A. WOLLENSAK.

PHOTOGRAPHIC SHUTTER.

APPLICATION FILED AUG. 9, 1909.

961,192. Patented June 14, 1910.

9 SHEETS—SHEET 1.

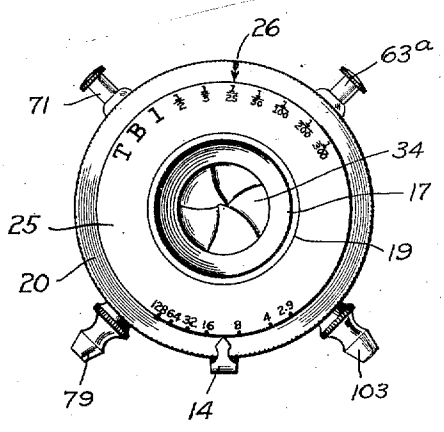

FIG. 1.

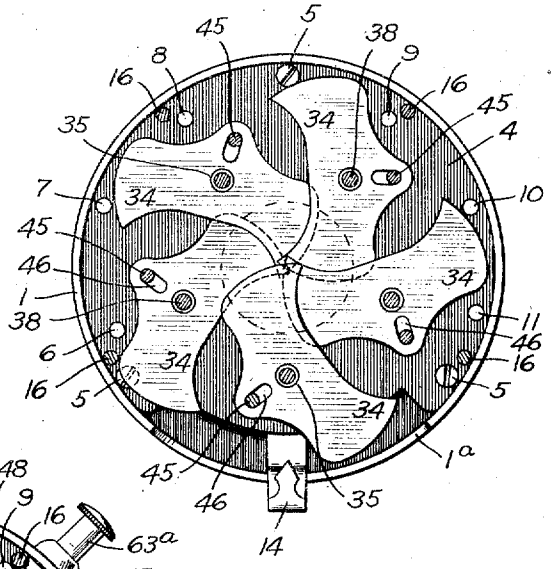

FIG. 2.

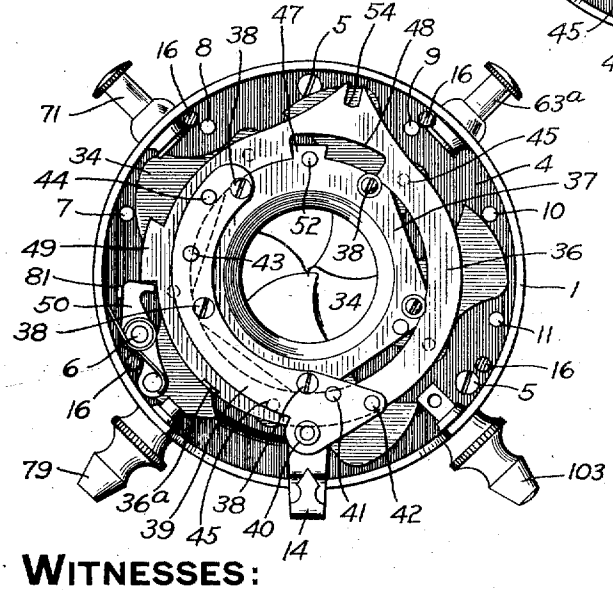

FIG. 3.

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9 SHEETS—SHEET 2.

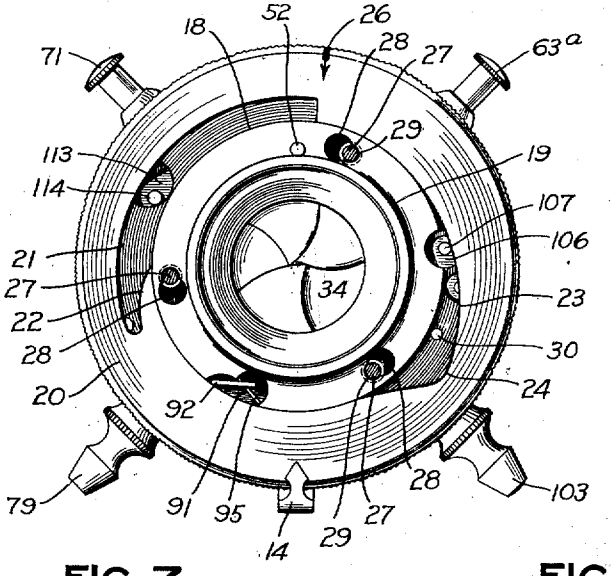


FIG. 4.

FIG. 7.

FIG. 5.

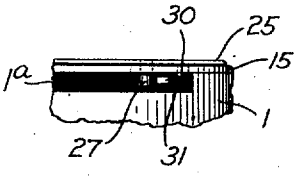
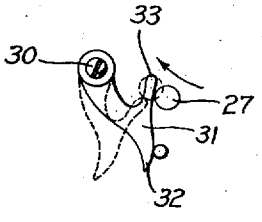
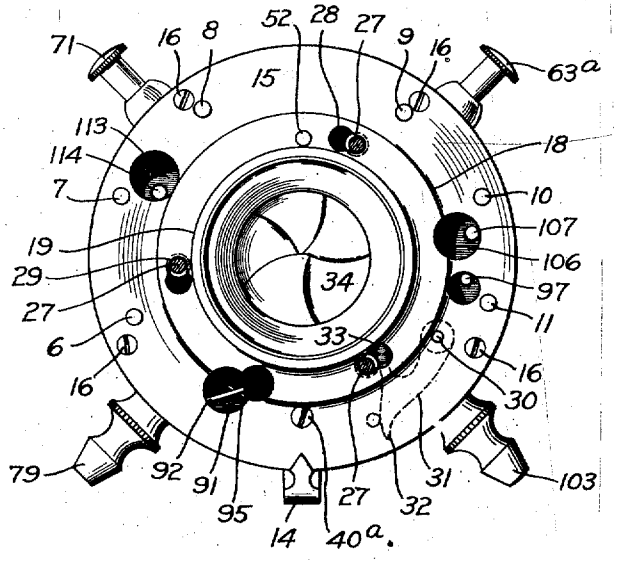


FIG. 6.





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9 SHEETS—SHEET 3.

FIG. 8.

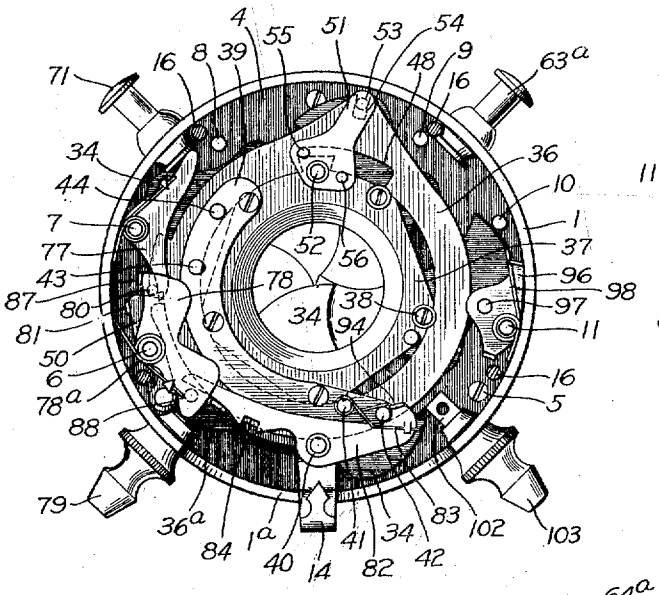


FIG. 10.

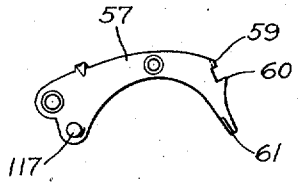


FIG. 11.

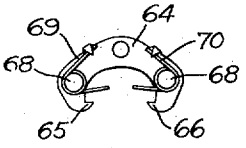


FIG. 12.

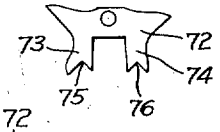


FIG. 15.

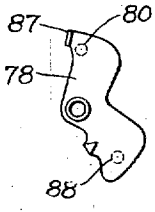
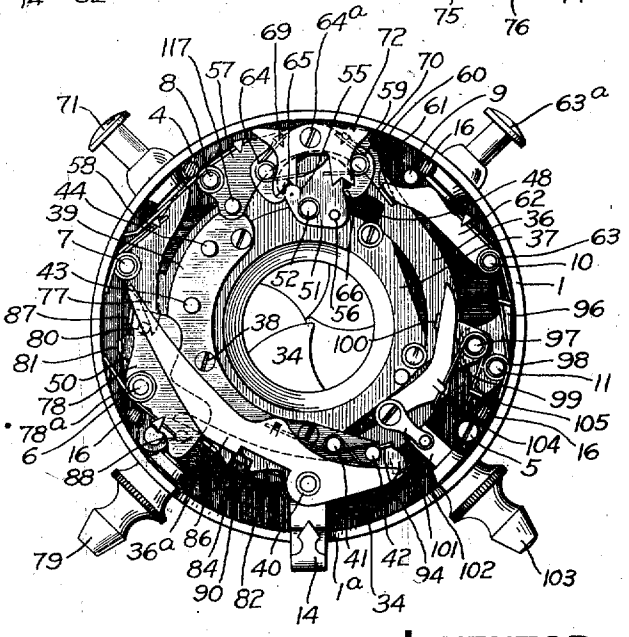


FIG. 9.



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9 SHEETS—SHEET 4.

FIG. 13.

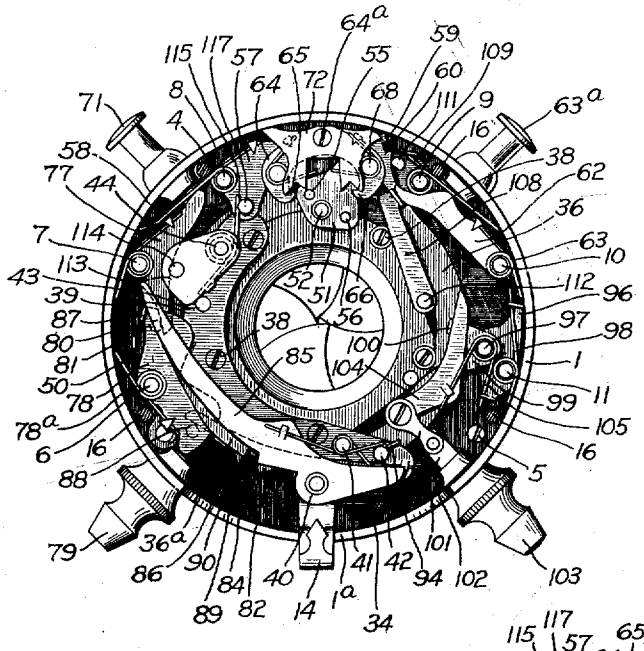


FIG. 17.

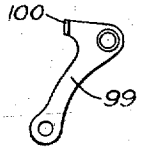


FIG. 18.

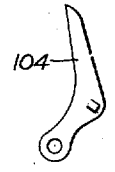
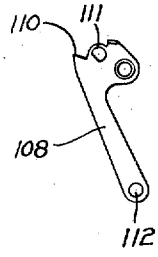


FIG. 16



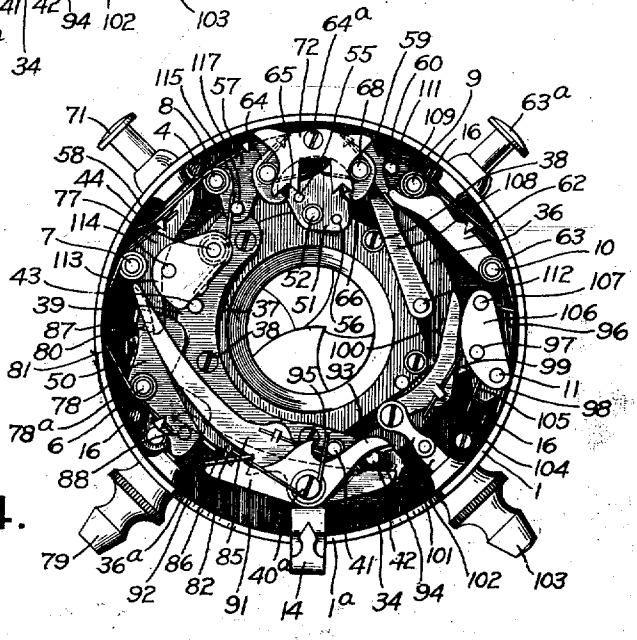


FIG. 14.

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9 SHEETS—SHEET 5.

FIG. 19.

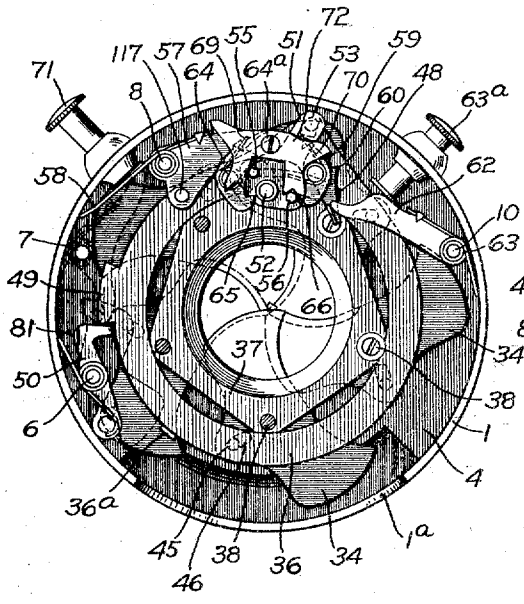


FIG. 20.

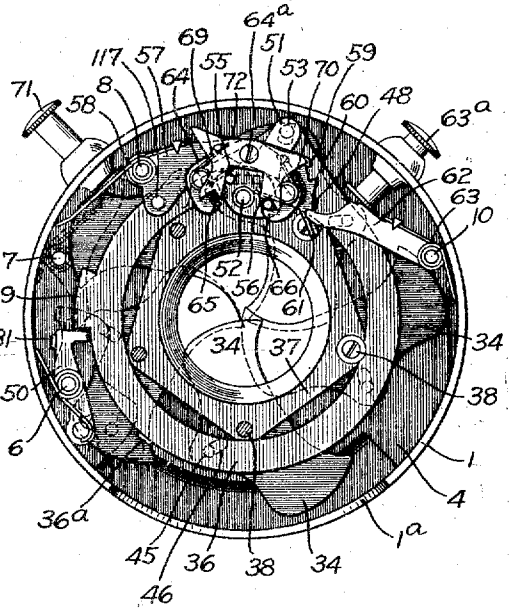


FIG. 21.

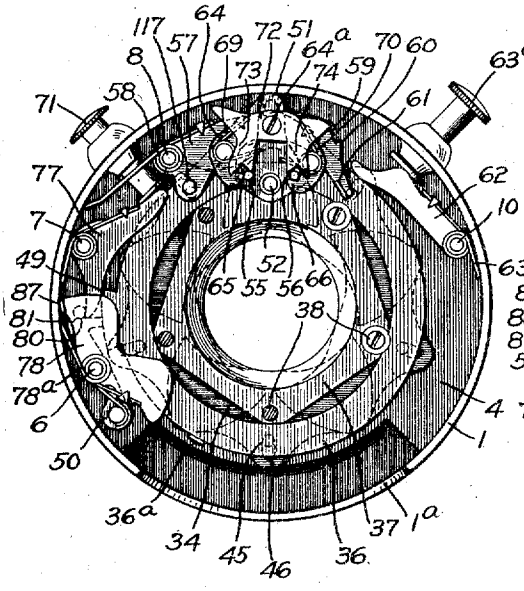
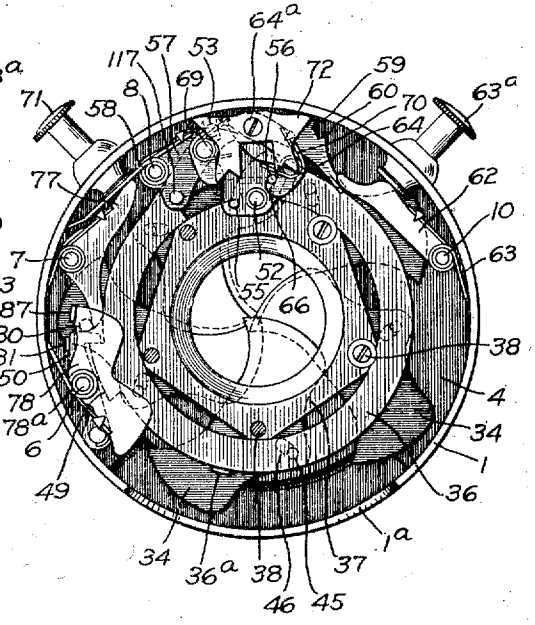


FIG. 22.



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Patented June 14, 1910.

9 SHEETS—SHEET 6.

FIG.23.

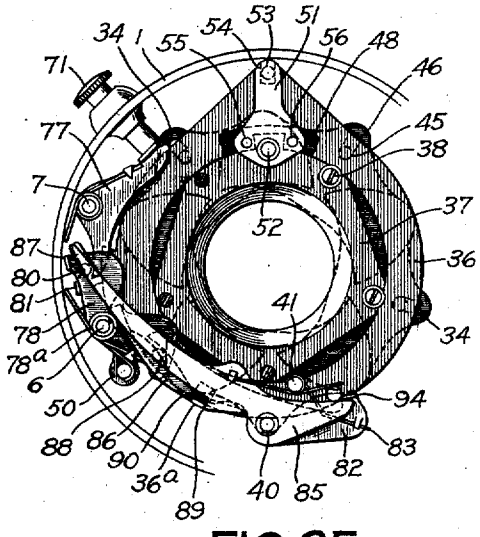


FIG.24.

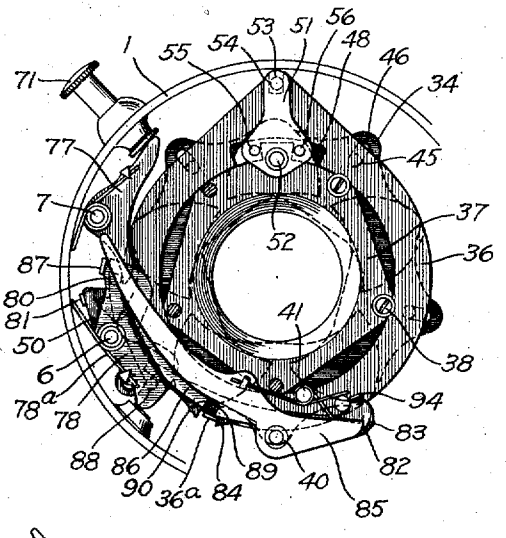


FIG.25.

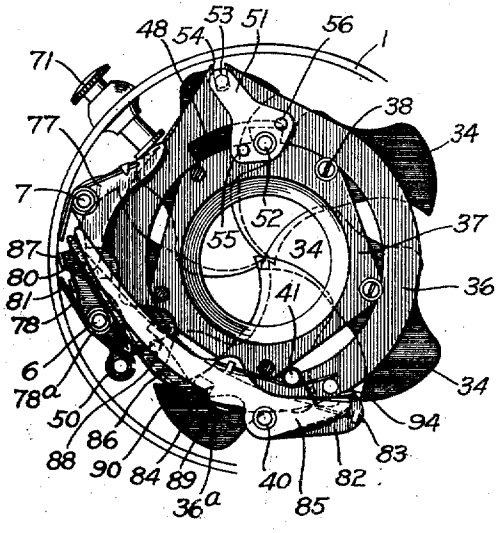


FIG.26.

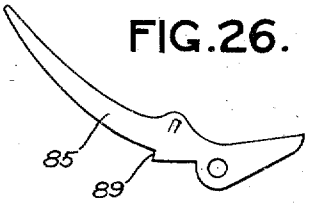


FIG.27.

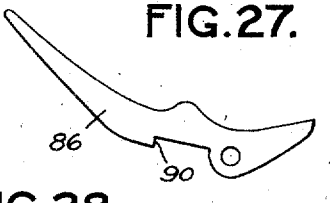
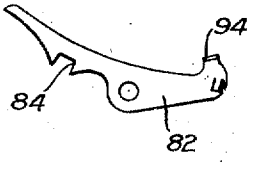


FIG.28.



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APPLICATION FILED AUG. 9, 1909.

961,192. Patented June 14, 1910.

9 SHEETS—SHEET 7.

FIG. 29.

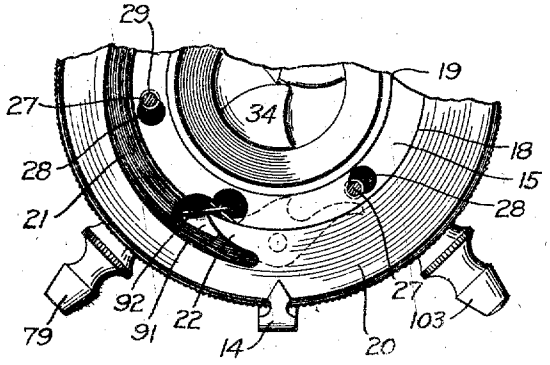


FIG. 30.

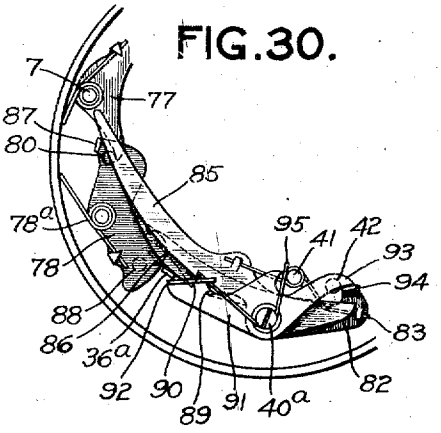


FIG. 31.

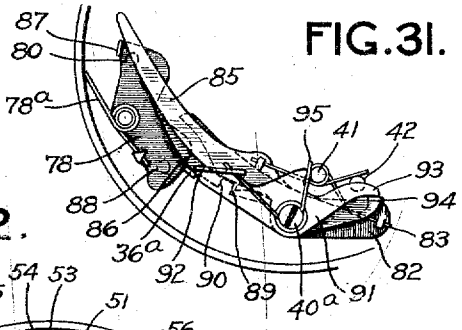


FIG. 32.

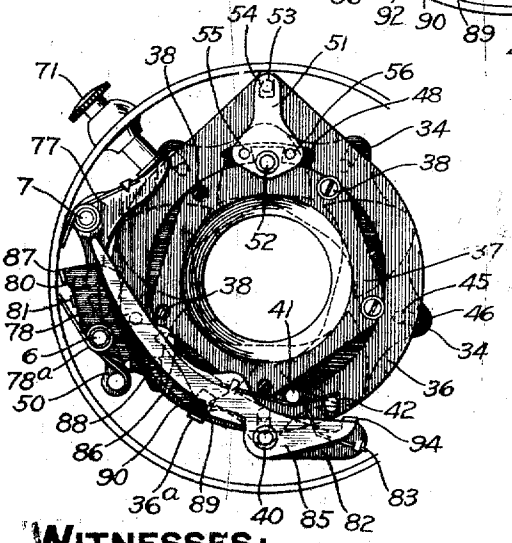
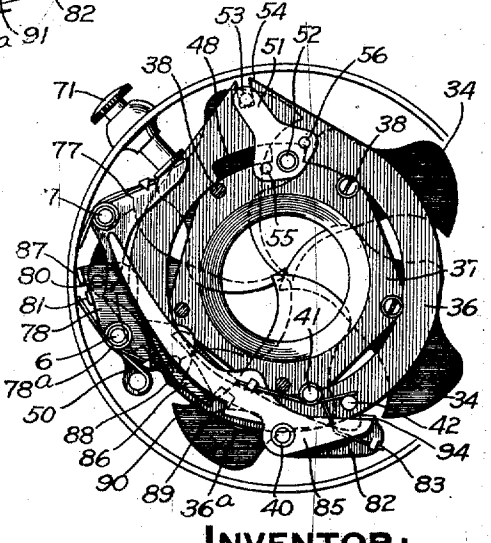


FIG. 33.



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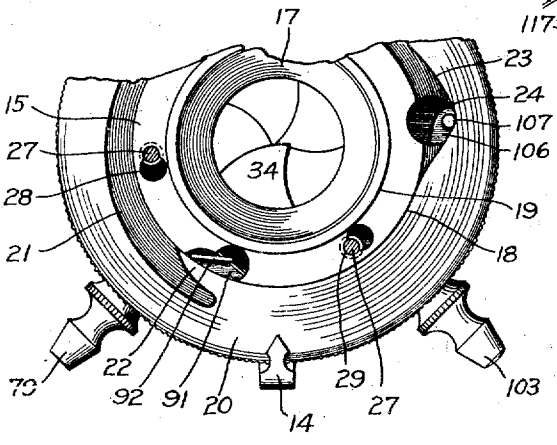
9 SHEETS—SHEET 8.

FIG.34.



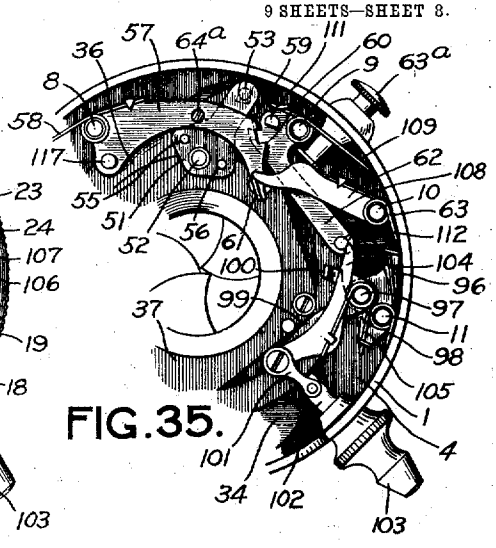
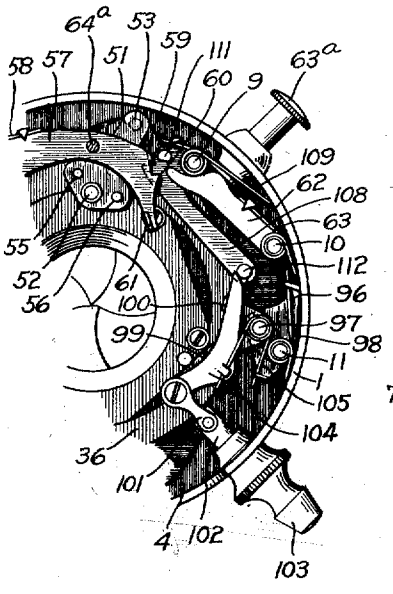
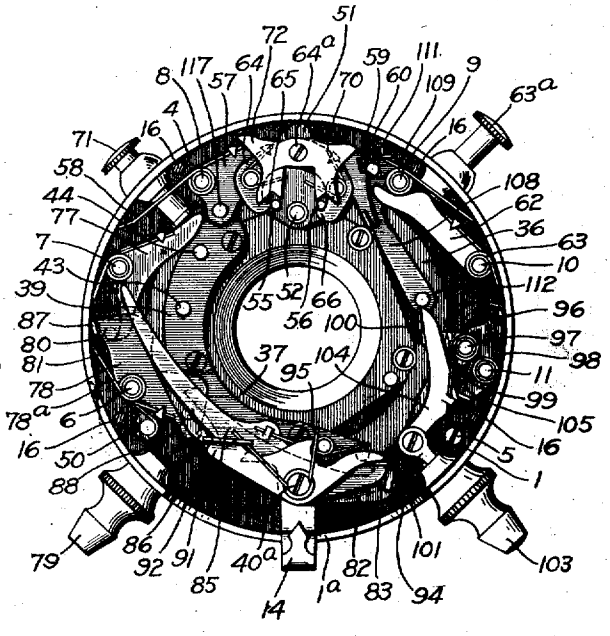


FIG.35.

FIG.37.

FIG.36.





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Patented June 14, 1910.

9 SHEETS—SHEET 9.

FIG. 38.

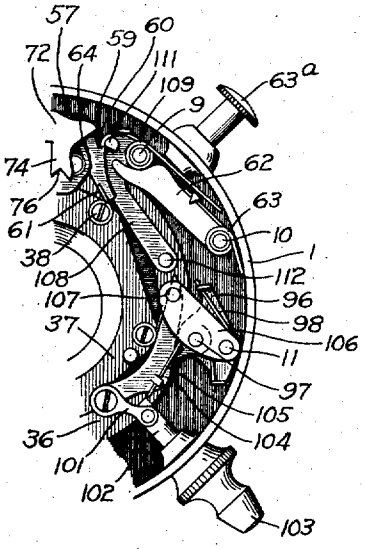


FIG. 39.

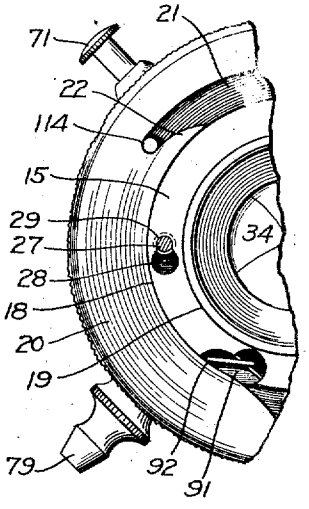


FIG. 40.

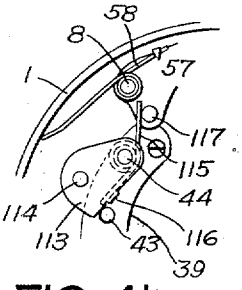


FIG. 41.

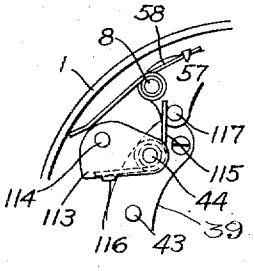


FIG. 42.

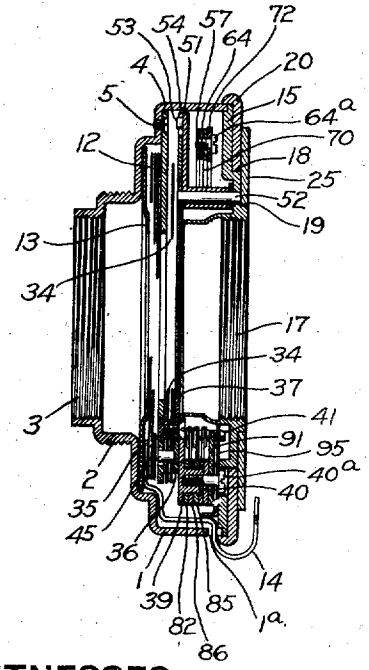
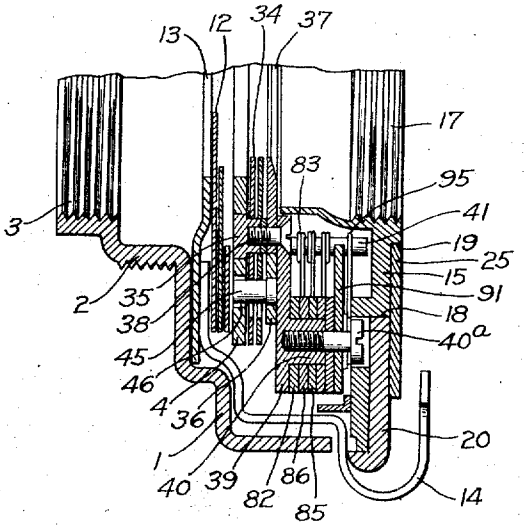


FIG. 43.



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UNITED STATES PATENT OFFICE.

ANDREW WOLLENSAK, OF ROCHESTER, NEW YORK, ASSIGNOR TO WOLLENSAK OPTICAL COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

PHOTOGRAPHIC SHUTTER.

961,192. Specification of Letters Patent. Patented June 14, 1910.

Application filed August 9, 1909. Serial No. 512,044.

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 relates to photographic shutters, and consists in the apparatus hereinafter described and claimed.

The object of the invention is to produce an efficient and satisfactory between-the-lens shutter, capable of high speeds and operating without jar. The shutter may be supplied with means for producing certain high speeds adapted to photograph rapidly moving objects. At the same time the shutter is compact and of good appearance.

In the drawings:—Figure 1 is a front elevation of the shutter complete, on a smaller scale than the succeeding figures; Fig. 2 shows the shutter casing with all parts removed therefrom except the shutter blades and their supporting plate; Fig. 3 shows the same parts, and, in addition, the blade-actuator and a pivot-support; Fig. 4 is a front elevation of the shutter with the scale plate removed, showing the cam-ring; Fig. 5 is a front elevation of the shutter showing the cover plate, the cam-ring being removed; Fig. 6 is a rear view of the device for locking certain parts of the casing together; Fig. 7 is a partial bottom plan of the same locking device with a part of the shutter casing; Fig. 8 is a view similar to Fig. 3, with certain parts added; Fig. 9 is the same as Fig. 8, but with the motor-lever, the retarder mechanism, the setting-lever, and the "time" and "bulb" detents in place; Figs. 10, 11 and 12 show the parts of the motor-lever; Fig. 13 shows the same parts as Fig. 9, with the addition of the secondary motor spring; Fig. 14 is the same as Fig. 13, with the addition of the detent controller lever and the retarder controller; Fig. 15 shows the bulb release-lever; Fig. 16 shows the main trip lever; Fig. 17 shows the retarder lever; Fig. 18 shows the retarder trip; Fig. 19 shows the blade-actuating parts during the setting movement; Fig. 20 shows the same parts after the setting operation is completed; Fig. 21 shows the same parts while the shutter is open during release; Fig. 22 shows the same parts when the shutter-blades have completed their movement; Fig. 23 shows the position of the detents when the shutter is open during a "time" exposure, the release-button being depressed; Fig. 24 shows the same parts after the release-button is freed; Fig. 25 shows the same parts with the release-button again depressed, the shutter-blades having closed; Figs. 26 and 27 show the "bulb" detents; Fig. 28 shows the "time" detent; Fig. 29 is a view similar to Fig. 4, showing the shutter set for a "bulb" exposure; Fig. 30 shows the position of the detents when the cam-ring is set as in Fig. 29; Fig. 31 shows the position of the detents when the cam-ring is set for a slow-speed instantaneous exposure; Fig. 32 shows the blade-actuating parts and the detents while the shutter is open during an instantaneous exposure; Fig. 33 shows the same parts after the shutter has closed; Fig. 34 is a view similar to Figs. 4 and 29, showing the shutter set for instantaneous exposures of the slowest speed; Fig. 35 is a partial view showing the setting-button depressed, and the main trip lever about to engage the retarder trip; Fig. 36 shows the same parts after the main trip lever has fully engaged the retarder trip; Fig. 37 shows the same parts, and also the detents, while the shutter is open during an instantaneous exposure; Fig. 38 shows the position of the retarder mechanism when the shutter is open during a fast instantaneous exposure; Fig. 39 shows the position of the cam-ring when the shutter is set for instantaneous exposures of the highest speed; Fig. 40 shows the high-speed lever and spring in the inoperative position; Fig. 41 shows the same parts in operative position; Fig. 42 is a central, vertical section through the complete shutter; and Fig. 43 is an enlarged central vertical section through the lower part of the shutter.

The casing 1, within which the shutter-blades and the operating parts therefor are inclosed, is circular in form (Fig. 2). On the rear of the casing is a screw-threaded extension 2 (Fig. 42) adapted to enter the lens-board of a camera and so to support the

shutter in the proper position. This extension is also internally threaded at 3 to receive the rear combination of the lens.

A plate 4, fitting the inner periphery of the casing 1, is fastened to the latter by means of screws 5 (Fig. 2), and carries projecting studs 6, 7, 8, 9, 10 and 11 on its front side. Said studs serve as pivotal supports for certain operating parts. Between the plate 4 and the extension 2 is a depression (Fig. 42) in which is contained the iris diaphragm 12. The leaves of said diaphragm are pivoted on the rear side of the plate 4, and are moved by a ring 13 that has an operating arm 14 projecting through a slot 1^a in the lower edge of the casing 1.

The front of the casing is closed by a cover plate 15, Fig. 5, that is fastened in place by screws 16. An internally-threaded aperture 17 in said plate is adapted to receive the front combination of the lens. On the front side of the cover plate 15 are circular shoulders 18 and 19, the latter being smaller in diameter and projecting farther forward than the cover plate (Figs. 5 and 42.)

A flat ring 20, Fig. 4, (hereinafter designated the cam-ring) lies against the face of the plate 15, and has an annular bearing on the shoulder 18. Said ring has a knurled outer edge, so that it may be easily turned in either direction. The inner edge, which bears upon the shoulder 18, is irregular in form, having on one side an aperture 21 terminating in a wedge or cam-face 22, and on the other side a cam 23 that extends outwardly from the shoulder 18 to a notch 24, in an eccentric curve. By rotating the cam-ring 20, the irregular inner edge acts on certain parts that project through the cover plate 15 in ways to be described in detail hereinafter.

Against the front face of the cam-ring is the scale plate, which consists of a ring 25, Fig. 1, fitting around the shoulder 19 and of larger diameter than the annular shoulder 18. Said ring carries a series of figures near its upper edge, indicating the different exposures for which the shutter may be adjusted, and near its lower edge other figures to indicate the diaphragm opening and cooperating with the arm 14. By rotating the cam-ring 20 as aforesaid, until an indicator 26 thereon is opposite the desired figure on the scale plate 25, the shutter parts may be brought to the proper positions to accomplish the desired exposure. The scale plate 25 is so attached to the cover plate 15 that it may be removed only by some one familiar with its construction. The internal mechanism of the shutter, therefore, cannot be reached and tampered with by a novice, as the scale plate and cam-ring must be removed before the screws 16 that hold the cover plate 15 in place become visible.

On the rear side of the scale plate are projecting studs 27 (Figs. 5, 6 and 7) having enlarged heads that are adapted to enter a corresponding number of keyhole slots 28 in the cover plate 15. Said slots are large at one end and small at the other, so that if the heads of the studs 27 are pushed through the large portions of the slots, and the scale plate 25 is turned slightly in a clockwise direction, the heads pass under the contracted portions 29 of the slots 28 and cannot be taken out except by turning the scale plate in a contrary direction. It may be seen from Figs. 4 and 5 that the shanks of the studs 27 closely fit the smaller parts 29 of the keyhole slots 28.

Near one of the slots 28 is a pivot 30, projecting inwardly from the plate 15, and carrying a latch 31, (a rear view of which is shown in Fig. 6). The lower end 32 of the latch projects into the slot 1^a, Figs. 7 and 42, at the bottom of the casing 1, and may be operated by a suitable tool such as an awl inserted therein, and may be swung either upward or downward about the pivot 30. When swung upward (see full lines, Fig. 6, and dotted lines, Fig. 5), a tongue 33 on the latch is brought close up to the adjacent stud 27, and lies in line with the stud and the pivot 30, thus forming an abutment which the stud cannot push aside when an attempt is made to turn the scale plate 25. The scale plate is thus securely locked to the cover plate 15, holding the cam-ring 20 in place, and may be turned and removed only after the latch 31 is swung downward (see dotted lines, Fig. 6). As the latch is practically invisible, the shutter is unlikely to be opened by an incompetent person.

The shutter proper comprises a series of pivoted blades, equal in size, and adapted to be moved simultaneously about their respective pivots by means of a connector that is attached to all of them. The blades 34, in the present instance, are of a modified crescent form, (Fig. 2) and are spaced at equal distances from each other on studs 35 that are set in the main supporting plate 4. The central aperture in the said plate is completely closed by the blades when the latter occupy the position shown in Fig. 2, as each blade then overlaps the adjacent one. The lowermost blade is double, *i. e.*, one blade is placed close to the plate 4, and another is placed on the same pivot, in front of the remaining blades, Fig. 42, so that the central overlap of the blades is thoroughly covered on both sides, as a safeguard against light leakage.

For one operation of the shutter the blades are simultaneously turned on the pivots 35 from the position shown in Fig. 2, through approximately 45 degrees, in a counter-clockwise direction. When the

blades have reached this position, the exposure-aperture is fully open. To close the shutter, the blades are moved in the same direction until they stand at right angles to the position shown in Fig. 2, the opposite ends over-lapping, Fig. 22. To accomplish the next exposure, the blades are moved in the reverse direction (clockwise), and after exposure again occupy the position shown in Fig. 2. This reversal of movement is obtained by automatic means.

The blade actuator, which swings the blades 34 about the pivots 35, comprises a blade-ring 36 (Fig. 3) that is connected, through suitable mechanism, with the motor spring. Said ring is concentric with the exposure-aperture, and its inner periphery bears on the edge of a guide plate 37 that is fastened to the front faces of the pivots 35 by screws 38. Portions of said guide plate are cut away to reduce the friction of the ring 36 thereon. The latter is held in its proper plane on one side by washers on some of the screws 38, and on the opposite side by an arc-shaped plate, Fig. 3, through which the remaining screws 38 pass. The plate 39 serves as a support for pivots 40, 41, 42, 43 and 44, on which certain movable parts are hung, it being impossible to fasten the pivots in suitable positions in the main supporting plate 4 because of the shutter blades and the blade actuator.

The blade ring 36 carries on its rear face a series of studs 45, which enter slots 46 in the blades 34 (Fig. 2). It is obvious that if said ring is rotated in the proper direction, the blades will be swung simultaneously about the pivots 35. The extent of movement of the ring 36 is governed by a lug 47, Fig. 3, on the guide plate 37 that projects into a recess 48 in the inner periphery of the ring. Another lug 49, on the outer periphery of the blade ring 36, cooperates with a spring-pressed latch 50 that is hung on the pivot 6. When the ring 36 is at the right-hand limit of its rotation, the latch 50 prevents it from rotating toward the left under action of the motor spring, by engaging the lower edge of the lug 49 (Fig. 3), and when said ring is at the left-hand limit of its rotation, an opposite movement is prevented by the latch engaging the upper edge of said lug. The length of the lug 49 is just equal to the distance through which any given point on the blade ring may move, as controlled by the stops forming the ends of the recess 48.

The shutter-actuating lever 51 by which the blade ring 36 is rotated from right to left, or vice versa (Fig. 8), is in effect a double bell-crank, serving to change the vertical movement of the motor or main lever (hereinafter more fully described) to the requisite movement for actuating the shutter ring 36. The lever 51 is hung on a pivot 52 that projects from the guide plate 37, and its upper end carries a pin 53 that enters a notch 54 in the ring 36. Pins 55 and 56 are set in the lower end of said lever, on the left and right side of the pivot 52, respectively, and equidistant therefrom. It is obvious from the foregoing that if upward pressure is applied to the pin 56 when the parts occupy the positions shown in Fig. 8, and the latch 50 is disengaged from the lug 49, the lever 51 will be swung about the pivot 52 until the pin 53 has carried the ring 36 toward the left to the limit of its movement, thereby causing a complete opening and closing of the blades 34. Similarly, another exposure is obtained by upward pressure on the pin 55, which tilts the lever 51 toward the right and opens and closes the shutter by moving the parts back to their former positions.

The motor lever before mentioned is supported on the pivot 8, and its construction may be clearly understood by reference to Figs. 9 to 12. The lever proper 57 (Fig. 10) is a curved arm that is normally held up against the top of the shutter casing by the action of the motor spring 58 that is coiled around the said pivot. The right-hand end of the lever has a backwardly-extending lug 59 and a projection 60, for purposes to be described. Below the projection 60 is a forwardly-extending lug 61.

The setting lever 62, hung on the pivot 10, is pressed upwardly by a spring 63 against the setting-button 63^a that extends through the casing 1 with its axis conveniently in a radius of the latter. The lug 61 on the motor lever 57 normally rests against the free end of the setting lever 62, and when the latter is depressed by pushing the button 63^a, the motor lever is swung downward on its pivot 8 and the motor spring 58 is put under tension (Figs. 19 and 20).

The motor lever 57 carries a catch that automatically engages the lowermost of the pins 55 and 56 when the lever is depressed. This catch constitutes automatic reversing means for applying the action of the motor spring to the shutter-actuating lever in either of two opposite directions. In the present instance the catch consists of a crescent-shaped piece 64 (Fig. 11) that is pivoted at its upper center on a stud 64^a on the lever 57. The lower ends of the catch terminate in hooks 65 and 66, and between said hooks and the stud 64^a are studs 68, on which are coiled springs 69 and 70. The upper ends of these springs engage lugs on the edge of the piece 64, and their free ends project into the spaces above the hooks 65 and 66.

When the motor lever 57 is depressed by

the setting lever 62, the catch 64 moves downward with it. If the shutter-actuating lever 51 stands as shown in Fig. 8, the pin 55 is uppermost, and is struck by the free end of the spring 69 as the catch 64 approaches it. This causes the catch to tilt about its pivot 64^a and the hook 66 slips down along the right side of the pin 56 (Fig. 19) and when past it, said hook is carried underneath said pin (Figs. 19 and 20) by the action of the spring 69, which, by its pressure against the pin 55, tends to turn the catch 64 in a clockwise direction. This constitutes the operation of setting the shutter. When the latch 50 is moved away from the lug 49, by means of suitable release mechanism controlled through the release button 71, the motor spring 58, being in tension, instantly raises the lever 57, and therefore the catch 64. The hook 66 on the latter exerts an upward pull on the pin 56, and the actuating lever 51 is thereby swung to the left (Figs. 21 and 22) moving the blade ring 36 to its limit as before described, causing a complete opening and closing of the shutter blades 34. The parts are then ready to be reset for another exposure, and by pressing the button 63^a the motor lever 57 is again moved downward. This time the pin 56 is uppermost, and is therefore struck by the spring 70, which causes the catch 64 to tilt toward the left. The hook 65 then passes along the pin 55 and snaps under it, being held there by the action of the spring 70. A depression of the button 71 then releases the latch 50, and the motor spring 58 raises the lever 57 and the catch 64, which throws the lever 51 toward the right, causing the ring 36 to move in that direction and so again to open and close the shutter blades. It is thus seen that at each operation of the shutter the blades and parts connected therewith move in directions opposite to those followed in the preceding operation. Therefore, after one exposure, it is unnecessary to return the blades to their former position to make another exposure, obviating the use of an aperture-cover or "blind" to prevent exposure in resetting.

On the same stud 64^a that carries the catch 64, is a piece 72 (Fig. 12) that acts as a stop for the pins 55 and 56, and is operative only during slow-speed instantaneous exposures. Its function will be described in detail hereinafter. The said stop has two depending arms 73 and 74, having notches 75 and 76, respectively, in their lower ends.

The release mechanism is controlled, as before stated, by the button 71, which acts directly on the spring-pressed release lever 77 (Fig. 8) that is hung on the pivot 7. On the pivot 6, in front of the latch 50, is a lever 78 (Fig. 15), hereinafter designated as the bulb release-lever. The lower end of this lever rests upon the plunger of the pump 79 that projects through the casing and is operated by bulb-pressure. The lever 77, when depressed by the button 71, may also move the lever 78, by striking a pin 80 on the rear side of the latter. When the lever 78 is tilted about its pivot, its left edge strikes a forwardly-projecting lug 81 on the latch 50, and releases said latch from the lug 49 on the blade-actuating ring 36. The shutter blades are then free to move under the impulse of the motor spring 58. Suitable detents are provided to hold the shutter open for "time" and "bulb" exposures. The construction and operation thereof will now be described.

The "time" detent is a lever 82 (Fig. 28) that is pivoted on the stud 40. The left end of said lever is normally forced downward by the action of a spring 83 (Fig. 8). A notch 84 in its lower edge is slightly wider than a lug 36^a (Fig. 3) that projects forwardly from the outer edge of the ring 36. When the shutter is closed, the said lug occupies a position to the right or left of the notch 84.

In front of the detent 82 are the bulb-detents 85 and 86 (Figs. 26 and 27) that are also pivoted on the stud 40. Suitable springs coiled on the pin 41 and reacting against the pin 42 (Figs. 9 and 13) tend to force the left ends of these detents downward. These ends overlie the bulb release-lever 78, resting against a lug 87 at the upper end of the latter, and may swing downward when said lever is tilted (Fig. 23), and are raised by the lug 87 when the lever is raised by its spring 78^a. The spring 83 continually presses the left end of the "time" detent 82 toward a stud 88 that projects rearwardly from the lower end of the bulb release-lever 78.

The operation of these parts in making a "time" exposure is as follows: When the button 71 is depressed, the lever 77 tilts the lever 78 as described. The stud 88 raises the left end of the "time" detent 82, and the lug 87 permits the detents 85 and 86 to drop under the action of their springs. The time detent can move only until its lower edge strikes the lug 36^a (if the ring 36 occupies the position shown), but the stud 88 moves to the position shown in Fig. 23, which position it attains before the latch 50 is freed by the lever 78. When this latter action occurs, the shutter opens, under the impulse of the previously-set motor spring, the ring 36 being rotated in a counter-clockwise direction. The detent 85 has a shoulder 89 (Fig. 26) that now lies in the path of the lug 36^a, in such a position that when said lug strikes it, and stops, the shutter is fully open. The detent 86 has a similar shoulder 90, facing in the opposite direction, and said

shoulder prevents a rebounding of the ring 36 by dropping down behind the lug 36ª as soon as the latter has passed it. When the button 71 is released, the lever 78 tends to resume its normal position, and therefore to raise the ends of the detents 85 and 86, and to permit the end of the time detent 82 to move downward. Before the lug 36ª can slip off the end of the shoulder 89, it is caught in the notch 84 of the detent 82 (Fig. 24), and the shutter is thus held open, and remains open until the button 71 is again depressed. The notch 84 is slightly wider than the space between the shoulders 89 and 90. Therefore, when the detent 85 has reached its normal position, the lug 36ª escapes from the shoulder 89 and rests against the right-hand edge of the notch 84 (Fig. 24). When the button 71 is again depressed, the lever 78 is tilted as before, and the "time" detent 82 is raised, permitting the lug 36ª to escape from the notch 84. As the edge of said lug is beyond the shoulder 89, the detent 85 rests upon it, and cannot drop, although the detent 86 is free to do so. Nothing then obstructs the movement of the lug 36ª, and the shutter is therefore closed by its operating mechanism (Fig. 25). When the shutter is operated in the opposite direction, the detent 86 drops first and the shoulder 90 thereon stops the lug 36ª. On the first release of the button 71, said lug is caught as before in the notch 84, and is released therefrom on the second depression of said button, having passed beyond the shoulder 90 after the first release. To make "bulb" exposures, the "time" detent 82 is rendered inoperative, and the lug 36ª is then caught by the shoulder 89 or 90, as the case may be, and is freed therefrom as soon as the button 71 is released. The means for holding the said time detent consists of a detent controller-lever 91 (Figs. 14, 30, 31 and 37), which has a forwardly-turned end 92 that projects through the cover plate 15 (Figs. 4 and 5) into the slot 21 in the cam-ring 20 (see Fig. 29). When the latter is turned so that the pointer 26 stands at "B" on the scale, the point of the wedge or cam-face 22 moves under the end 92 and slightly raises it (Fig. 29). The opposite end 93 of the lever 91 then presses downward against the upper side of a lug 94 on the time detent 82, and holds the latter above the lug 36ª. The lever 91 is pressed away from the lug 94 by a spring 95. Said spring is coiled around the pivot-screw 40ª that enters the pivot 40 and retains all the detents thereon.

By referring to Fig. 30, which shows the position of the detents and the detent controller lever 91 when set for "bulb" exposures, it will be clear that the bulb detents 85 and 86 are free to operate as in "time" exposures. Therefore, when the button 71 is depressed, the lug 36ª strikes the shoulder 89, and is retained only as long as said button is held down. On releasing the latter, the detent 85 rises with the lever 78 and the shutter is closed by the motor mechanism. Exposures in which the shutter opens and closes on a single pressure of the release button 71 are effected by moving the cam ring 20 until the pointer 26 is at "I". The end 92 of the lever 91 is thus raised upon the inner periphery of said cam-ring (Fig. 34), and the end 93 depresses the lug 94 until it strikes the right-hand ends of both the detents 85 and 86. These detents and the detent 82 are thus prevented from dropping into the path of the lug 36ª when the lever 78 is tilted (see Fig. 37). When the button 71 is depressed, the lug 36ª is free to have its full travel, and the shutter opens and closes. Means are provided for regulating the length of time that the shutter remains open in the automatically-timed or "instantaneous" exposures. Said means comprise retarding mechanism that may be placed in the path of the motor lever for any desired portion of its stroke, together with a suitable tripping device to release said lever suddenly at the end of the period of retardation. The parts whereby this action is accomplished are illustrated in Figs. 13, 14, 16, 17 and 18.

On the pivot 11 is a plate 96 (Fig. 13) that bears a stud 97. Said plate is pressed toward the right side of the casing 1 by a spring 98. On the stud 97 is hung a lever 99 (Fig. 17) that has a lug 100 at its upper left end. Its lower end is pivotally connected to a link 101 that is attached to a plunger 102. The latter is slidable in a dashpot 103 that projects through the casing 1 and which preferably corresponds in size and appearance with the bulb-pump 79. A lever 104 (Fig. 18) is also pivoted to the link 101, and its upper end is normally pressed against the lug 100 by the action of a spring 105 that is coiled around the pivot 97 (Fig. 13) and bears against the lower end of the plate 96. This lever 104 may be called the retarder trip. In front of the lever 104 and conecting the stud 97 on the plate 96 and the stationary pivot 11, is the speed-controller arm 106, having at its upper end a stud 107 that projects through the cover plate 15 and into the path of the cam-edge 23 on the ring 20. The action of the spring 98 serves to press said stud 107 close against said cam-face. When the cam-ring 20 is turned in a clockwise direction, the face 23 forces the stud 107, and therefore the arm 106 and the plate 96, toward the left. The stud 97 is thus swung downward, moving the levers 99 and 104 nearer to the dashpot 103, (Fig. 38).

A lever 108 (Fig. 16), which may be designated the main trip-lever, is hung on the pivot 9, and through the action of a spring 109 that is coiled about the same pivot, its lower end is pressed toward the center of the shutter, but movement in this direction is limited by one of the blade-pivot screws 38 (Figs. 13 and 14). On the upper end of said lever, to the left of the pivotal center, is a shoulder 110, and between said shoulder and the pivot 9 is a stud 111 that has a flat lower side. The shoulder 110 is in such a location that it is caught by the lug 59 on the motor lever 57 when the latter moves downward, and the lower end of the lever 108 is thus swung toward the right. The stud 111 is in such a location that it is struck by the projection 60 on the motor lever 57 when the latter moves upward, and the lever 108 is thereby swung toward the left. On the lower end of said lever 108 is a stud 112 that is adapted to strike the upper end of the retarder-trip 104 when the latter is in its normal position, but which swings clear of said trip when the parts are set as shown in Fig. 38.

With the pointer 26 set at "I" on the scale, the detents 82, 85 and 86 are prevented from interfering with the movement of the shutter-actuating ring 36, as before described. When the setting-button 63^a is depressed, the motor lever is moved downward, and the catch 64 engages one of the pins 55 or 56. At the same time the lower end of the main trip lever 108 is swung over against the retarder-trip 104, and the latter is moved toward the right (Fig. 35) until the stud 112 slips over its upper end, which occurs before the motor lever reaches its downward limit of movement. As soon as the stud 112 has passed over the top of the trip 104, the spring 105 again presses the latter against the lug 100 on the retarder-lever 99, and as soon as the motor lever is completely set, the action of the spring 109 carries the main trip lever 108 toward the left until the stud 112 rests against the right upper edge of the retarder trip 104 (Fig. 36). When the parts are in this position, there is a slight space between the stud 111 and the projection 60 on the motor lever. If the release button 71 is then depressed, the ring 36 is freed from the latch 50, the motor lever 57 flies upward under the impulse of the motor spring 58, and the shutter is fully open when the projection 60 strikes the lower side of the stud 111. In order to move farther, the motor lever must swing the main trip lever 108, which, resting against the trip 104, causes the latter and the lever 99 (both being in effect one lever) to swing inwardly, pushing the plunger 102 into the dashpot 103. As the dashpot is closed at its outer end, the air within it can escape only around said plunger, and as the latter fits the said dashpot closely, it can move but slowly, and at a uniform rate of speed. As the stud 112 is several times farther from the pivot 9, than is the stud 111, it is obvious that the latter need move vertically but a short distance in order to swing the stud 112 to the point at which it slips off the upper end of the retarder trip 104 (Fig. 37). Therefore, no appreciable movement of the shutter blades occurs during the time that the retarder mechanism is in operation. When the retarder parts are in this position (Fig. 37) the projection 60 has moved to the left edge of the flat lower side of the stud 111, and slips off the latter at the same instant that the stud 112 slips off the trip 104. The motor lever 57 then being free to move through the remainder of its stroke, the shutter is instantly closed. The spring 109 then returns the main trip lever 108 to its normal position.

During the movements just described, the stop 72 hereinbefore mentioned, becomes operative. Its purpose is to prevent a rebound of the shutter-blades and actuating-ring when the projection 60 strikes the stud 111. In the "time" and "bulb" exposures this rebound is prevented by the detents 85 and 86. If the stop 72 were removed, the actuating lever 51, when moved by the hook 66, would fly past the center and over to the left side, under the impulse of the motor spring, because the hook 65 would not be in position to catch the pin 55. With said stop in place, the pin 55 strikes the inner or right hand edge of the arm 73 at its extreme end as the lever 51 moves from right to left, and tends to turn the stop around the stud 64^a in a clockwise direction. Movement in this direction is prevented, however, by the arm 74, because the notch 76 in its end comes down on the pin 56, which is moving toward it. Thus movement of the stop in one direction is prevented by the pin 55, and in the other direction by the pin 56, the action and reaction through said stop occurring instantaneously. As a result, the movement of the blades 34, the ring 36, and the actuating lever 51 is arrested just as said blades are fully opened, and at that point the projection 60 strikes the stud 111 and the retarding mechanism becomes operative. The shutter-operating parts then occupy the positions shown in Fig. 21, the pin 55 having just passed off the end of the arm 73. On a reverse movement of the actuating lever 51, the pin 56 strikes the left side of the arm 74, and the notch 75 comes down upon the pin 55, resulting in the same effect as before.

The length of time the shutter remains open is determined by the position of the retarder trip 104, which is governed by the

cam-face 23, acting through the stud 107, the arm 106, the plate 96 and the stud 97. The farther the cam-ring is turned toward the left, the lower the end of the retarder trip 104 is carried, and consequently, the shorter becomes the distance the plunger 102 must move before the stud 112 slips off said trip. An exposure of practically any desired length may thus be obtained. When the retarder trip 104 has been lowered so far that the stud 112 passes without striking it (Fig. 38), the shutter opens and closes at the highest speed with which the spring 58 is capable of driving the actuating parts. To provide for still higher speeds, an auxiliary spring is used, that is normally inoperative, but which is wound up and exerts its pressure on the motor lever when the cam-ring is turned far enough to engage its controlling parts. Said spring is illustrated in Figs. 40 and 41. On the pivot 44 is an arm 113, from which a stud 114 projects into the slot 21 in the cam-plate 20. The auxiliary spring 115 (which is preferably stronger than the spring 58) is coiled around the pivot 44, back of the arm 113. One end of said spring is caught against a lug 116 on said arm, and its other end rests against a stud 117 on the motor lever 57, below the pivotal point of the latter. Normally, the spring 115 is under very slight tension, just sufficient to hold the arm 113 against the post 43 (Fig. 40). When the cam-ring 20 is moved far enough, the wedge or cam-face 22 thereon wedges under the stud 114 (Fig. 39), and swings said arm toward the left (Fig. 41) partially winding up the spring 115. The upper end of the latter then presses with considerable force upon the stud 117, so that its power is added to that of the main motor spring 58 when the shutter is operated, and a very rapid exposure is obtained. Owing to the form of the shutter-blades, and their simultaneous operation, the whole plate is covered at the instant of exposure, which is a distinct advantage in extremely rapid work, as it obviates the distortion that is common in the use of the curtain type of shutter.

It will be noted from the drawings that the pump 79, the retarder dashpot 103, the setting-button 63^a and the release button 71, are disposed at equal intervals around the circumference of the shutter-casing. This construction gives the shutter an exceedingly trim and symmetrical appearance (Fig. 1), the diaphragm-lever 14 being the only other visible moving part.

What I claim is:—

1. In a photographic shutter, a casing; shutter mechanism inclosed therein; a fixed plate within said casing having keyhole slots therein; a scale plate forming the front of said casing and having posts provided with enlarged heads adapted to engage in said keyhole slots; and a locking lever in said casing for holding one of said posts in the narrow portion of its keyhole slot.

2. In a photographic shutter having an exposure opening, a blade movable in either of two directions to open and close said opening; a motor spring acting in one direction only; and mechanism interposed between the motor spring and the blade for operating the blade by the spring in either of two opposite directions to open and close the shutter by movement in each direction.

3. In a photographic shutter having an exposure opening, shutter blades pivoted around said opening; a ring connected to said blades for opening and closing the blades by motion in either of two opposite directions; a motor spring acting in one direction only; and mechanism interposed between the ring and the motor spring for operating said ring by the spring in either of two opposite directions to open and close the shutter by movement in each direction.

4. In a photographic shutter, a casing; shutter mechanism inclosed therein; a fixed plate within said casing having keyhole slots therein; a scale plate forming the front of said casing and having posts provided with enlarged heads adapted to engage in said keyhole slots; a locking lever in said casing for holding one of said posts in the narrow portion of its keyhole slot; and a rotary controlling plate held between said two plates and provided with cams for engaging and controlling parts of the shutter mechanism.

5. In a photographic shutter, a shutter blade; a motor spring acting in one direction only; and automatic reversing mechanism interposed between the motor spring and the shutter blade for operating the blade in opposite directions by successive spring impulses.

6. In a photographic shutter having an exposure opening, shutter blades arranged around said opening; a ring connected to said blades for operating them; a motor spring acting in one direction only; and automatic reversing mechanism interposed between the ring and the motor spring for operating said ring in opposite directions by successive spring impulses.

7. In a photographic shutter having an exposure opening, shutter blades arranged around said opening and adapted to open and close said exposure opening by a simultaneous continued movement of the blades in one direction; a ring connected to said blades for operating them; a motor spring acting in one direction only; and automatic reversing mechanism interposed between the motor spring and the ring for operating the ring in opposite directions by successive spring impulses.

8. In a photographic shutter having an exposure opening, shutter blades arranged around said opening; a motor spring acting in one direction only; a motor lever actuated thereby; a ring connected with the shutter blades for operating the same; a pivoted shutter lever connected to said ring for operating the same; and automatic reversing means for connecting said motor lever with said shutter lever for tilting it in opposite directions by successive impulses of said spring.

9. In a photographic shutter having an exposure opening, a shutter blade arranged around said opening; a motor spring acting in one direction only; a motor lever actuated by said spring; a shutter ring connected to said shutter blades; a pivoted shutter lever connected to said ring; and means for connecting the motor lever with the shutter lever selectively on opposite sides of its pivot for throwing the shutter in opposite directions by said spring.

10. In a photographic shutter having an exposure opening, a series of shutter blades pivoted around said opening; a ring connected to said blades for operating them; a motor spring acting in one direction only; a pivoted shutter lever for oscillating said ring in opposite directions; a motor lever operated by said motor spring; means for connecting said shutter lever and said motor lever for oscillating the ring in one direction by one complete operation of the motor spring; and means for connecting the shutter lever and the motor lever for oscillating the ring in the opposite direction by another complete operation of the motor spring.

11. In a photographic shutter having an exposure opening, a series of shutter blades pivoted around said opening; a motor spring acting in one direction only; an oscillating ring connected to the shutter blades for operating them; and means interposed between the motor spring and the shutter ring for oscillating the shutter ring in opposite directions by successive actions of said motor spring.

12. In a photographic shutter having an exposure opening, a series of shutter blades pivoted around said opening; a motor spring acting in one direction only; an oscillating ring connected to the shutter blades for operating them; means for placing said motor spring under tension; latch mechanism for releasing the same; and means interposed between the motor spring and the ring for operating the latter in opposite directions upon successive settings of the motor spring.

13. In a photographic shutter having an exposure opening, a shutter blade for said opening; a motor spring; means between the spring and the shutter blade for operating the latter; and a second motor spring adapted to be set to supplement the action of the first motor spring to produce higher speeds of the shutter blade.

14. In a photographic shutter, a casing; shutter mechanism inclosed therein; a fixed plate within the casing; an outer plate covering the fixed plate, the two plates being provided with interlocking devices for retaining the outer plate and said devices being disengageable by relative movement of the plates; and a locking device concealed within the casing but accessible from without and operating to prevent relative disengaging movement of the plates.

15. In a photographic shutter, a casing comprising two members; screws securing the members together; shutter mechanism inclosed within the casing; a plate covering the heads of the screws; and means concealed within the casing for locking the plate in position.

16. In a photographic shutter, a shutter blade; a motor spring; connections between the spring and the blade for actuating the blade; a second motor spring arranged to supplement the action of the first mentioned motor spring; and means for adjusting the second spring to vary its force and regulate the speed of the shutter blade.

17. In a photographic shutter having an exposure opening, a shutter blade movable in either of two directions to open and close said opening; a motor spring acting in one direction only; mechanism connecting the shutter blade and the motor spring for actuating the shutter blade in either direction; and means for arresting said mechanism when the shutter blade is in open position.

18. In a photographic shutter, shutter mechanism including a pivotally-mounted member operative in either direction to produce an exposure, said member being provided with two abutments on opposite sides of its pivotal center; a motor spring; and means for connecting the motor spring alternatively with said abutments to actuate said member in either direction.

19. In a photographic shutter, shutter mechanism including a pivotally-mounted member operative in either direction to produce an exposure; a motor spring acting in one direction only; mechanism for connecting the spring with said member to operate it in either direction; and means for arresting both said mechanism and said member when the shutter is open.

20. In a photographic shutter, shutter mechanism including a pivotally-mounted member operative in either direction to produce an exposure, said member being provided with two abutments on opposite sides of its pivotal center; a motor spring; and means for connecting the spring alternatively with the abutments to actuate said member

in either direction, said means comprising a hook-shaped member arranged to engage each of said abutments.

21. In a photographic shutter, shutter mechanism including a pivotally-mounted member operative in either direction to produce an exposure, said member being provided with two abutments on opposite sides of its pivotal center; a motor spring; means for connecting the spring alternatively with the abutments to actuate said member in either direction; a detent for arresting said means when the shutter is open; and a detent arranged to engage one of the abutments to arrest the movement of the pivotally-mounted member when the shutter is open.

ANDREW WOLLENSAK.

Witnesses:
L. THON,
C. W. CARROLL.