out and slide over said bed means for disposal, spring means urging said bed means into its first position, electromagnetic means connected to said bed means and energizable to move said bed means into its second position against the force of said spring means, means forming a magazine for guiding and containing a vertical stack of cassettes adjacent said bed means, means forming opposed slots in said magazine means through which the lowermost cassette in the stack in said magazine means can be driven into engagement with said bed plate means, reciprocating means operable to enter one of said slots and drive the lowermost cassette in a stack in said magazine into engagement with said bed plate means, said bed plate means being responsive to engagement by a cassette driven by said reciprocating means to move toward said second position and admit the cassette to said receptacle when said receptacle is empty, means responsive to an applied signal for energizing said electromagnetic means to move said bed plate means to its second position and thereby cause a cassette in said receptacle to fall out for disposal, and means responsive to the movement of said bed plate means to its second position for operating said reciprocating means to load a cassette from said magazine into said receptacle.

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