June 5, 1951 G. N. BUMSTEAD 2,555,631

BOX FOR SENSITIZED MEDIUM USED IN PHOTOGRAPHIC REPRODUCTION

Filed April 19, 1948 5 Sheets-Sheet 1

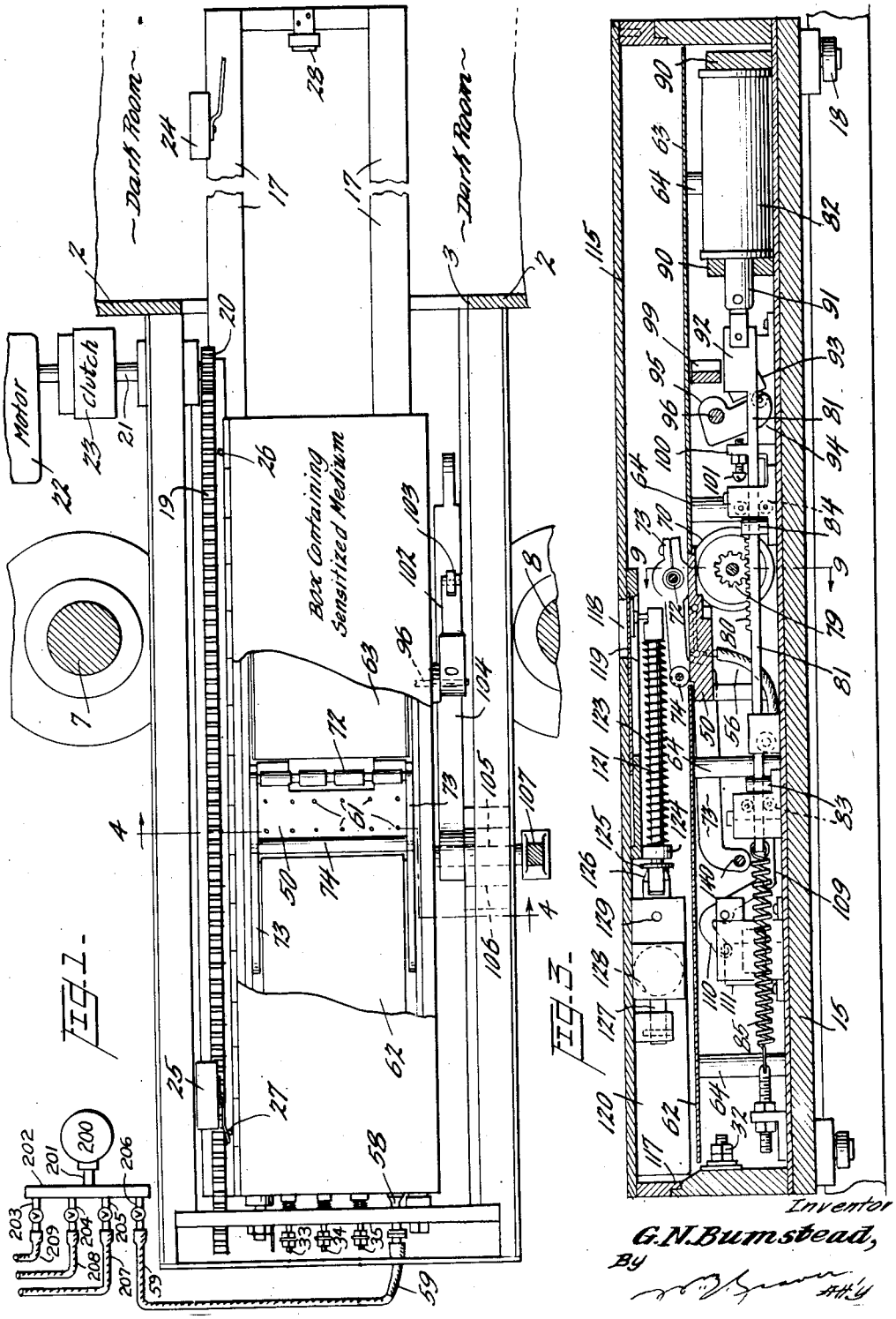


FIG. 1.

FIG. 3.

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BOX FOR SENSITIZED MEDIUM USED IN PHOTOGRAPHIC REPRODUCTION

Filed April 19, 1948 5 Sheets-Sheet 2

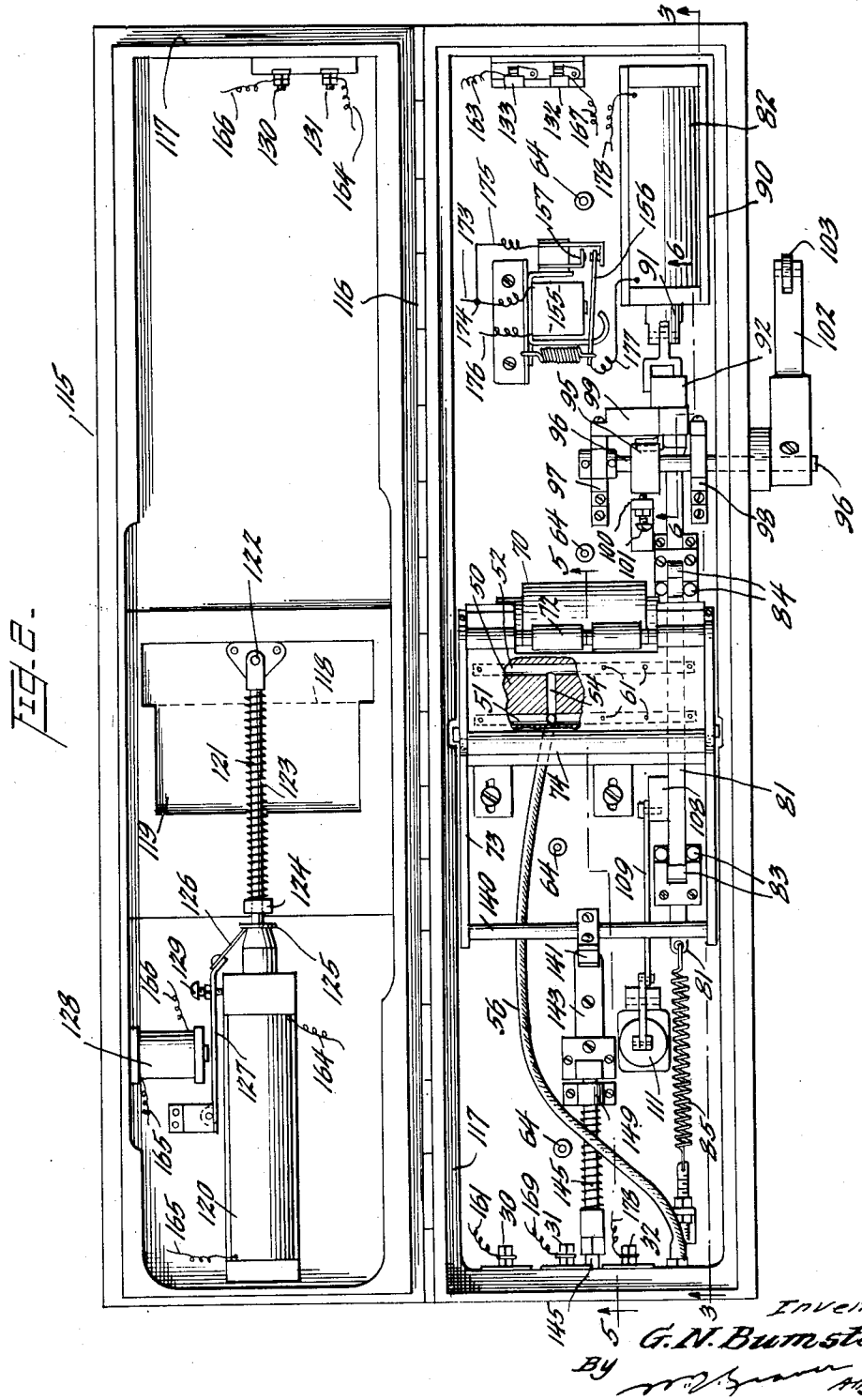


FIG. 2.

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BOX FOR SENSITIZED MEDIUM USED IN PHOTOGRAPHIC REPRODUCTION

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FIG. 4.

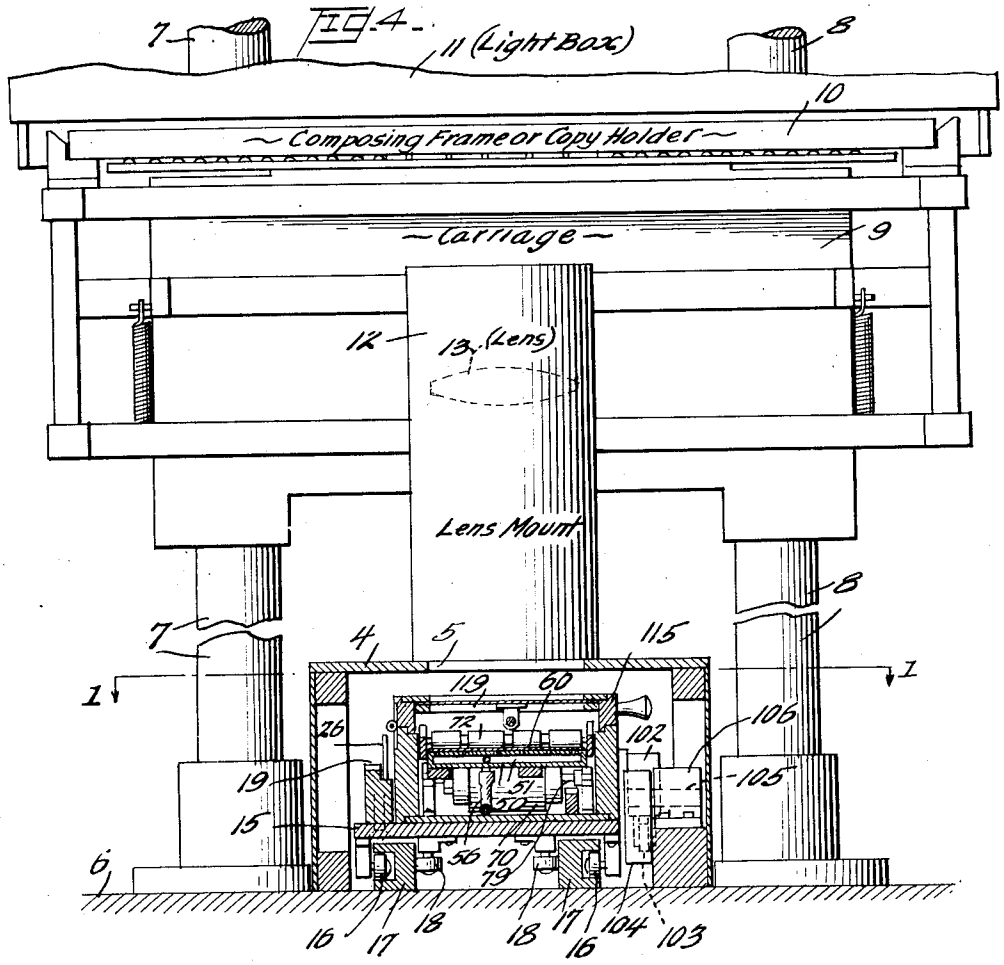
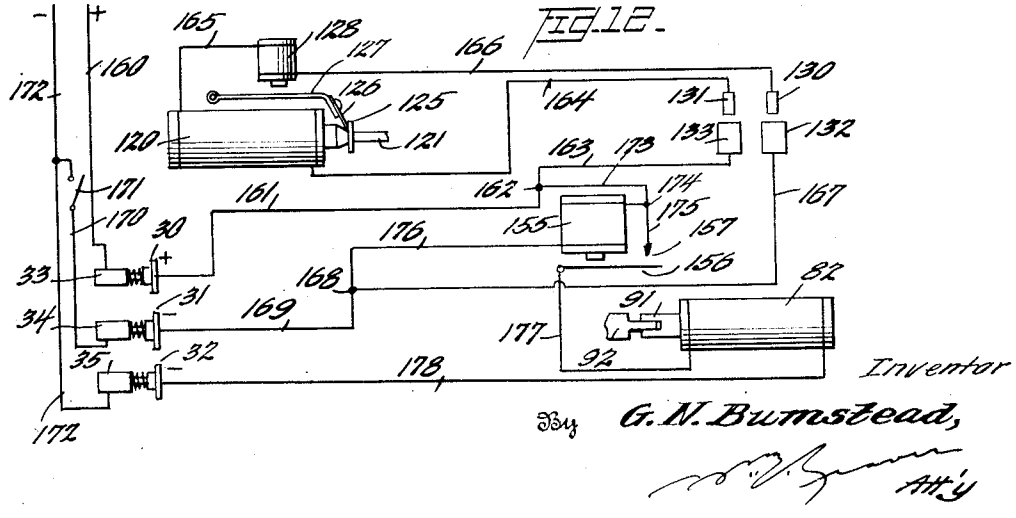


FIG. 12.



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BOX FOR SENSITIZED MEDIUM USED IN PHOTOGRAPHIC REPRODUCTION

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FIG. 5.

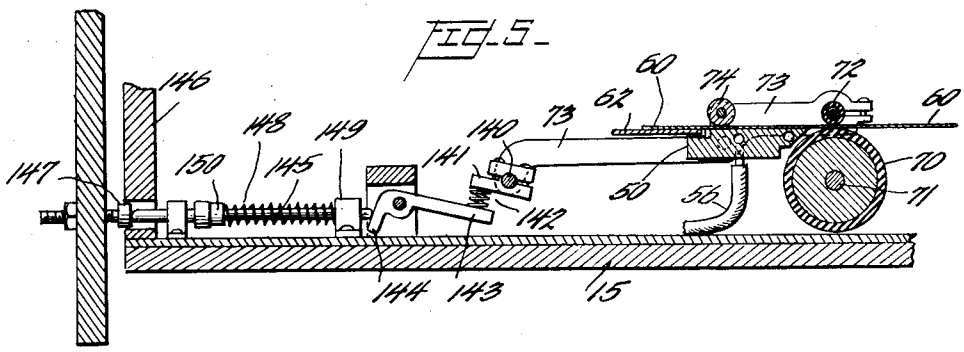


FIG. 6.

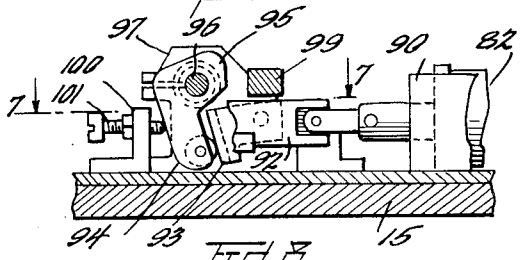


FIG. 7.

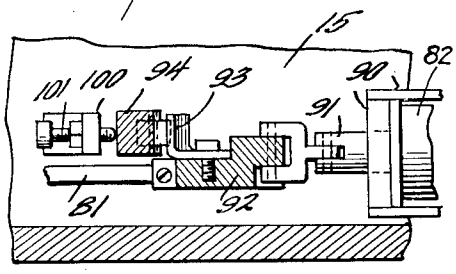


FIG. 8.

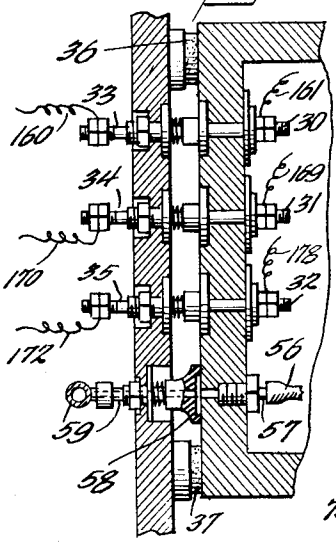


FIG. 9.

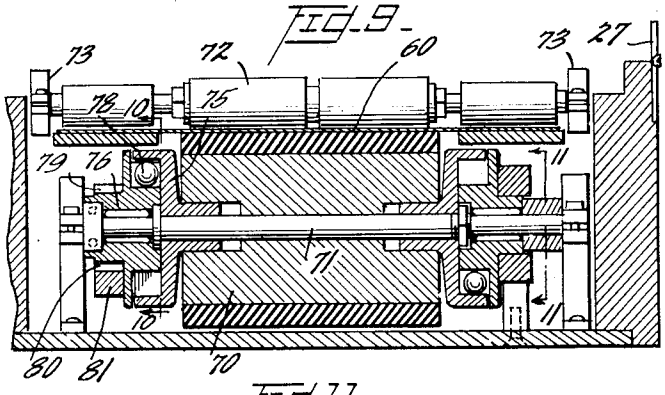


FIG. 10.

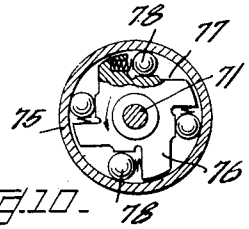
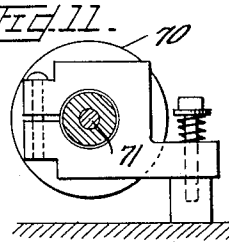


FIG. 11.



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BOX FOR SENSITIZED MEDIUM USED IN PHOTOGRAPHIC REPRODUCTION

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FIG. 13.

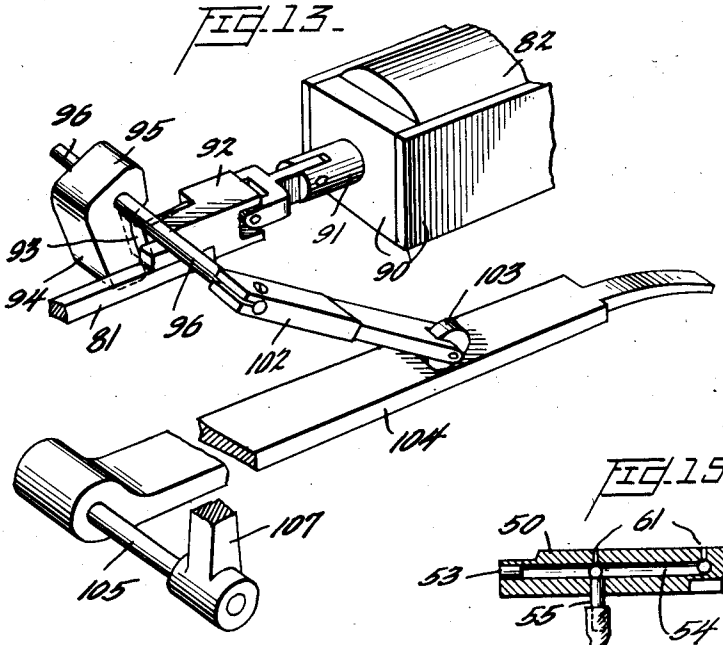
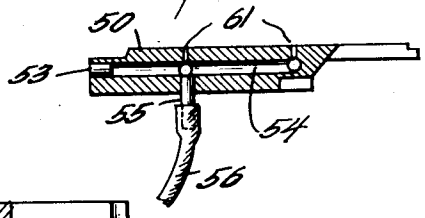


FIG. 15.



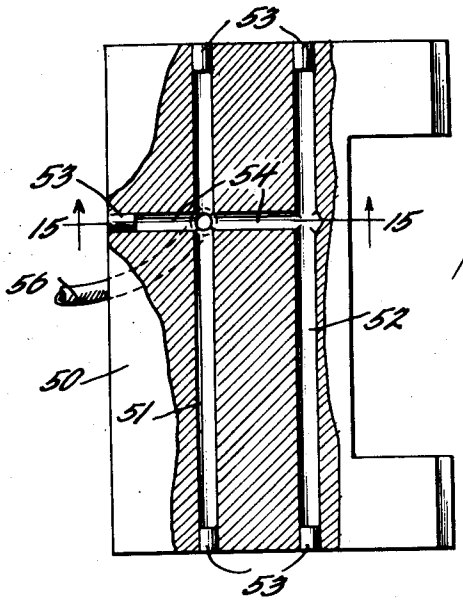


FIG. 14.

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Patented June 5, 1951 2,555,631

UNITED STATES PATENT OFFICE

2,555,631

BOX FOR SENSITIZED MEDIUM USED IN PHOTOGRAPHIC REPRODUCTION

George Newman Bumstead, Bethesda, Md., assignor to National Geographic Society, a corporation of the District of Columbia

Application April 19, 1948, Serial No. 21,994

15 Claims. (Cl. 88—24)

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This invention has to deal with cameras for photographic reproduction, and more specifically to a box for containing the sensitized medium upon which the photographic reproduction is made, the invention having for its object to provide such a box and operating mechanism associated therewith, all of which is more efficient in use than those heretofore proposed.

According to this invention a box is provided having a shuttered opening through which an image of an object is transmitted by light rays, and beneath which opening a strip of sensitized medium may be moved in successive steps to receive a plurality of images sequentially, said strip being held under pneumatic pressure at the area where each image is received thereon.

Another object of the invention is to provide a feeding means for the strip of sensitized medium, which means is automatically controlled by the desired size of the reproduced image.

A still further object of the invention is to provide means whereby the box may be moved from a dark room to a position where the shuttered opening thereof is in alignment with the image being projected, as well as moved reversely back into the dark room when the strip of sensitized medium has received all of the projected images that it is capable of holding.

With these and other objects in view the invention resides in the novel details of construction and combinations of parts as will be disclosed more fully hereinafter and particularly pointed out by the claims.

Referring to the accompanying drawings forming a part of this specification and in which like numerals designate like parts in all the views,

Fig. 1 is a horizontal plan view of the box and its support, said view being taken as on the line 1—1 of Fig. 4 and looking in the direction of the arrows, said view having parts broken away for a better understanding of the assemblage;

Fig. 2 is a view of the box with the hinged cover thereof in full opened position to show the interior mechanism of the box as well as the shutter mechanism associated with the cover of the box;

Fig. 3 is a vertical sectional view taken through the box as on the line 3—3 of Fig. 2 and looking in the direction of the arrows;

Fig. 4 is a vertical sectional view of the box and its mounting with respect to the camera, said view being taken as on the line 4—4 of Fig. 1 and looking in the direction of the arrows;

Fig. 5 is a vertical sectional view of a portion of the feeding means for the sensitized medium,

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said view being taken as on the line 5—5 of Fig. 2 and looking in the direction of the arrows;

Fig. 6 is a vertical sectional view of another portion of the feeding means for the sensitized medium, said view being taken as on the line 6—6 of Fig. 2 and looking in the direction of the arrows;

Fig. 7 is a horizontal sectional view of the parts illustrated in Fig. 6, said view being taken as on the line 7—7 of said Fig. 6 and looking in the direction of the arrows;

Fig. 8 is an enlarged horizontal sectional view illustrating the mounting of the electrical and pneumatic connections used with reference to the movement of the sensitized medium and its exposure within the box;

Fig. 9 is an enlarged vertical sectional view through the feed roller for the sensitized medium, said view being taken as on the line 9—9 of Fig. 3 and looking in the direction of the arrows;

Fig. 10 is a vertical sectional view of one of the clutch devices used in connection with the feed roller for the sensitized medium, said view being taken as on the line 10—10 of Fig. 9 and looking in the direction of the arrows;

Fig. 11 is a vertical sectional view illustrating the mounting of one end of the shaft of said feed roller, said view being taken as on the line 11—11 of Fig. 9 and looking in the direction of the arrows;

Fig. 12 is a wiring diagram of the electrical connections for motivating the box shutter as well as the feeding means for the sensitized medium;

Fig. 13 is a perspective detail view illustrating the means for automatically controlling the amount of movement of the strip of sensitized medium in accordance with the size of the photographic reproduction of the image;

Fig. 14 is an enlarged detail view, with parts broken away, of the pneumatic chamber employed for holding the strip of sensitized medium in a fixed horizontal plane at the time of receiving the projected image thereon; and

Fig. 15 is a vertical sectional view through the pneumatic chamber, said view being taken as on the line 15—15 of Fig. 14 and looking in the direction of the arrows.

The numeral 2 indicates a vertical wall of a dark room, said wall having the opening 3 therein through which the box may be horizontally reciprocated, said wall having a chamber attached thereto and in registry with said opening, into which chamber the box is moved from the dark room to a position where the shuttered opening

of said box is in alignment with a beam of light carrying the projected image and, after the sensitized medium within the box has received the projected images, the box is reversely moved from said chamber back into the dark room for removal of the exposed medium (see Fig. 1). This chamber comprises walls which are light-proof with the exception of the top wall 4 which has the opening 5 therein (see Fig. 4) through which the light beam and the projected image may pass to the shuttered opening of said box. This chamber is of course exterior with respect to the dark room and may have for its bottom wall the support 6 for the camera which likewise is exterior of the dark room.

In Fig. 4 the camera is more or less diagrammatically illustrated as comprising the standards 7 and 8 secured to and rising from the camera support 6, a carriage generally identified by the numeral 9 slidably mounted on said standards, a composing frame generally identified by the numeral 10 supported on said carriage and containing the copy or image to be photographically reproduced, a light box (source of light) generally identified by the numeral 11 attached to and movable with said carriage and disposed above the composing frame, and a lens mounting generally identified by the numeral 12 and carried by the top wall 4 of said chamber. The camera constitutes the subject matter of my separate application for Letters Patent filed December 31, 1948, under the Serial No. 63,566; the composing frame constitutes the subject matter of my separate application for Letters Patent filed January 15, 1948, under the Serial No. 2,532, now Patent No. 2,495,887, issued January 31, 1950.

The lens mounting comprises a shield (preferably cylindrical) within which is disposed the lens 13, said lens, said shield and said opening 5 having a substantially common vertical axis upon which the copy matter (image) in the composing frame is substantially centered. The carriage is vertically adjustable on said standards, and the lens is vertically adjustable within its shield, such adjustability of both carriage and lens being with respect to the fixed horizontal plane of the sensitized medium in the box, whereby the desired size of photographic reproduction may be had.

The box has a base 15 (see Fig. 4) to which are secured a plurality of rollers such as 16 riding on a fixed horizontal track such as 17 secured to the camera support 6 whereby the box may be rolled into and out of the dark room, guide rollers such as 18 also being provided and bearing upon vertical sides of said track to prevent sidewise motion of said box. The base of the box also carries a horizontal rack 19 engaged by a pinion 20 mounted upon a shaft 21 having a bearing in a side wall of the box chamber (see Fig. 1), said shaft receiving rotation by any suitable means such for example as a reversible motor 22 operating said shaft through a clutch 23.

It thus results that when the motor is energized the pinion 20 will cause the box to be moved in one direction (as into the dark room) and when the motor is reversely energized the box will be caused to move in the opposite direction. Any suitable limit switches such as indicated at 24 and 25 may be positioned to be engaged by pins 26 and 27 carried by the box and/or rack, when said box reaches the limits of its reciprocation, and the motor may be energized in any suitable manner as through the actuation of circuit closers. A bumper 28 may be provided at one end if necessary.

The box as best seen in Fig. 8 has mounted in the end wall thereof a plurality of spaced electrical contact pins 30, 31 and 32 extending through said wall and adapted to make electrical connection with companion contact pins 33, 34 and 35 respectively when the box is moved outwardly of the dark room and to the limit of its movement in the box chamber, bumpers 36 and 37 being provided if necessary to cushion the box at the limit of this movement. The electrical connection between the companion pairs of contact pins may be made yieldable if desired by the provision of a coil spring around a pin in each pair of contacts as shown.

Spaced above the floor of the box and suitably supported therefrom substantially midway the ends of the box, is a pneumatic chamber generally identified by the numeral 50 (see Figs. 2, 3, 14 and 15) and comprising preferably a solid block of material provided with a pair of parallel horizontal bores 51 and 52 extending transversely of the box, said bores having their ends tightly closed as by the plugs 53 indicated in Fig. 14. These bores are interconnected by a horizontal cross bore 54, all of said bores being in communication with each other and with a nipple 55 (see Fig. 15) connected by a pipe or hose 56 to another nipple 57 (see Fig. 8) passing through the end wall of the box, the external end of said latter nipple adapted to register with a yieldable cup-like member 58 carried at the extremity of a pipe line generally identified by the numeral 59 leading to a suitable source of negative pneumatic pressure (vacuum) whereby suction may be produced in the pneumatic chamber 50 when the box is at the limit of its travel in the direction away from the dark room.

The upper surface of this pneumatic chamber is disposed in a horizontal plane which is the fixed plane of travel of the sensitized medium 60 (see Figs. 5 and 9) and the bores 51 and 52 communicate with the air in the box by virtue of perforations 61 (see Figs. 1, 2, 3 and 15), so that when said medium is fed over said surface, the suction just described will hold said medium in contact with said surface. This suction area is disposed immediately beneath the shuttered opening provided in the cover of the box.

Also disposed in the horizontal plane of the pneumatic chamber surface just described, are two plates 62 and 63 extending in opposite directions from said chamber and suitably supported at their edges in the box to provide a continuous travel surface for the sensitized medium, posts such as 64 being provided if necessary to support the central portions of said plates. Preferably the sensitized medium is photographic film in strip form of a length to extend from an end of the box to and over the suction area of the centrally disposed pneumatic chamber whereby, when said medium is in the left end of the box as seen in Fig. 3, the right hand end of said medium will be disposed in the suction area below the shuttered opening and ready for receiving the first projected image through said opening, and when said medium is in the right end of the box the left hand end of said medium will be disposed in said suction area and ready for receiving the last projected image through said opening. After receiving the last image the box may be moved into the dark room, opened, and the exposed medium removed therefrom.

The feeding means for the sensitized medium or film comprises a main feed roller 70 (see Figs. 2, 3, 9, 10 and 11) mounted upon a horizontal shaft 71 having suitable bearings supported by the box, the roller so mounted as to be below and tangent to the fixed horizontal plane of film travel so as to bear upon on contact the under surface of said film. A companion pressure roller 72 is provided above the roller 70 for contacting the upper surface of said film, said pressure roller 72 being journalled in a bracket 73. A parallel pressure roller 74 (see Fig. 5), freely mounted at its ends in vertical slots in the said bracket so as to function solely under the urge of gravity, operates also on the upper surface of the film, the two pressure rollers being spaced apart on opposite sides of the suction area just described.

The main feed roller 70 has a clutch mechanism at each of its ends, which clutch may be of any suitable type, whereby rotation in one direction only may be given to said roller through one of the clutches, retrograde or reverse rotation of said roller being prevented by the other of the clutches; that is to say the clutches are opposite in their function though they may be of similar construction. In Figs. 9 and 10 simple clutches are shown comprising a drum 75 rigid with the roller, and an actuating member 76 loosely mounted on roller shaft 71 and having cam surfaces such as 77 for pinching a roller or ball 78 between the members 75 and 76 when the latter is given rotation. The balls 78 of each clutch may be spring pressed as indicated in Fig. 10 to urge them into pinching engagement between the members 75 and 76, and the clearance of said balls between the cam surfaces and the inner surface of said drum is almost negligible so as to make the action of the clutches substantially instantaneous and thereby minimize and/or make impossible any reverse unwanted rotation of the main feed roller. The portion of the actuating member 76 exterior of said drum is formed as a pinion 79 for engagement with a rack 80 carried by a horizontally reciprocable bar 81 motivated in one direction by an electrical solenoid generally identified by the numeral 82 (see Figs. 6 and 7).

The bar 81 passes between two sets of vertically and horizontally spaced guide rollers, said sets indicated generally by the numerals 83 and 84 (see Figs. 2 and 3) for preventing vertical and lateral movement of said bar. The extremity of said bar (opposite the end thereof which is connected to the solenoid) is connected to one end of a coil spring 85 which exerts a pressure capable of moving said bar in a direction away from said solenoid thereby causing the pinion 79 to actuate its clutch member 76 to rotate the main feed roller 70 to feed the film to the right as seen in Fig. 3, the opposite clutch slipping in this movement.

When however the solenoid 82 is energized, its core (connected to the other end of said bar) will exert a pull on said bar, overcoming the tension of said spring 85 and moving said bar in the opposite direction, in this movement said clutch member 76 slipping and the opposite clutch holding said roller 70, whereby said roller will not rotate but will hold the advanced film in the position to which it was just moved due to the contact of said film with both the main feed roller 70 and the superposed pressure roller 72.

The action of the solenoid therefore is to "cock" or set said bar 81 in its extreme right hand limit of reciprocation whereby the desired amount of feed may be given to the film when said bar is reversely moved by the spring 85. The length of horizontal movement imparted to said bar by said spring is controlled in accordance with the desired size of the image being reproduced, as will now be described.

With particular reference to Figs. 3, 6 and 7, it will be seen that the solenoid 82 is suitably secured in the bottom of the box as by the fence or walls 90, and that the outer extremity of the solenoid core 91 is connected to an end of bar 81 by the coupling 92 which latter has a lateral extension 93 adapted to contact one face of a depending lug 94 of a collar 95 rigidly mounted upon a horizontal rock shaft 96 supported in bearings 97 and 98 interconnected by brace 99 and secured to the floor 15 of the box. Also secured to said floor is a bracket 100 threadedly receiving the screw 101 manually adjustable in said bracket and adapted to contact the opposite face of lug 94 for limiting the rocking movement thereof in one direction.

The rock shaft 96 is extended through a wall of the box (see Figs. 1, 2 and 13) and to its outer end is secured a crank 102 the free end of which carries a roller 103 adapted to engage the upper surface of a cam arm 104 rigidly mounted upon the inner end of a horizontal rock shaft 105 journalled in the bearing 106 carried by a side wall of the chamber constituting the extension of the dark room and into which the box is reciprocated, the crank 102 and the cam arm 104 occupying the space between said box wall and said chamber wall. To the outer end of the rock shaft 105, outside of said chamber, is rigidly secured the lower end of a vertical crank 107 whose upper end (not shown) is adapted to be operated in any suitable manner to rock the shaft 105 and thus position the cam arm 104 to give the desired "throw" of crank 102 which through rock shaft 96 moves lug 94 to a position controlling the amount of horizontal movement of rack bar 81. Preferably, the upper end of vertical crank 107 is controlled by a cam associated with the vertically slidable carriage 9 of the camera as disclosed in said application Serial No. 68,566, whereby the movement of said vertical crank is automatically controlled by the position to which said carriage is moved (for focusing purposes), and this is in accordance with the desired size of the reproduced image, but obviously the vertical crank could be moved or adjusted manually.

Thus it will be understood that if small reproduction is desired, the film feed will be in short sequential steps governed by a corresponding short pull of bar 81 by its control spring 85 (due to cam arm 104 being elevated). On the other hand if large reproduction is desired, the film feed will be in long sequential steps governed by a corresponding long pull of bar 81 due to cam arm 104 being lowered. To prevent too quick a pull on bar 81 by its spring 85, said bar is provided with a lateral extension 108 to which is pivoted one end of a link 109 the other end of which has pivotal connection with a lever 110 controlled by any retarding device such as the dashpot indicated at 111 and secured to the floor of the box (see Figs. 2 and 3). The manually adjustable screw 101 is provided on the side of safety, to contact depending lug 94 and thus prevent crank 102 "dropping"

when it rides off of cam arm 104 as when the box is rolled back into the dark room.

The lid 115 as best seen in Figs. 2 and 3 is mounted on the box in light-tight relation as by the "piano" type hinge 116 and the rabbeted interfitting edges 117. A shutter opening 118 is provided in said lid at such a position as to be in registry with the light rays passed by the lens 13 from the light box 11, said opening preferably being rectangular and of such area as to make possible the largest reproduction on the sensitized medium of which the camera is capable of making, said opening adapted to be opened and closed by virtue of the shutter 119 slidable in suitable guides carried by the lid. Movement of the shutter is effected by a solenoid 120 rigidly secured to the under surface of said lid, the outer extremity of the core of said solenoid having a coaxial extension comprising the rod 121 whose far end is connected to the under surface of said shutter as at 122, wherefore when the solenoid is energized the shutter will be moved to uncover the shutter opening 118.

The rod 121 is encircled by a coil spring 123 operating at one end against a fixed abutment 124 to exert a pressure tending to move said rod to the right as seen in Fig. 3 and thereby move said shutter to its closed position, the tension of said spring being such as to be overcome by the action of the solenoid when energized. On the side of safety said rod is provided with a collar 125 forming one member of a latch device for holding the shutter in closed position, the other member of said latch comprising a detent 126 carried at the free end of an armature 127 of an electromagnet 128 mounted on the under surface of said lid, said armature being adjustable as by the set screw 129 to provide the proper amount of engagement of said detent with said collar. The electromagnet 128 may be connected in the same electric circuit with the solenoid 120 so that the armature 127 will be attracted and move the detent 126 from its normal position behind the collar 125 so that the shutter will be opened by the action of said solenoid. Electric current is supplied to the electromagnet and the solenoid through the provision of contact members 130 and 131 carried by the lid and which are engageable (when the lid is closed) respectively with companion contacts 132 and 133 carried by the bottom portion of the box.

With particular reference to Figs. 2 and 5 there is illustrated a means for maintaining contact between the sensitive medium or film and the means for feeding said film past the shutter. As heretofore described there is provided a bracket 73 carrying the pressure rollers 72 and 74 under which the film 60 feeds. One end of said bracket has a cross bar 140 carrying a lug 141 against which is disposed one end of a coil spring 142 the other end of which bears against one end 143 of a bell crank the other end 144 of which is adapted to receive the thrust of a horizontally disposed rod 145 the other end of which extends into or through the front wall 146 of the film box in alignment with and adapted to contact with a pin 147 mounted in the front wall of the chamber in which said box reciprocates, a coil spring 148 encircling said rod between a fixed abutment 149 and a collar 150 carried by said rod. It thus results that after the film has been placed in the box and the box has been moved to the limit of its travel out of the dark room, contact will be made between the pin 147 and the rod 145 to move the latter against the tension of its spring, to the right as seen in Fig. 5, thus oscillating the bell crank and in turn pivotally moving the bracket 73 to bring the upper pressure roller 72 into contact with the film and pressing the film against the main feed roll 70, the spring 142 constituting a yieldable connection whereby undue pressure on the film is prevented. With the film thus "pinched" between rollers 70 and 72, the film will be subsequently fed in sequential steps upon actuation of the main feed roller 70 as heretofore described, without damage to the film by virtue of said yieldable connection. When the box is moved back into the dark room, pin 147 will no longer control rod 145 whereupon its spring will move it axially to the left as seen in Fig. 5, thus releasing the bracket 73 from said control and permitting the pressure roller 72 to rise from out of contact with the film, whereupon said film may be abstracted from the box without impairment of its surface.

With specific reference to Figs. 2 and 12, means are disclosed for delaying the deenergization of the film control solenoid 82 until after the shutter has moved to closed position. This means comprises a time delay relay 155 provided with the armature 156 and a front contact 157. Said relay is of conventional construction and designed to give a sufficient time delay in the release of its armature to permit the closing of the shutter before the release or opening of the circuit energizing the solenoid, all as will be made clear from the following description of the wiring diagram illustrated in Fig. 12.

Current from a suitable source is constantly supplied over wire 160 to the pair of contacts 33—33 and thence over wire 161 to the point 162 where the current divides, one portion thereof passing over wire 163 to the pair of contacts 133—131 thence over wire 164 to and through the coil of solenoid 120 controlling the shutter, thence over wire 165 to and through the electromagnet 128, over the wire 166 to the companion pair of contacts 130—132, thence over wire 167 to the point 168 thence over wire 169 to the pair of contacts 31—34, thence over wire 170 to one side of a switch 171, the other side of said switch being connected to wire 172 which conducts the current back to the source. At the point 162 the other portion of this current passes over wire 173 to the point 174 where it divides, one portion passing over wire 175 to the front contact 157 of the time delay relay 155, the other portion of said current passing to and through the coil of said relay and thence over wire 176 to point 168 and thence back to source over wires 169, 170, switch 171, and wire 172.

When the time delay relay is energized its armature 156 will be attracted to close with its front contact 157 whereupon current from wire 175 will then pass through said armature, over wire 177 to and through the solenoid 82 associated with the film feed mechanism, thence over wire 178 to and through a pair of contacts 32—35 and over wire 172 back to the source. It therefore results that when the switch 171 is closed current will be supplied to solenoids 82 and 120 as well as to the time delay relay 155 by virtue of the attraction of armature 156 of said relay, the solenoid 82 thereupon "cocking" the film feed rack bar 81 but not actuating the film feed roll 70 due to the slippage of its clutch 75—76. Simultaneously therewith the latch 125—126 is disengaged by the attraction of armature 127 of the electromagnet 128, whereupon the coincident

energization of solenoid 120 opens the shutter and the exposure of the film is made. The switch 171 is then opened thereby breaking the circuit through the shutter-opening solenoid 120 permitting the shutter to close and simultaneously breaking the circuit to relay 155. However, in spite of the open condition of said switch the time delay in coil 155 maintains contact between front contact 157 and armature 156, after switch 171 is opened, thus maintaining for approximately $\frac{1}{10}$ of a second, a flow of current through wires 160, 161, 173 and 175, solenoid 82, and wires 178 and 172 back to source, wherefore it will be understood that said film feed rack bar 81 is still maintained in its "cocked" position and will be so maintained until the relay releases its armature 156. At the end of the time delay period, the relay will release its armature and permit it to drop out of contact with its front contact 157 thereby breaking the circuit through solenoid 82, thereby permitting spring 85 to draw the film feed rack bar 81 in which movement the main feed roll 70 will be rotated by virtue of the engagement of its clutch 75—76, this accomplishing the feed of the film, but positively after the shutter has been closed. The film is then ready for its next exposure which is made by closing switch 171 whereupon the shutter is again opened by virtue of the circuits just described.

A pneumatic line for creating a vacuum in the film suction box 50 is diagrammatically illustrated in Fig. 1 from which it will be seen that hose 59 leads to a vacuum creating pump the cylinder of which is generally indentified by the numeral 200 and which is connected by the pipe 201 to a manifold 202 having a plurality of valved nipples such as 203, 204, 205 and 206, the hose 59 being connected for example to the nipple 206, the other nipples being connected as by the hoses 207, 208 and 209 leading to separate and different cameras, whereby a plurality of cameras may be simultaneously operated. In each nipple for example there is provided a bore having a diameter which is less than the diameter of the hose to which it is connected, said restricted diameter, relative to the power of the pump, being such as to maintain in the hose connection a vacuum equal for example to two inches of mercury when the hose connection to any camera is broken or opened as when a film box is moved from its exposure position back into the dark room. Consequently, when operating plural cameras, the such breaking or opening of one hose connection will not materially affect the vacuum pressure relative the other cameras. A control or cut-off valve (not shown but readily understood) may be provided in each hose connection and/or in the pipe 201.

It is obvious that those skilled in the art may vary the details of construction and arrangements of parts without departing from the spirit of this invention, wherefore it is desired not to be limited to the exact foregoing disclosure except as may be required by the claims.

What is claimed is:

1. For a camera, a film-containing box provided with an aperture through a wall thereof and a shutter movable to open and close said aperture, means for actuating said shutter to expose a portion of the film to the action of a light ray to obtain a photographic reproduction, means for feeding the film in said box in sequential steps past said aperture, said feeding means comprising a feed roller, a reciprocable member for imparting rotation thereto, and clutch mechanism mounted on said roller for making the such rotation effective in one direction only, said feeding means controlled by a time-delay element which is energized simultaneously with the shutter actuating means, and pivoted cam means for regulating the amount of the stepping movement of said feeding means in accordance with the size of photographic reproduction desired.

2. For a camera, a film-containing box provided with an aperture through a wall thereof and a shutter movable to open and close said aperture, means for actuating said shutter to expose a portion of the film to the action of a light ray to obtain a photographic reproduction, and means for feeding the film in said box in sequential steps past said aperture; said feeding means comprising a feed roller and a reciprocable member for imparting rotation thereto, a one-way clutch coupling said member to said feed roller, a spring for moving said reciprocating member in that direction which engages said one-way clutch, a solenoid for moving said member in the opposite direction to reset the same for its next operative movement, said solenoid controlled by a time-delay element which is energized simultaneously with the shutter-actuating means, and pivoted cam means for regulating the amount of the stepping movement of said feeding means in accordance with the size of photographic reproduction desired.

3. For a camera provided with a support, a focusable lens, a source of light and a copy holder adjustably mounted with respect to the focusable lens, the combination of a film-containing box adapted to receive an illumined image of the copy in the copy holder, said chamber provided with an aperture through a wall thereof and a shutter movable to open and close said aperture, means for actuating said shutter to expose a portion of the film to the action of the received image to obtain a photographic reproduction thereof of a size in accordance with the adjusted position of the copy holder and the focus of the lens, means for feeding the film in said box in sequential steps past said aperture, said feeding means controlled by a time-delay element which is energized simultaneously with the shutter actuating means, and cam means for regulating the amount of the stepping movement of said feeding means in accordance with the size of photographic reproduction as governed by the adjusted position of the copy holder, said cam means comprising a box-carried member and a companion member carried by the camera support.

4. For a camera, a film-containing box provided with an aperture through a wall thereof and a shutter movable to open and close said aperture, means for actuating said shutter to expose a portion of the film to the action of a light ray to obtain a photographic reproduction, means for feeding the film in said box in sequential steps past said aperture, said feeding means comprising a feed roller and clutch mechanism for permitting unidirectional rotation only thereof, said clutch mechanism comprising a clutch unit mounted on each end of said roller, one clutch unit being a drive unit for rotating said feed roller in one direction and the other clutch unit operating to hold said roller against retrograde movement, said feeding means controlled by a time-delay element which is energized simultaneously with the shutter actuating means, and means for regulating the amount of the stepping movement of said feeding means in

accordance with the size of photographic reproduction desired.

5. For a camera, a film-containing box provided with an aperture through a wall thereof and a shutter movable to open and close said aperture, means for actuating said shutter to expose a portion of the film to the action of a light ray to obtain a photographic reproduction, means for feeding the film in said box in sequential steps past said aperture, said feeding means comprising a feed roller carrying a rack gear, a reciprocable rack in engagement with said rack gear for imparting rotation thereto, a dashpot device for slowing the action of said member in its rotation imparting movement, and clutch mechanism for making the such rotation effective in one direction only, said feeding means controlled by a time-delay element which is energized simultaneously with the shutter actuating means, and means for regulating the amount of the stepping movement of said feeding means in accordance with the size of photographic reproduction desired.

6. For a camera provided with a support, a focusable lens, a copy holder and a source of light adjustably mounted with respect to the focusable lens, the copy holder and light source each being centered in the axis of the lens, the combination of a film-containing box provided with an aperture through a wall thereof and a shutter movable to open and close said aperture; means for moving said box to and from a position where the shuttered aperture is in registry with the lens axis; electrically responsive means for actuating said shutter to expose a portion of the film to the action of a ray from the light source; electrically controlled means for feeding the film in said box in sequential steps past said aperture and including a time-delay element which is energized simultaneously with the shutter actuating means; electrical connections including a source of current, a manually operable circuit closing device, and terminals stationarily mounted on the camera support; and electrical connections carried by said box and including terminals engageable with and disengageable from the terminals on the camera support when said chamber is moved respectively to and from the position of registry of the shuttered aperture with the lens axis, said last named connections for energizing the shutter actuating means and the time-delayed film feeding means upon operation of said circuit closing device.

7. For a camera provided with a support, a focusable lens and a source of light disposed on the axis of the lens, the combination of a film-containing box provided with an aperture through a wall thereof and a shutter movable to open and close said aperture; means for moving said box to and from a position where the shuttered aperture is in registry with the lens axis; electrically responsive means for actuating said shutter to expose a portion of the film to the action of a ray from the light source; electrically controlled means for feeding the film in said box in sequential steps past said aperture; a suction box over which the film is fed, said suction box in registry with said aperture and adapted to maintain the film in a fixed plane while being exposed; an air conduit leading from said box through, and openly terminating at the outer surface of, a wall of said film-containing box; a valved pipe line connected to a source of subatmospheric pressure and openly terminating on the camera support at a position to communicably register with said air conduit when said film-containing box is moved to establish registration of the shuttered aperture with the lens axis; electrical connections including a source of current, a manually operable circuit closing device, and terminals stationarily mounted on the camera support; and electrical connections carried by said film-containing box and including terminals engageable with and disengageable from the terminals on the camera support when said film-containing box is moved respectively to and from the position of registry of the shuttered aperture with the lens axis, said last named connections for energizing the shutter actuating means and the film feeding means upon operation of said circuit closing device.

8. For a camera provided with a support, a focusable lens and a source of light disposed on the axis of the lens, the combination of a film-containing box provided with an aperture through a wall thereof and a shutter movable to open and close said aperture; means for moving said box to and from a position where the shuttered aperture is in registry with the lens axis; electrically responsive means for actuating said shutter to expose a portion of the film to the action of a ray from the light source; electrically controlled means for feeding the film in said box in sequential steps past said aperture, said feeding means comprising a main feed roller and a superposed pressure roll between which the film passes, a pivotally mounted bracket carrying said pressure roll, means including a spring and a movable member carried by said box for movement between end positions in which it stresses or alternatively relieves the stress of said spring to adjust said bracket between end positions in which it is yieldingly pressed against a film on said feed roller or alternatively may move freely away from the film, and means carried by the camera support in position for engagement by said movable member to shift the same into said spring-stressing end position on movement of said box to locate said shuttered aperture on said lens axis; electrical connections including a source of current, a manually operable circuit closing device, and terminals stationarily mounted on the camera support; and electrical connections carried by said chamber and including terminals engageable with and disengageable from the terminals on the camera support when said chamber is moved respectively to and from the position of registry of the shuttered aperture with the lens axis, said last named connections for energizing the shutter actuating means and the film feeding means upon operation of said circuit closing device.

9. For use with a camera exterior to a dark room and including a light-tight chamber opening into said dark room, the camera including an object support and a lens for focusing an image of an object carried by said support upon a plane within said chamber; a film box having an aperture through one wall thereof, a shutter carried by said box and movable to open and close said aperture, solenoid means carried by said box for actuating said shutter, means for moving said box between an end position within said dark room into an alternative end position within said chamber to position a film carried by said box in the image plane of said camera, and a circuit for energizing said solenoid means; said circuit including a current source external to said box, and circuit elements for connecting said current source to said solenoid means, said circuit ele-

ments including cooperating sets of contact members carried respectively by said box and said chamber in positions for engagement upon movement of said box into end position within said chamber.

10. The invention as recited in claim 9, in combination with film-feed means within said box for advancing a film between successive exposures; said film-feed means including a feed roller, a solenoid having a reciprocating plunger, a spring for moving said plunger in one direction on de-energization of the solenoid, means actuated by said plunger and including a one-way clutch for imparting unidirectional rotation to said feed roller, and means for adjusting the length of reciprocation of said plunger, thereby to determine the amounts of film advance at each film-feeding operation; said last means comprising cooperating elements carried by said chamber and said box respectively in positions for operative engagement upon movement of said box into said end position within said chamber.

11. The invention as recited in claim 10, wherein said film-feed means includes an idler roller, a bracket carrying said idler roller and angularly adjustable to move said idler roller towards and away from said feed roller, and cooperating members carried respectively by said box and said chamber for moving said bracket angularly to press said idler roller into engagement with a film on said feed roller when the box is in said end position within said chamber.

12. The invention as recited in claim 10, in combination with circuit elements for connecting said current source to said solenoid; said circuit elements including said cooperating sets of contact members mounted respectively on said box and chamber.

13. The invention as recited in claim 10, wherein said one-way clutch drives said feed roller upon movement of said plunger by said spring, and said circuit elements include a delayed drop-out relay between said current source and said solenoid; in combination with spring means for closing the shutter on de-energization of said solenoid means; and wherein said circuit elements include a switch for simultaneously energizing said solenoid means and said relay from said current source, whereby said solenoid of the film-feed means remains energized for the time-delay interval of said relay upon the opening of said switch to deenergize said relay and said solenoid means which opens the shutter, thereby to delay a film-feed movement of said plunger by said spring until said shutter is closed by said spring means.

14. In a camera, a film box for holding a film upon which successive exposures may be made, a film-feed roller and a cooperating idler roller between which a film may be positioned, and electrically energized means within said box for actuating said film-feed roller; said means comprising a rack bar mounted for reciprocation, a one-way clutch connecting said rack bar to said feed roller and including a member provided with a pinion in mesh with said rack bar, a spring connected to said rack bar for moving the same in film-feeding direction, a solenoid having an armature plunger connected to said rack bar for moving the same in the opposite direction, and a feed-adjusting means including an arm at the exterior of the box and cam means adjustable angularly to limit movement of said rack bar by said spring for determining the extent of the rotation of said film-feed roller at an actuation of the same.

15. In a camera, the invention as recited in claim 14, wherein said film box includes a flat plate for supporting a film, said plate having openings in the film-supporting surface thereof, and means for reducing the pressure at said opening to sub-atmospheric to maintain a film in close surface engagement with said flat plate.

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