

A. WOLLENSAK.
 PHOTOGRAPHIC SHUTTER.
 APPLICATION FILED MAY 27, 1912.

1,035,762.

Patented Aug. 13, 1912.

4 SHEETS—SHEET 1.

Fig.1.

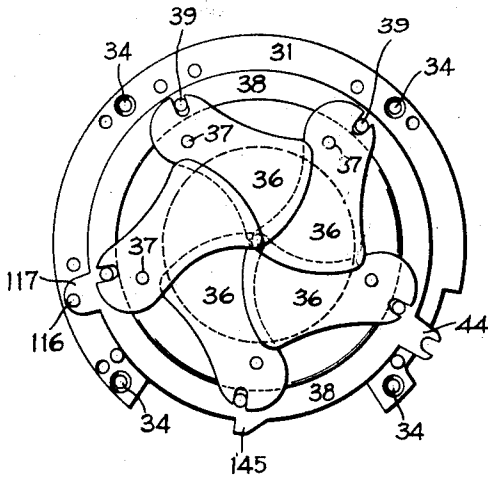


Fig.2.

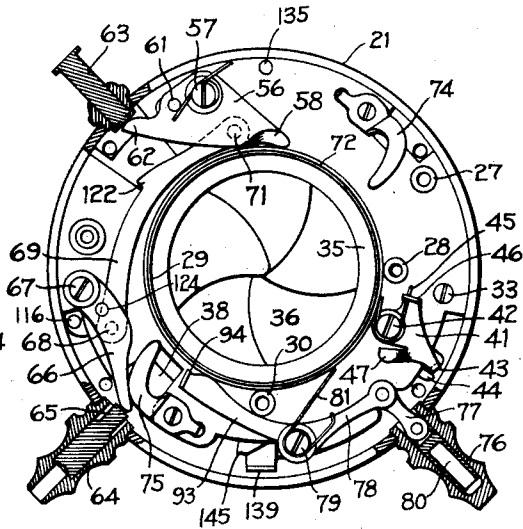


Fig.3.

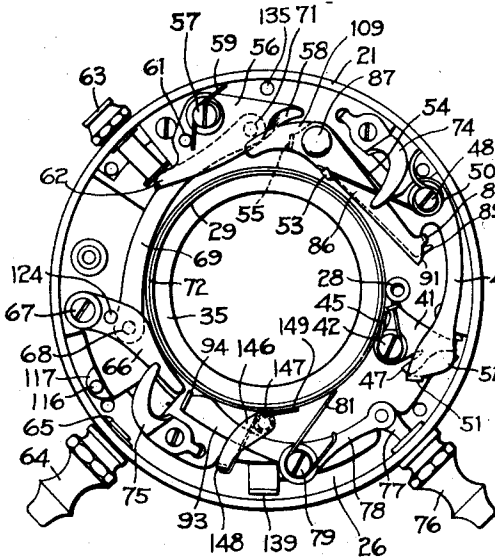
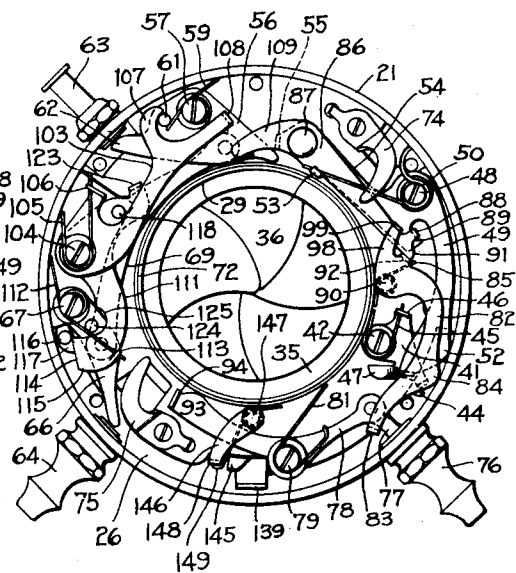


Fig.4.



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4 SHEETS—SHEET 2.

Fig. 5.

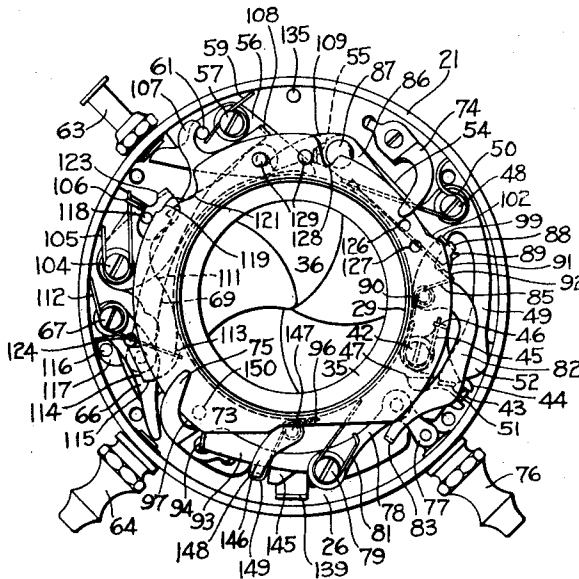


Fig. 7.

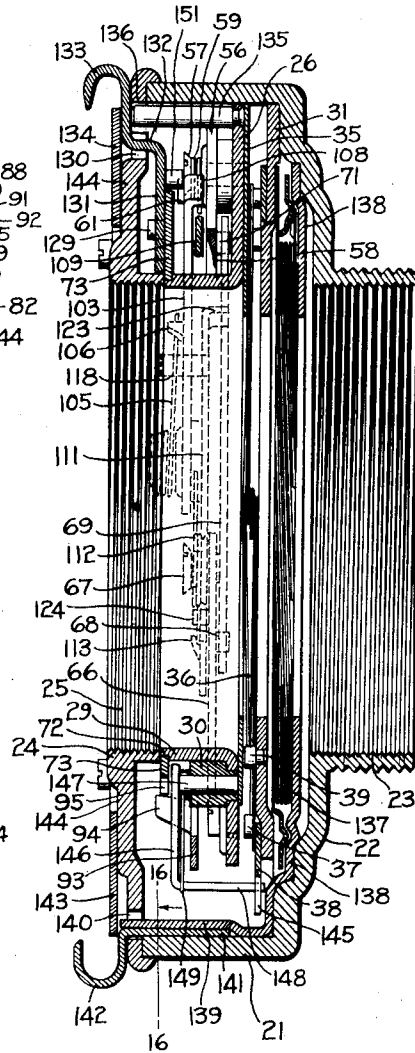
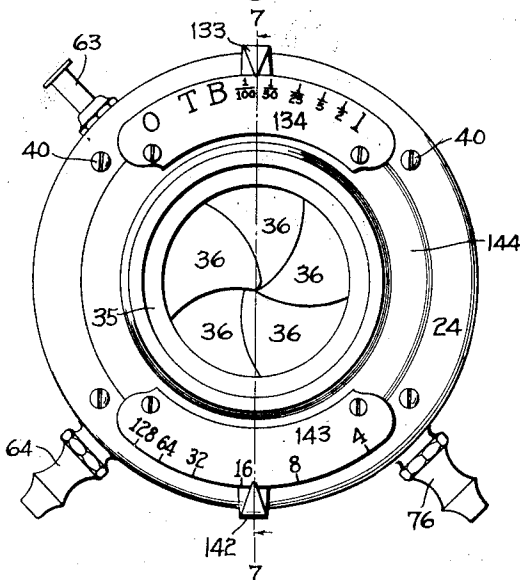


Fig. 6.



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4 SHEETS—SHEET 3.

Fig. 9.

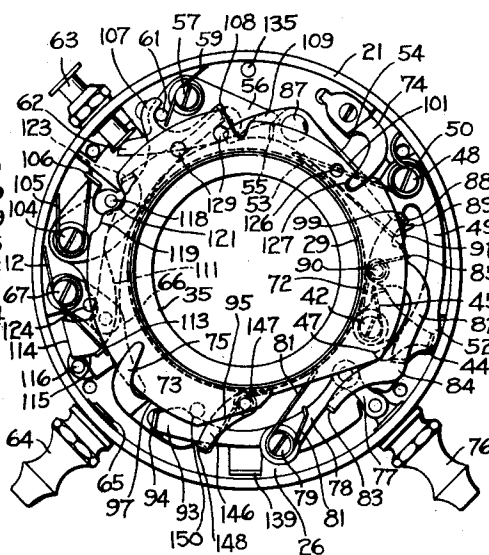
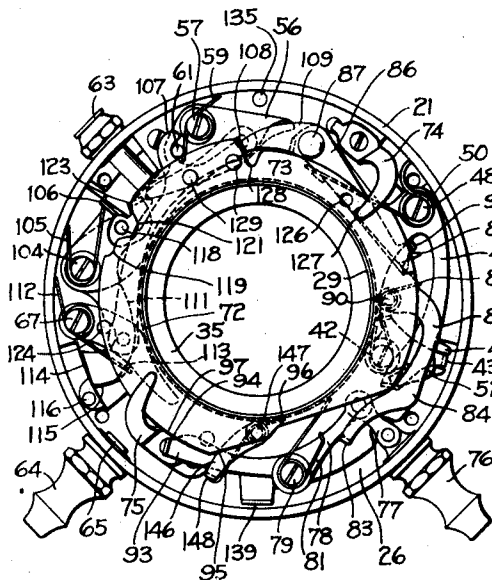
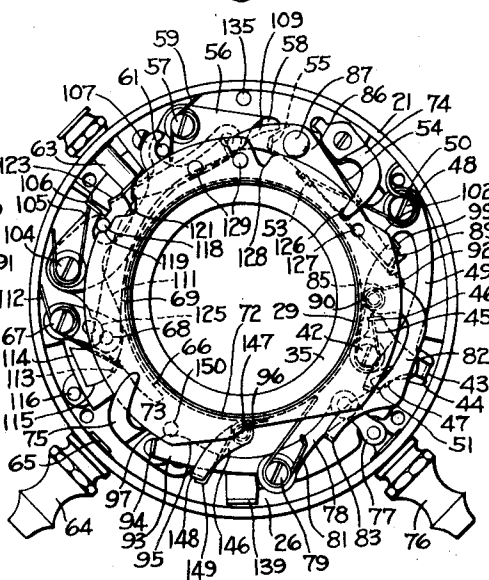
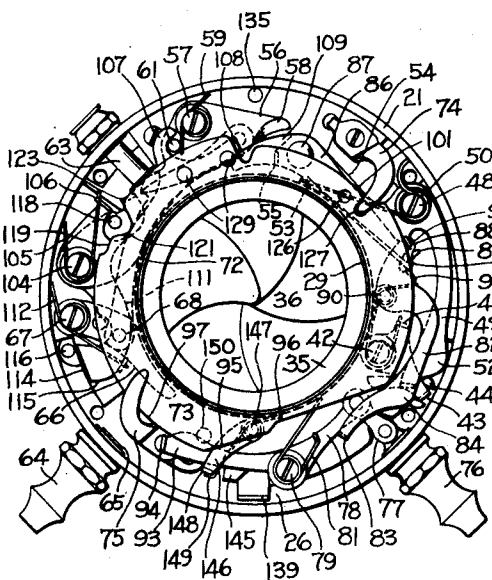


Fig.10.

Fig. 11.



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4 SHEETS—SHEET 4.

Fig.12.

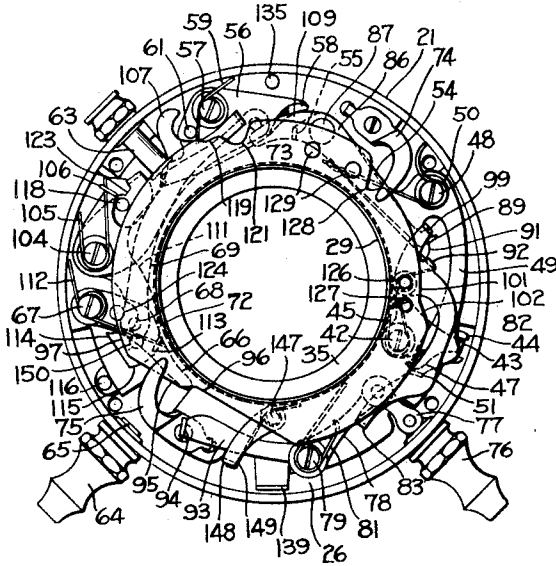


Fig.13.

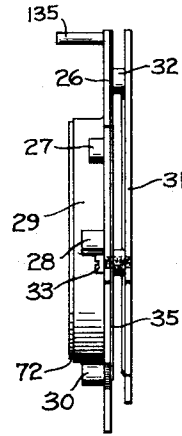


Fig.17.

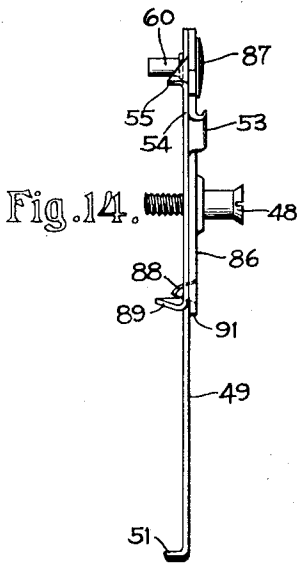


Fig.15.

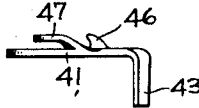


Fig.16.

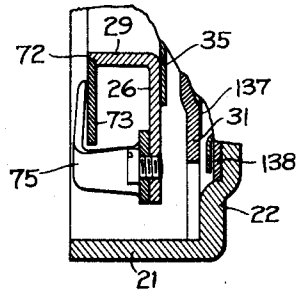
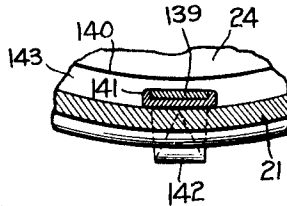
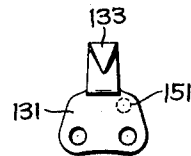


Fig.18.



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PHOTOGRAPHIC SHUTTER.

1,035,762.

Specification of Letters Patent.

Patented Aug. 13, 1912.

Application filed May 27, 1912. Serial No. 700,131.

To all whom it may concern:

Be it known that I, ANDREW WOLLENSAK, a citizen of the United States, and resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Photographic Shutters, of which the following is a specification.

This invention, while comprising features applicable to shutters of various forms and types, relates particularly to shutters of the type in which the moving parts are inclosed within a casing of generally-circular form, having a central exposure-aperture which is controlled by a series of pivoted blades, the blade-actuating and controlling mechanism being arranged in the annular space surrounding the exposure-aperture.

One of the principal objects of the invention is to produce a shutter, of the type in question, in which the mechanism is so compact in form and arrangement as to permit of the use of a casing of comparatively small diameter in proportion to the exposure-aperture, without the sacrifice of strength or efficiency in the mechanism.

Another object of the invention is to produce a shutter in which the mechanism is so arranged, particularly with reference to the frame upon which its elements are mounted, that the mechanism may be assembled as a whole independently of the shutter-casing, and thus may be removed from, or replaced in, the casing without deranging the operative relations of its parts.

A third object of the invention is to produce a shutter, adapted to make exposures of graded lengths, in which a more complete and effective control of the duration of the shortest exposures is attained.

Other objects of the invention, and the features of construction by which the several objects are attained, will be set forth in connection with the following description of the illustrated embodiment of the invention.

In the accompanying drawings:—Figure 1 is a front-elevation of a portion of the shutter comprising the blade-mechanism and the base-plate; Fig. 2 is a front-elevation of a portion of the shutter including the casing, the frame and certain parts of the mechanism; the press-button, the pneumatic actuator, and the pneumatic retarder being shown in section; Figs. 3, 4 and 5 are front-

elevations showing the shutter with the successive additions of various parts of the mechanism, Fig. 5 being complete except that the cover-plate of the casing is removed together with the finger-pieces by which the exposure-mechanism and the diaphragm are controlled; Fig. 6 is a front-elevation of the complete shutter; Fig. 7 is a vertical-section on the line 7—7 in Fig. 6, but on a larger scale, showing the complete shutter; Figs. 8, 9, 10, 11 and 12 are front-elevations of the shutter with the cover-plate removed, showing the mechanism in different operative positions; Fig. 13 is a side-elevation of the frame upon which the mechanism is supported; Fig. 14 is a side-elevation, on a larger scale, of the master-lever and parts immediately associated therewith; Fig. 15 is a bottom view of the blade-ring lever; Fig. 16 is a section on the line 16—16 in Fig. 7, showing in detail the form and arrangement of the finger-piece for actuating the diaphragm; Fig. 17 is a partial radial section on a large scale, showing particularly one of the lugs for holding the controller in position; and Fig. 18 is a front-elevation of the finger-piece for actuating the controller.

In the following description of the illustrated embodiment of the invention the term "blade-mechanism" is employed, for convenience, to designate particularly the shutter-blades together with the blade-ring by which they are immediately actuated, and the pivotal connections between these parts.

The term "exposure-mechanism" is employed to indicate generally the mechanism, or any part of it, by which the blades are opened and closed, as distinguished, however, from the manually-operable actuating-means and from the detent-mechanism and the retarder-mechanism by which the character and duration of the exposure are determined. The term "master-lever" designates the principal element of the exposure-mechanism, through which this mechanism coöperates with the actuating-mechanism, and the term "controller" is applied to the manually-operable member which coöperates with the various mechanisms hereinbefore referred to, to determine the character and duration of the exposure.

The illustrated shutter is provided with a casing of generally-circular form, comprising a cylindrical body 21 integral with

a back 22. Surrounding the central exposure-aperture in the back is a rearwardly-projecting sleeve 23, which is threaded internally to receive the rear-element of the lens in the usual manner, and is externally threaded to screw into the front of the camera. The front of the casing is formed by a removable annular cover-plate 24, and this plate is provided with a rearwardly-projecting sleeve 25, which is internally threaded to receive the front-element of the lens.

All of the mechanism of the shutter proper is mounted independently of the casing, upon a frame which is illustrated particularly in Fig. 13. This frame comprises a flat annular plate 26, hereinafter referred to as the "frame-plate," which is provided with various forwardly-projecting bosses 27, 28, 30, &c., constituting bearings for various elements of the shutter-mechanism. A sleeve 29 integral with the frame-plate projects forwardly around the exposure-aperture and constitutes both a closure for this part of the casing and a support for the annular controller.

Parallel with, and in the rear of, the frame-plate 26 is an annular plate 31, which is hereinafter referred to as the "base-plate," and this plate is fixed to the frame-plate by means of posts 32 and screws 33, by which the two plates are held in parallel position. The space between the plates is occupied by the blade-mechanism, while the space in front of the frame-plate and in the rear of the cover-plate 24 is occupied by other parts of the exposure-mechanism, and by the actuating-mechanism, the detent-mechanism and the retarder-mechanism. The base-plate affords a convenient means for fixing the frame and the mechanism carried thereby within the casing, being provided, for this purpose, with apertures 34 to receive screws threaded into the back 22 of the casing.

In addition to the plates 26 and 31 the frame comprises a thin annular-plate 35 fixed between the base-plate and the posts 32, which is hereinafter designated as the "blade-plate." This plate constitutes both an extended bearing for the shutter-blades, and a septum of which the inner edge defines the diameter of the exposure-aperture.

The blade-mechanism (Fig. 1) comprises five shutter-blades 36 of well known form, these blades being pivoted upon studs 37 projecting in a circle from the base-plate and being adapted to produce a star-shaped opening during their exposure-movement and until the exposure-aperture is completely uncovered. The blades 36 are immediately actuated by means of a flat blade-ring 38, which is provided with studs 39 engaging slots in the respective blades. This ring has an annular bearing in a shallow

recess on the forward surface of the base-plate, as shown particularly in Fig. 7.

The blade-ring is actuated by a lever 41, hereinafter designated as the "blade-ring lever," which is pivoted on a screw 42 threaded into the frame-plate. This lever has a rearwardly-projecting finger 43 which engages a notched arm 44 projecting from the blade-ring. It is normally held in the position of Fig. 2 by means of a spring 45 coiled about the screw 42 and engaging a lug 46 on the lever, and the shutter-blades are thus held normally closed. The blade-ring lever is further provided, however, with a beveled lug 47 which coöperates with the master-lever.

The master-lever is pivoted, between its ends, on a stud 48 threaded into the boss 27, and it has, at the end of its lower arm 49, a rearwardly-bent lug 51, which coöperates with the lug 47 on the blade-ring lever. Near its lower end the master-lever has also a projection 52, which normally engages the inner surface of the case and constitutes a stop for the lever. The master-lever is held normally in the position of Fig. 4 by a spring 50 which is coiled about the stud 48 and engages, at one end, the inner surface of the casing, and, at the other end, a lug 53 forming a part of a dog, hereinafter described, which is carried by the upper arm 54 of the master-lever. The upper extremity of the arm 54 is provided with a beveled rearwardly-projecting lug 55, which coöperates with the beveled extremity 58 of the actuating-lever 56. This lever is pivoted on a screw 57 threaded into the frame-plate, and is normally held in the position of Figs. 2 and 4 by a spring 59 coiled around the screw 57. This spring engages, at one end, the inner surface of the casing and, at the other end, a pin 61 which projects forwardly from the actuating-lever. The actuating-lever may be operated manually, either through a pneumatic bulb, or similar device, or directly. For the latter purpose it has an extremity 62 engaged by a press-button 63 which slides radially in a bearing screwed into the wall of the casing.

For pneumatic control of the shutter a cylinder 64 is screwed radially into the casing and provided with the usual piston 65. This piston engages a lever 66, hereinafter referred to as the "bulb-lever," which is pivoted upon a screw 67 threaded into the base-plate. For convenience in the arrangement of the different parts of the shutter-mechanism, particularly for the sake of compactness, the bulb-lever and the actuating-lever are mounted at remote points instead of being embodied in a single element as usual, and they are accordingly connected by a link 69 which is pivoted upon studs 68 and 71 on the two levers, respectively, so that these levers always move in unison

whether actuated by the press-button or by the pneumatic actuator.

The shutter-mechanism is primarily controlled, as to the character of the exposures produced, by means of a manually-movable controller in the form of a flat annulus 73, which is mounted to turn upon a bearing 72 formed by shouldering the forward extremity of the projection 29. The controller is located immediately behind the sleeve 23 on the cover-plate 24, but it is retained upon its bearing independently of this part by means of two lugs 74 and 75, of which the form is shown particularly in Figs. 2 and 17. These lugs are screwed to the frame-plate and have extremities which overhang and resiliently engage the front surface of the controller, thus not only retaining it upon its bearing, but also frictionally resisting rotation of the controller.

The retarder is illustrated as of the pneumatic type, comprising a cylinder 76 screwed radially into the casing and inclosing a piston 80 (Fig. 2). This piston is connected, by a link 77, with one arm 78 of a lever hereinafter described as the "retarder-lever." This lever is pivoted on a screw 79 threaded into the boss 30 on the frame-plate, and it is controlled normally by a spring 81 coiled around the screw, this spring tending to rock the retarder-lever to the right and to thus force the piston into the cylinder.

The retarder controls the movement of the master-lever through the interposition of a lever 82 hereinafter described as the "connecting-lever." This lever has, at its lower end, a rearwardly-projecting lug 83 which is adapted to engage the arm 78 of the retarder-lever so as to rock the latter to the left and draw the piston 80 outwardly in the cylinder 76, against the resistance of the air-pressure. The connecting-lever is provided with a rearwardly-projecting stud 90 having a bearing in the boss 28 on the frame-plate, and by means of a spring 85, which is coiled around the stud and engages a lug 92 projecting rearwardly from the connecting-lever, the latter is normally held in the position of Fig. 4, being arrested in this position by means of a projection 84 upon the lever, which engages the inner surface of the casing.

The connecting-lever coöperates with a dog which is pivoted upon a stud 87 projecting forwardly from the upper end of the master-lever. This dog has a lower arm 86 provided, near its lower end, with a rearwardly-projecting lug 88 adapted to coöperate with a projection 89 on the master-lever. The dog carries also the lug 53 hereinbefore referred to, so that the master-lever spring 50 performs the further function of retaining the dog normally in the position of Fig. 4 with respect to the mas-

ter-lever, in which position it is arrested by engagement of the lug 88 and the projection 89.

When the actuating-lever 56 swings to the left, in the production of an exposure, the un-beveled upper edge of its extremity 58, by engagement with the lug 55 on the master-lever, swings the latter to the right, thus causing the lug 51 to ride over the inclined lug 47 on the blade-ring lever owing to the resilient yielding of the master-lever. At the same time the lower extremity 91 of the dog is drawn across the upper edge of the lug 92 on the connecting-lever, this movement being permitted freely by the yielding of the dog around its pivot 87 against the resistance of the spring 50. The completion of the movement of the master-lever just described thus causes the master-lever to assume a position in which, during the succeeding return-movement of the master-lever, due to the action of the spring 50, the lug 51 may actuate the blade-ring lever through engagement with the left-hand extremity of the lug 47, while the dog 91 assumes a position in which, upon said return movement, it will operatively engage the lug 92, so as to rock the connecting-lever 81 to the right, thus causing the latter to move in a direction to engage the retarder-lever and move the retarder, in case the latter is not at the time held out of operative position by the controller. To support the master-lever against its tendency to rock transversely upon the bearing-stud 48 when the lower arm 49 is bent forwardly in permitting the lug 51 to ride over the lug 47, the rear-end of the stud 87 has an extension 60 (Fig. 14), which bears loosely against the base-plate. At the completion of the return-movement of the actuating-lever the beveled lower edge of its extremity 58 passes easily under the lug 55 on the master-lever, owing to the resiliency of the upper arm of the master-lever, and the parts thus resume a position in which the master-lever may be actuated for another exposure.

As shown in Fig. 4, after the right-hand edge of the lug 51 on the master-lever, during its operative return-movement, has engaged the left-hand extremity of the lug 47 on the blade-ring lever and swung the latter lever to its extreme position, a further movement of the master-lever, of substantial extent, occurs during which the lug 47 bears against the upper surface of the lug 51. Since this surface is approximately concentric with the pivot 48 of the master-lever no movement of the blade-ring lever occurs at this time, but the shutter-blades are held wide open. It is during this period that the retarder acts, its entire effect being attained while the blades are held wide open, so that whatever the length of the exposure the exposure-aperture is rapidly and fully opened

and closed at the beginning and the end, respectively, of the exposure.

The controller determines the position of rest and the extent of operation of the retarder, through engagement with a lug 94 projecting forwardly from the left-hand arm 93 of the retarder-lever. This lug normally engages the edge of the controller, as shown in Fig. 5, and the controller is provided, at this part, with an inclined cam-like portion 95 which is so formed that in different angular positions of the controller it causes the retarder-lever to assume positions in which it interferes with the movement of the connecting-lever at different points in its path, according to the length of exposure required.

By rotating the controller to the left, or counterclockwise, the arm 93 is moved farther downward, thus shortening the retarding action so as to produce successively shorter exposures, until finally the lug 94 engages a circular portion 97 of the edge of the controller, and in this position the controller-lever is entirely out of the range of movement of the connecting-lever.

While the arrangement just described affords provision for a range of exposure down to a small fraction of a second, it will be noted that, in so far as the operation has been described, the connecting-lever 82 is still in position to be engaged by the dog 86, after the retarder has been thrown entirely out of operation, so that the exposure-movement of the master-lever is still, to a slight degree, retarded by the inertia of the connecting-lever. To provide for a still shorter exposure the controller is arranged to throw the connecting-lever out of position to be engaged by the dog. For this purpose the lever has a forwardly-projecting lug 99 at its upper extremity, which may be engaged by an inclined portion 102 on the periphery of the controller. This portion is so located that it comes into action just after the controller has been moved sufficiently to throw the retarder entirely out of operation as above described. This arrangement accordingly provides for exposures of two distinct lengths beyond those provided for by the graded operation of the retarder, and thus permits a regulation of the shortest exposures which is more minute and definite than can be attained by the use of a retarder alone.

For exposures of the type commonly designated as "bulb-exposures" and as "time-exposures" provision is made in the usual manner, by means of detent-mechanism co-operating with the exposure-mechanism and controlled by the controller, but this detent-mechanism has novel features of form and arrangement imposed partly by the requirement of compactness in the mechanism.

Both detents are in the form of levers piv-

oted upon a common stud 104 which is screwed into the base-plate (Fig. 4). The bulb-detent 103, which is in front of the time-detent, coöperates with the left-hand extremity 109 of the dog 86. There is no functional significance in this coöperation as distinguished from coöperation with the master-lever proper, but the arrangement is convenient in construction since the corresponding extremity of the arm 54 of the master-lever is employed to form the lug 55 which coöperates with the actuating-lever 56.

The bulb-detent is actuated, in one direction, by a spring 105 coiled about the stud 104 and engaging a lug 106 on the detent. This spring tends to swing the detent to the right and into a position in which a rearwardly-bent lug 108 on the extremity of the detent may intercept the dog shortly before the termination of the return-movement of the master-lever, at a time when the shutter-blades have been swung to fully-open position, and just before the lug 51 on the master-lever disengages the lug 47 on the blade-ring lever and permits the shutter-blades to close. When the bulb-detent operates as just described the master-lever is arrested in the position of Fig. 3, and the blades are thus held open until the detent is disengaged from the dog. This disengagement is provided for by a hooked abutment 107 on the bulb-detent which is in position to be engaged by the pin 61 on the actuating-lever. When the actuating-lever is released by the release either of the press-button 63 or of the bulb-mechanism by which it has been moved to operative position, the return of the actuating-lever to normal position causes the pin 61 to engage and raise the bulb-detent, thus releasing the master-lever and permitting the shutter-blades to close.

The time-detent 111 (Fig. 4), instead of coöperating in the usual manner with the master-lever, is arranged to coöperate immediately with the blade-ring, so as to arrest the return-movement of the latter by which the blades are closed. To this end the time-detent is provided with a lower extremity, having an approximately radial edge 114 terminating in a shoulder or abutment 115, while the blade-ring 38 is provided with a pin 116 projecting forwardly from a projection 117 at the periphery of the ring. A spring 112, coiled upon the stud 67, engages a lug 113 on the time-detent and tends to swing the detent into a position in which its edge 114 engages the pin 116 (Fig. 4). With the parts in this position, if the pin 116 descends, the detent swings farther so that its abutment 114 acts to prevent the rise of the pin (Fig. 9) and thus arrests the return-movement of the blade-ring. When the parts are in this operative relation they are disengaged by the next succeeding movement of the actuating-mechanism. During this

movement, whether caused by the press-button or by the pneumatic actuator, the bulb-lever 66, in swinging to the right, causes a pin 124, which projects forwardly from the bulb-lever, to engage the edge of the time-detent at a point 125, thus swinging the detent to the right and away from the path of movement of the pin 116.

The operation of the detents is controlled by the controller 73, through engagement with a pin 118 projecting forwardly from the upper arm of the time-detent. When neither a bulb-exposure nor a time-exposure is required the controller is placed in such position that this pin rests upon a portion of greatest diameter on the periphery of the controller, as shown in Figs. 5 and 12. The time-detent is thus held directly out of operative position, while the bulb-detent is indirectly held by engagement of the pin 118 with the arm from which the lug 106 projects. When a bulb-exposure is required the controller is moved to the position shown in Fig. 11, the pin 118 at this time engaging a slight depression 119 on the controller. This permits the bulb-detent to move freely to operative position when the actuating-lever is moved to effect an exposure, as in Fig. 11, but the time-detent is still held beyond the path of movement of the pin 116.

When a time-exposure is required the controller is moved farther to the left, into the position shown in Figs. 8, 9 and 10. At this time a deep depression 121 in the controller registers with the pin 118 so as entirely to release the detents from the action of the controller. The several stages of a time-exposure are shown in Figs. 8, 9 and 10. Upon the first operative movement of the actuating-mechanism, it assumes the position of Fig. 8 and causes the master-lever to swing first to the right and then perform a part of its return-movement, thus opening the shutter-blades while the pin 116 moves to its lowermost position, and the return-movement of the master-lever is arrested by the bulb-detent. Upon the subsequent release and return of the actuating-lever the bulb-detent is raised, as above described, to inoperative position, but just previous to its disengagement from the dog 86 the time-detent is permitted, by the return movement of the pin 124 on the bulb-lever, to swing into position above the pin 116, as in Fig. 9, thus preventing the return of the blade-ring, although the master-lever has completely returned and has disengaged the lug 47 on the blade-ring lever. It is necessary at this time to prevent complete return-movement of the actuating-lever 56, in order that upon the next succeeding movement of the actuating-lever, by which the exposure is terminated, this lever may not operatively engage and again actuate the master-lever.

For this purpose the time-detent is provided with a rearwardly-projecting lug 123 which is adapted to engage a shoulder 122 (Fig. 2) on the upper edge of the link 69. Accordingly, the return-movement of the actuating-lever is arrested when it has reached the position of Fig. 9, and the parts then remain in this position until the next succeeding operative movement of the actuating-lever, by which the operator terminates the exposure. When this succeeding movement occurs the pin 124 on the bulb-lever thrusts the time-detent to the right, thus disengaging it from the pin 116, and the blade-ring immediately returns to normal position and causes the blades to close. By the same movement of the time-detent the lug 123 is removed from the path of movement of the shoulder 122, so that upon the release of the press-button or the pneumatic bulb the actuating-mechanism returns to normal position, thus completing the cycle of operations of a time-exposure.

The controller is adapted to remain in any position to which it is set, owing to the frictional engagement of the lugs 74 and 75 as above described. It is convenient, however, for the operator to have further means for determining the positions of the controller for bulb-exposures and time-exposures, and accordingly two perforations are provided in the controller, these perforations being engaged resiliently by the end of the lugs 74 when the controller is set in these respective positions. Owing to this arrangement the operator may readily set the controller for time or bulb-exposures without the necessity of even looking at the indicator on the front of the shutter, since the engagement of the perforations may be readily felt in moving the controller, and the arrangement has the further advantage that it causes the controller to be fixed with accuracy in the required position.

When the shutter-mechanism is assembled either independently of the casing or with the cover-plate of the casing removed, the controller is still held in operative position, as previously described, by the lugs 74 and 75. For convenience in assembling the shutter and in removing the controller for access to the underlying mechanism, a notch 128 is formed in the periphery of the controller, and when the controller is turned to bring this notch into registry with the lug 74 it may be withdrawn from its bearing without detaching either of the lugs from the base-plate.

In previous constructions it has been common to make the finger-piece by which the controller is moved either integral, or permanently connected, with the controller. For convenience in removing the cover-plate, however, particularly in view of the fact that the controller remains in operative

position at this time, the finger-piece in the present construction is arranged to be removable from the controller by the mere operation of removing the cover-plate. To this end two studs 129 project from the front of the controller, and the finger-piece 131 has two perforations which loosely engage these studs. The finger-piece, as shown in Figs. 7 and 18, has a portion 132 which projects forwardly through a slot 130 in the cover-plate, and a hooked extremity 133 at the front of the cover-plate by which it may be manipulated. The slot 130 is covered and the finger-piece is held in operative relation to the controller by means of an indicator-plate 134 screwed to an annular raised portion 144 on the front of the cover-plate, and is provided with letters and numerals to indicate the position of the finger-piece for the various exposures (Fig. 6). When the cover-plate is removed the finger-piece comes freely away with it, being readily disengaged from the studs 129, but leaves the controller still in operative position. For convenience in properly locating the cover-plate when it is replaced upon the body of the casing, a post 135 projects forwardly from the base-plate (Figs. 5 and 7), and engages a notch 136 in the upper portion of the slot 130.

Any ordinary form of iris diaphragm-mechanism may be used in the present shutter, and the general construction of the diaphragm is not particularly illustrated. In Fig. 7 the diaphragm-blades 137 are shown together with the rotary annular member 138 by which they are moved to vary the aperture. In connection with the diaphragm I employ, however, a finger-piece of novel form and arrangement, which is similar to the finger-piece 131 in the respect that it is removable with the cover-plate while leaving the other parts of the mechanism in position. The finger-piece in question has a shank 141 in the form of a shallow channel (Figs. 7 and 16), and this shank normally embraces an arm 139 projecting forwardly from the member 138 at a short distance from the inner surface 21 of the casing. By engagement with this surface the shank and the arm are held in operative relation, and the finger-piece projects forwardly through a curved slot 140 in the cover-plate, and has a hooked extremity 142 by which it may be manipulated. When the cover-plate is removed the shank 141 slides freely out of engagement of the arm 139. It is normally held in such engagement, however, by means of an indicator-plate 143, which is screwed to the portion 144 of the cover-plate and which covers the slot 140. This indicator-plate is provided with the usual designations corresponding to the different apertures for which the diaphragm may be regulated.

In addition to the functions previously described the controller has the further function of causing the shutter-blades to be opened and held open, for the purpose of focusing, independently of the actuating-mechanism. For this purpose the blade-ring 38 is provided with a lug 145 on its periphery (Figs. 1 and 5), and a lever 146 is pivoted upon the front of the base-plate, by means of a stud 147 which projects rearwardly from this lever into the boss 30 on the base-plate. A spring 149 coiled upon this stud and engaging a rearwardly-projecting arm 148 on the lever normally holds the lever in the inoperative position of Fig. 3, in which it rests against a shoulder upon the periphery of the base-plate. A pin 150 projects rearwardly from the controller (Fig. 5), and this pin is so located that when the controller is moved to its extreme left-hand position, that is, so as to bring the finger-piece 133 opposite the letter O on the indicator-plate 134, the pin engages the lever 146 and swings it to the right. This movement causes the arm 148 to engage the lug 145 and rotate the blade-ring to the left, so as to move the blade to and hold them in, open position. To prevent any derangement in the exposure-mechanism which might result from a heedless attempt to operate the actuating-mechanism at his time, the finger-piece 131 is provided with a rearwardly-projecting stud 151 (Figs. 7 and 18), which is so located that in the above-described position of the controller it lies directly beneath the pin 61 on the actuating-lever, thus positively preventing the inoperative movement of the latter.

The operation of the shutter as a whole, except in so far as it has previously been described, is similar to that of various well-known shutters of what is commonly designated as the "automatic" type, and will be understood without further description.

While the various novel features which I have described and illustrated are best used in conjunction to produce a shutter having in the highest degree the valuable features of compactness, simplicity and reliable operation, it will be understood that these several features are not necessarily so used, and that, in general, the invention is not limited to the embodiment thereof hereinbefore described and illustrated in the accompanying drawings, but may be embodied in various other forms within the nature of the invention as it is defined in the following claims.

I claim:—

1. A photographic shutter having, in combination, a casing provided with a central exposure-aperture, an annular frame-plate inclosed within the casing and surrounding said aperture, a tubular extension from the inner margin of the frame-plate,

exposure-mechanism mounted upon the frame-plate on the same side as said extension, and a controller-ring journaled upon the end of the extension and coöperating with the exposure-mechanism to control the action thereof.

2. A photographic shutter having, in combination, a casing provided with a central exposure-aperture, an annular frame-plate inclosed within the casing and surrounding said aperture, a tubular extension from the inner margin of the frame-plate, exposure-mechanism mounted upon the frame-plate on the same side as said extension, a controller-ring journaled upon the end of the extension and coöperating with the exposure-mechanism to control the action thereof, and blade-mechanism on the opposite side of the frame-plate and operatively connected with the exposure-mechanism.

3. A photographic shutter having, in combination, a casing provided with a central exposure-aperture and with a removable front cover-plate, an annular frame-plate inclosed within the casing and surrounding the exposure-aperture, a tubular forward extension from the inner margin of the frame-plate, exposure-mechanism mounted upon the same side of the frame-plate as said extension, an annular controller coöperating with the exposure-mechanism and journaled upon the extension, the controller being independent of the front cover-plate, and a finger-piece extending forwardly from the controller for manipulating the same, the cover-plate having an aperture through which the finger-piece projects to the front of the casing.

4. A photographic shutter having, in combination, a casing provided with a central exposure-aperture, an annular frame-plate and an annular base-plate fixed together in parallel position, shutter-blades pivoted between the base-plate and the frame-plate, exposure-mechanism connected with said blades and mounted on the front of the frame-plate, and means for removably securing the base-plate and frame-plate within the casing, said means being independent of the connections between said plates so that the plates and the mechanism attached thereto may be assembled independently of the casing.

5. A photographic shutter having, in combination, a casing provided with a central exposure-aperture, an annular frame-plate, a tubular projection extending forwardly from the inner margin of the frame-plate, an annular base-plate fixed to the back of the frame-plate and parallel thereto, blades and blade-mechanism movably mounted between said plates, exposure-mechanism mounted on the front of the frame-plate, and a controller-ring coöperat-

ing with the exposure-mechanism and journaled on said tubular extension, said parts being removable as a whole from the casing without disconnecting them from each other.

6. A photographic shutter having, in combination, a casing comprising a body-portion and a removable front cover-plate, said body-portion and plate having a central exposure-aperture, an iris-diaphragm comprising a rotary member located in the back of the casing and provided with an arm extending forwardly in the casing near the periphery thereof, a frame and shutter-mechanism carried thereby, said frame and mechanism being assembled independently of the casing and removable as a whole therefrom, the diaphragm-mechanism being located between said frame and the back of the casing, and a finger-piece for manipulating said arm and the diaphragm-mechanism, the front cover-plate having an aperture through which said finger-piece extends to the front of the casing.

7. A photographic shutter having, in combination, an annular frame-plate with a central exposure-aperture, an annular base-plate fixed parallel to and in the rear of the frame-plate, a blade-ring journaled on the front of the base-plate, shutter-blades pivoted between said plates, in front of the blade-ring, and operatively connected with the ring, and exposure-mechanism mounted on the front of the frame-plate and operatively connected with the blade-ring.

8. A photographic shutter having, in combination, an annular frame-plate with a central exposure-aperture, a forwardly-projecting tubular extension integral with the frame-plate at its inner margin, an annular base-plate fixed to the frame-plate parallel therewith and in the rear thereof, a blade-ring journaled upon the front of the base-plate, blades pivoted between the frame-plate and the base-plate and blade-ring, an annular blade-plate fixed between the blades and the frame-plate and extending inwardly beyond the tubular extension so as to define the exposure-aperture and afford a guiding surface for the forward surfaces of the blades, and exposure-mechanism mounted on the front of the frame-plate and operatively connected with the blade-ring.

9. A photographic shutter having, in combination, a casing provided with a central exposure-aperture, an annular frame-plate within the casing, exposure-mechanism mounted on the front of the frame-plate, and blade-mechanism operatively connected with the exposure-mechanism and mounted in the rear of the frame-plate, the frame-plate and said mechanisms being separable, as an assembled whole, from the casing.

10. A photographic shutter having, in

combination, a casing provided with a central exposure-aperture, an annular frame-plate inclosed within the casing, exposure-mechanism mounted on the front of the frame-plate, blade-mechanism mounted on the rear of the frame-plate and operatively connected with the exposure-mechanism, and a controller journaled at the front of the frame-plate and cooperating with the exposure-mechanism, the frame-plate with the controller and said mechanisms being separable, as an assembled whole, from the casing.

11. A photographic shutter having, in combination, a frame with a central exposure-aperture, exposure-mechanism mounted upon said frame, an annular controller journaled upon the frame around the exposure-aperture and cooperating with the exposure-mechanism, and lugs projecting from the frame and overhanging the controller to hold it in operative position.

12. A photographic shutter having, in combination, a frame provided with a central exposure-aperture and with a forwardly-projecting tubular extension surrounding said aperture and provided with an annular bearing, exposure-mechanism mounted on said bearing and cooperating with the exposure-mechanism, and lugs extending forwardly from the frame and overhanging and engaging the forward surface of the controller to retain the controller upon said bearing.

13. A photographic shutter having, in combination, a frame provided with a central exposure-aperture and with a forwardly-projecting tubular extension surrounding said aperture and provided with an annular bearing, exposure-mechanism mounted on the frame, an annular controller mounted on said bearing and cooperating with the exposure-mechanism, and lugs extending forwardly from the frame and resiliently engaging the forward surface of the controller to retain it upon its bearing and to hold it frictionally in adjusted position thereon.

14. A photographic shutter having, in combination, a frame provided with a central exposure-aperture and with a forwardly-projecting tubular extension surrounding said aperture and provided with an annular bearing, exposure-mechanism mounted on the frame, an annular controller mounted on said bearing and cooperating with the exposure-mechanism and lugs extending forwardly from the frame and resiliently engaging the forward surface of the controller to retain it upon its bearing and to hold it frictionally in adjusted position thereon, the controller being provided with recesses adapted to engage the end of

one of said lugs to determine the operative positions of the controller.

15. A photographic shutter having, in combination, a frame provided with a central exposure-aperture and with a forwardly-projecting tubular extension surrounding said aperture and provided with an annular bearing, exposure-mechanism mounted on the frame, an annular controller mounted on said bearing and cooperating with the exposure-mechanism, and lugs extending forwardly from the frame and overhanging and engaging the forward surface of the controller to retain the controller upon said bearing, the controller having a notch in its periphery adapted to be moved into registry with one of the lugs to permit the controller to be disengaged from said lug and removed from said bearing.

16. A photographic shutter having, in combination, a casing provided with a removable cover, shutter-mechanism inclosed within the casing and comprising a rotary controller, and a finger-piece removably engaging the controller, the cover having an aperture through which the finger-piece extends to the exterior of the casing and acting normally to retain the finger-piece in operative engagement with the controller.

17. A photographic shutter having, in combination, a casing provided with a removable cover, shutter-mechanism inclosed within the casing, diaphragm-mechanism inclosed within the casing and provided with an operating-arm extending toward the cover of the casing, and a finger-piece removably engaging said arm, the cover being provided with an aperture, through which the finger-piece projects, and acting normally to retain the finger-piece in engagement with said arm.

18. A photographic shutter having, in combination, a generally-cylindrical casing provided with a removable front cover-plate having a circularly-curved slot near its edge, diaphragm-mechanism located within the casing and having a controlling-arm projecting forwardly within the casing and close to the inner surface thereof, and a finger-piece recessed to receive said arm and adapted to be introduced lengthwise between the arm and the inner surface of the casing, the finger-piece extending forwardly through the slot in the cover-plate and being normally retained against removal from the arm by engagement with the cover-plate.

19. A photographic shutter having, in combination, an annular frame-plate with a central exposure-aperture, blade-mechanism in the rear of the frame-plate comprising blades and a blade-ring rotatable to actuate the blades, exposure-mechanism mounted on the front of the frame-plate and cooperating with the blade-ring, an annular con-

troller journaled at the front of the frame-plate, and an arm pivoted on the front of the frame plate and adapted to engage both the controller and the blade-ring, when the controller is moved to an extreme position in one direction, whereby the arm is actuated by the controller so as to move the blade-ring into position to hold the blades in open position for focusing.

20. A photographic shutter having, in combination, an annular frame-plate provided with a central exposure-aperture; blade-mechanism mounted in the rear of the frame-plate and comprising blades and a blade-ring rotatable to actuate the blades; exposure-mechanism mounted on the front of the frame-plate and coöperating with the blade-ring, said mechanism including a manually-operable actuating-member; an annular controller journaled at the front of the frame-plate and coöperating with the exposure-mechanism; an arm pivoted on the front of the frame-plate and adapted to coöperate with the controller and the blade-ring, when the controller is moved to an extreme position, so as to move the blade-ring into position to hold the blades open for focusing, the controller being provided with an abutment adapted, when the controller is in said extreme position, to operatively engage the actuating-member to prevent operative movement thereof.

21. A photographic shutter having in combination, shutter-blades, exposure-mechanism for actuating the blades to produce an exposure, primary means for yieldingly retarding the movement of the exposure-mechanism, said means being adapted to afford a comparatively slight resistance proportioned to a comparatively short exposure, secondary means for yieldingly retarding the exposure-mechanism, the secondary means being adapted to afford greater resistances proportioned to the longer graded exposures, and manually-operable means for throwing the secondary and primary retarding-means successively out of operation to produce exposures graded in duration from long to short.

22. A photographic shutter having, in combination, shutter-blades, exposure-mechanism for actuating the blades to produce an exposure, retarding-means operative principally through the action of inertia, for yieldingly retarding the movement of the exposure-mechanism, retarding-means operative through pneumatic resistance, for yieldingly retarding the movement of the exposure-mechanism, and manually-operable means for throwing said two retarding means successively out of operation to produce graded exposures.

23. A photographic shutter having, in combination, shutter-blades, exposure-mechanism for actuating the blades, a retarder,

connecting-means for operatively connecting the retarder with the exposure-mechanism to retard the action of the latter, and a controller for determining the length of exposure; the controller acting upon both the retarder and said connecting-means and being adapted, when moved to different successive positions, first to throw the retarder out of operative position and then to throw the connecting-means out of operative relation to the exposure-mechanism.

24. A photographic shutter having, in combination, shutter-blades, exposure-mechanism for actuating the blades, a retarder, a connecting-lever adapted to engage the retarder at one point and a portion of the exposure-mechanism at another point to operatively connect these parts, and a controller for determining the length of exposure; the controller acting upon both the retarder and the connecting-lever and being adapted, when moved to different successive positions, first to move the retarder out of position to operatively engage the connecting-lever, and then to move the connecting-lever out of position to operatively engage the exposure-mechanism.

25. A photographic shutter having, in combination, shutter-blades, exposure-mechanism for actuating the blades, a retarder including a pneumatic piston and a retarder-lever connected therewith and extending in one direction from the piston, a connecting-lever having an extremity adapted to engage the retarder-lever, near its point of connection with the piston, and extending in the opposite direction from the piston, the connecting-lever having also a point of engagement with the exposure-mechanism; and an annular rotary controller having cam-surfaces operatively engaging the remote extremities of the retarder-lever and the connecting-lever and adapted, in successive positions of the controller, first to move the retarder-lever out of operative relation with the connecting-lever and then to move the connecting-lever out of operative relation with the exposure-mechanism.

26. A photographic shutter having, in combination, shutter-blades; mechanism for actuating the blades including a master-lever; a manually-operable actuating-lever coöperating with the master-lever, a bulb-detent adapted to coöperate with the master-lever and movable to inoperative position by coöperative connection with the actuating-lever, a bulb-lever pivoted independently of the actuating-lever, a link operatively connecting the actuating-lever and the bulb-lever, and a time-detent coöperating with a portion of the exposure-mechanism and movable to inoperative position by coöperative connection with the bulb detent.

27. A photographic shutter having, in

combination, shutter-blades, mechanism for actuating the blades including a master-lever; a manually-operable actuating-lever coöperating with the master-lever, a bulb-detent adapted to coöperate with the master-lever and movable to inoperative position by coöperative connection with the actuating lever, a bulb-lever pivoted independently of the actuating-lever, a link operatively connecting the actuating-lever and the bulb-lever, and a time-detent coöperating with a portion of the exposure-mechanism and movable to inoperative position by coöperative connection with the bulb-detent; the link having an abutment adapted to coöperate with the bulb-detent to prevent full return of the actuating-lever when the latter is first actuated to produce a time-exposure.

28. A photographic shutter having, in combination, shutter-blades, exposure-mechanism for actuating the blades, a bulb-detent and a time-detent pivoted on a common center but extending in opposite directions therefrom and adapted to coöperate, at their remote extremities, with different parts of the exposure-mechanism, an actuating-lever immediately coöperating with the exposure-mechanism and with the bulb-detent, and an independently-pivoted bulb-lever immediately coöperating with the time-detent and operatively connected with the actuating-lever.

29. A photographic shutter having, in combination, shutter-blades, exposure-mechanism, for actuating the blades, including a rotary blade-ring and a master-lever; manually-operable means for actuating the

master-lever; and detent-mechanism, for controlling the operation of the exposure-mechanism, comprising a bulb-detent coöperating with the master-lever and a time-detent coöperating immediately with the blade-ring.

30. A photographic shutter having, in combination, shutter-blades, exposure-mechanism, for actuating the blades, including a rotary blade-ring and a master-lever; manually-operable means for actuating the master-lever; and detent-mechanism, for controlling the operation of the exposure-mechanism, comprising a bulb-detent and a time-detent co-axially pivoted and extending in opposite directions, the bulb-detent coöperating with the master-lever and the time-detent coöperating immediately with the blade-ring.

31. A photographic shutter having, in combination, shutter-blades, a retarder, a connecting-lever coöperating with the retarder, a manually-operable actuating-lever, a bulb-detent; exposure-mechanism, for actuating the blades, including a master-lever pivoted intermediate its ends and having, at its upper end, a lug to coöperate with the actuating-lever; and a spring-pressed dog pivoted near the upper end of the master-lever, the upper end of the dog coöperating with the bulb-detent and the lower end of the dog extending below the pivot of the master-lever and coöperating with the connecting-lever.

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Witnesses:

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

It is hereby certified that in Letters Patent No. 1,035,762, granted August 13, 1912, upon the application of Andrew Wollensak, of Rochester, New York, for an improvement in "Photographic Shutters," errors appear in the printed specification requiring correction as follows: Page 5, line 98, for the word "lugs" read *lug*; and page 6, line 18, before the word "is" insert the words *this indicator plate*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of September, A. D., 1912.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.

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