A. R. McPHEE.

PHOTOGRAPHIC SHUTTER.

APPLICATION FILED JAN. 10, 1913.

1,166,921.

Patented Jan. 4, 1916.

3 SHEETS—SHEET 1.

Fig. 1.

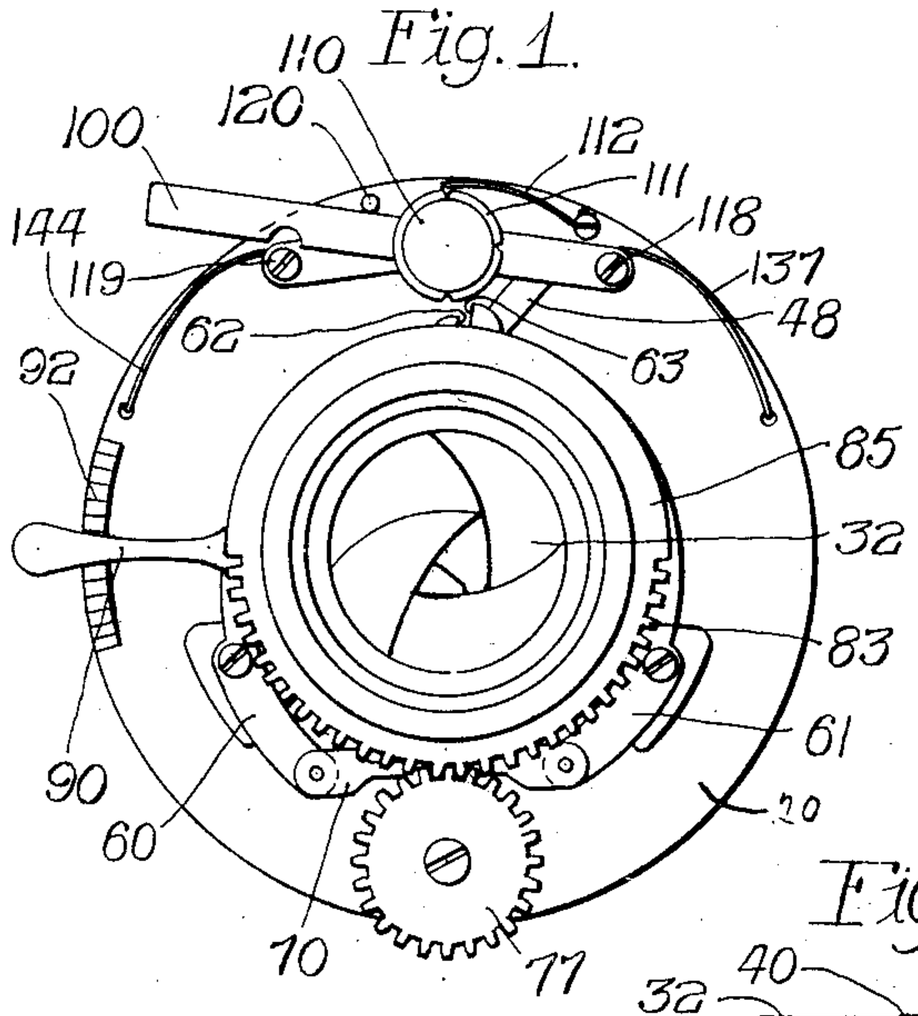


Fig. 2.

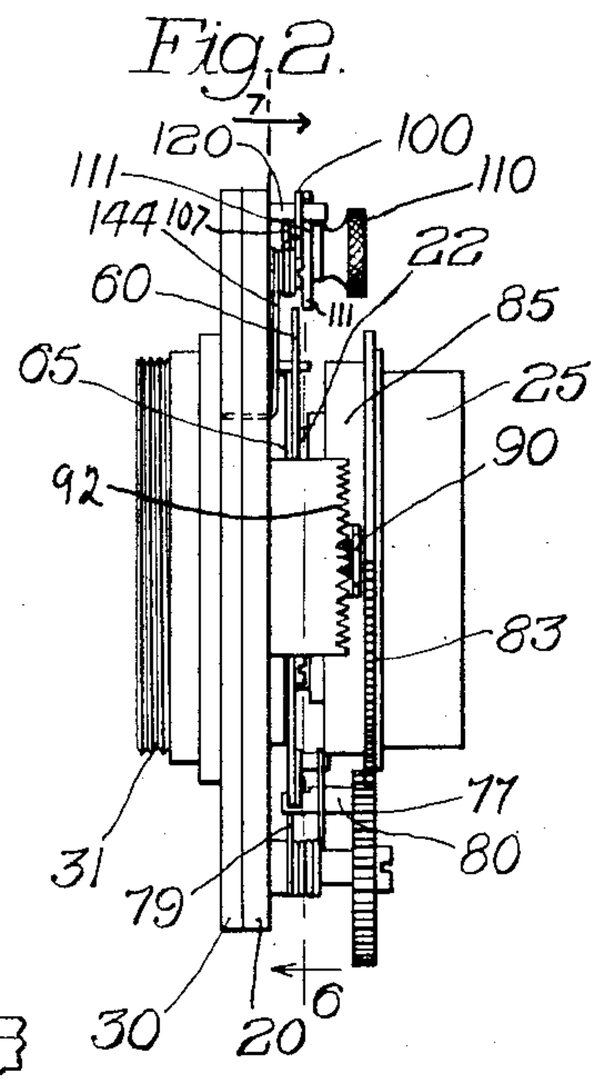


Fig. 5.

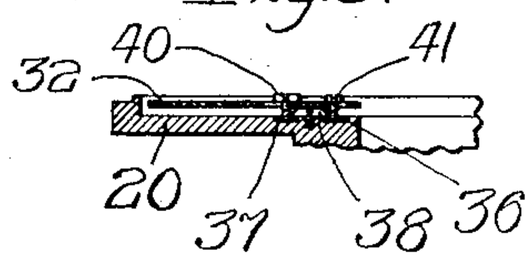


Fig. 4.

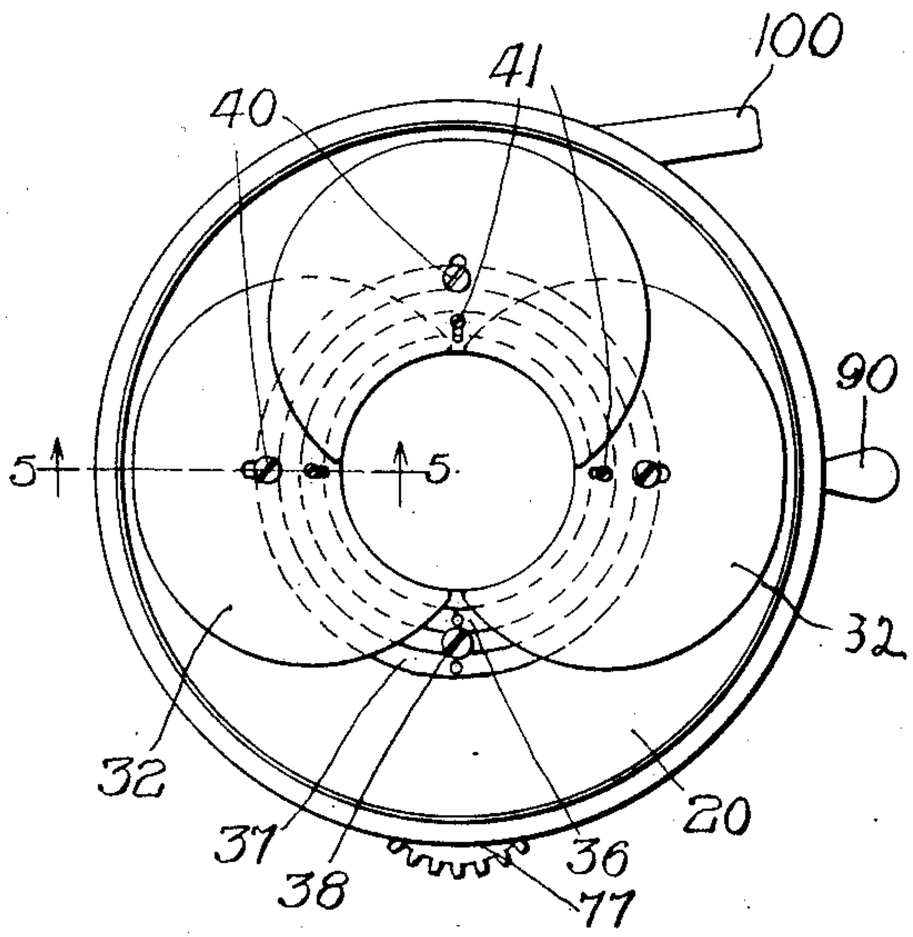
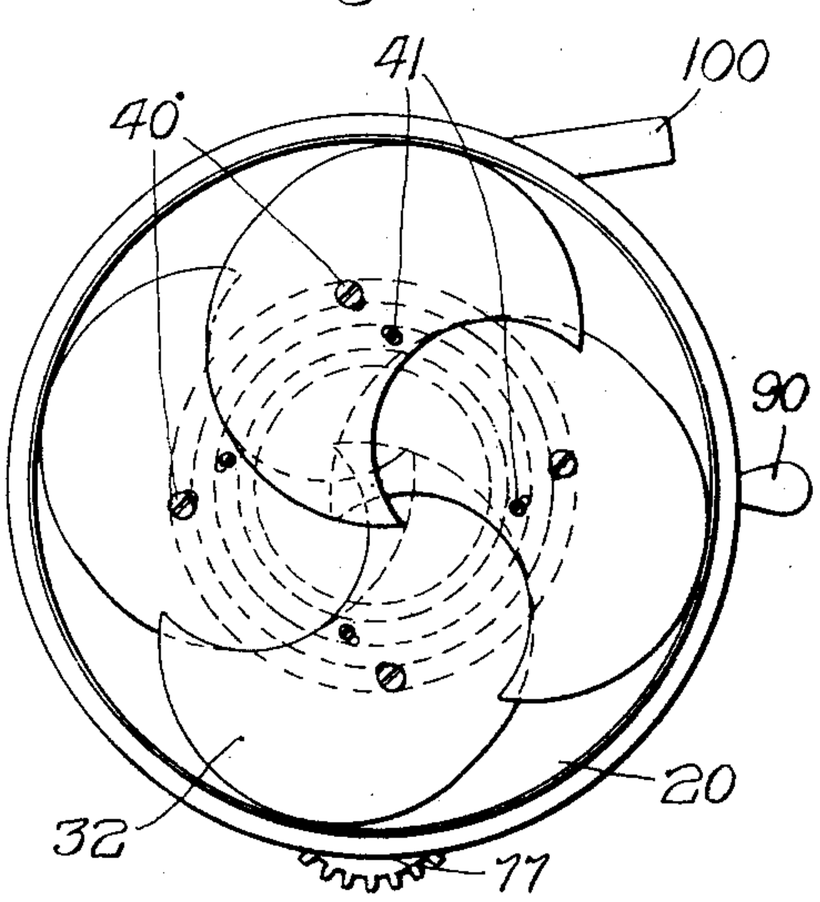


Fig. 3.



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3 SHEETS—SHEET 2.

Fig. 6.

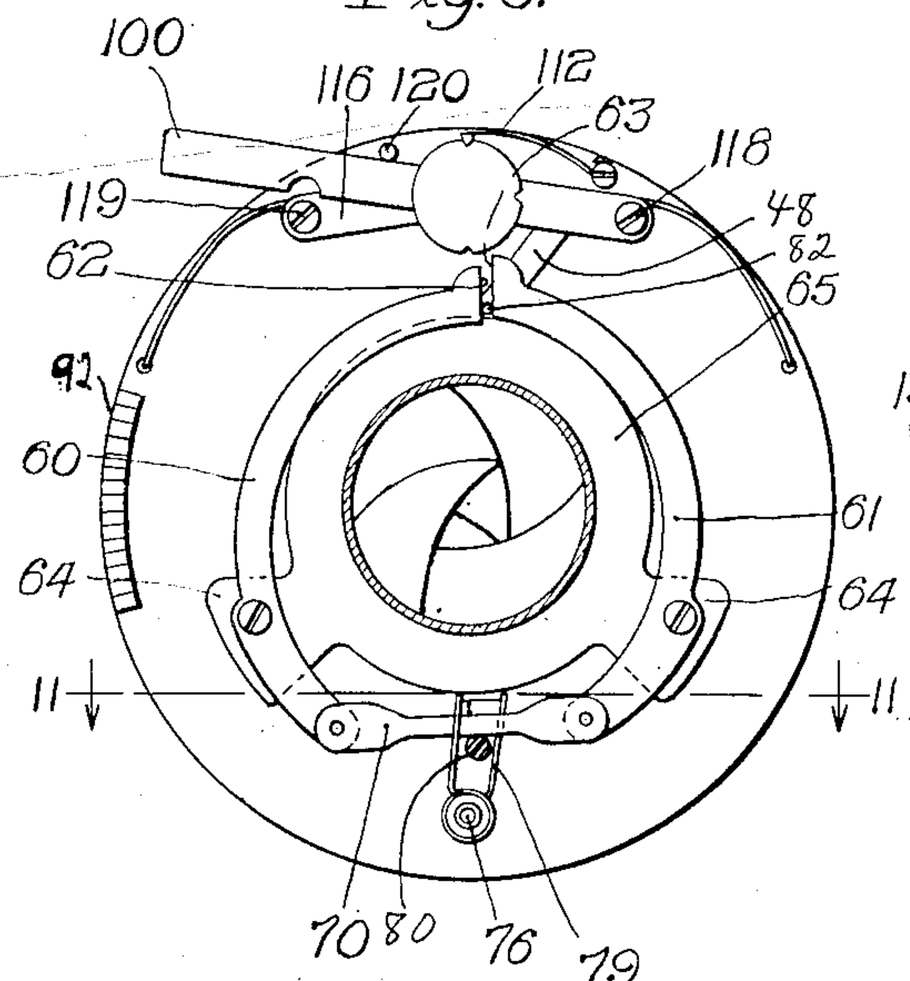


Fig. 7.

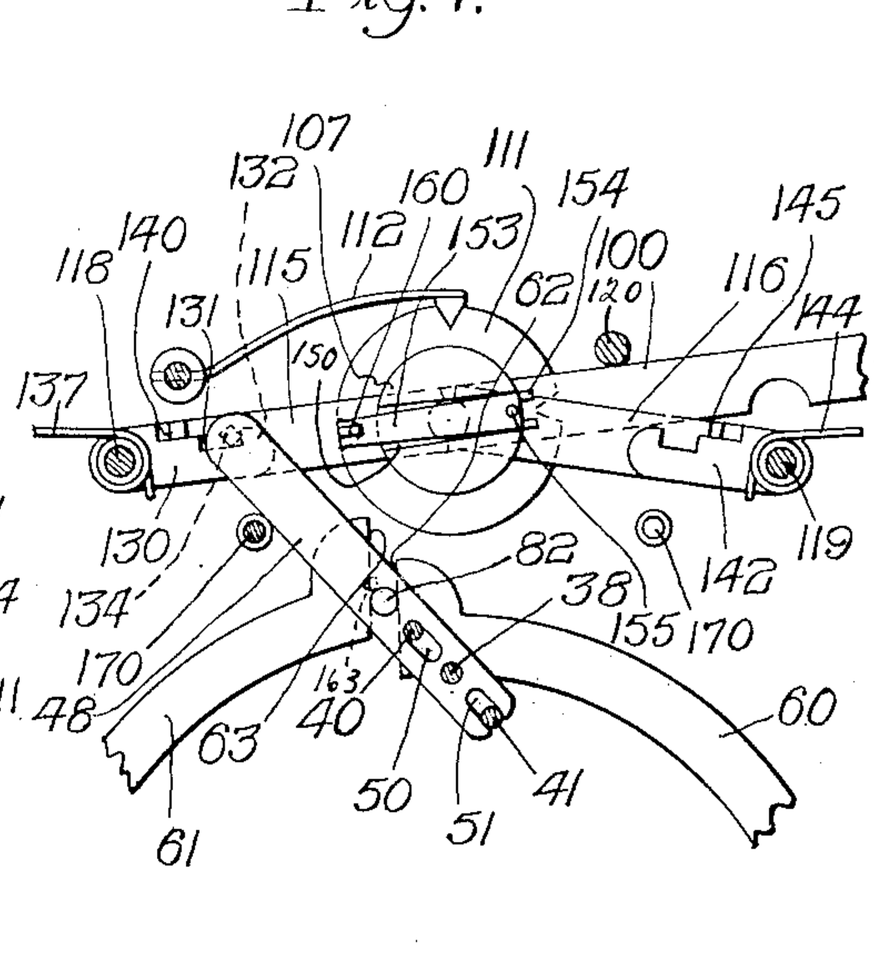


Fig. 9.

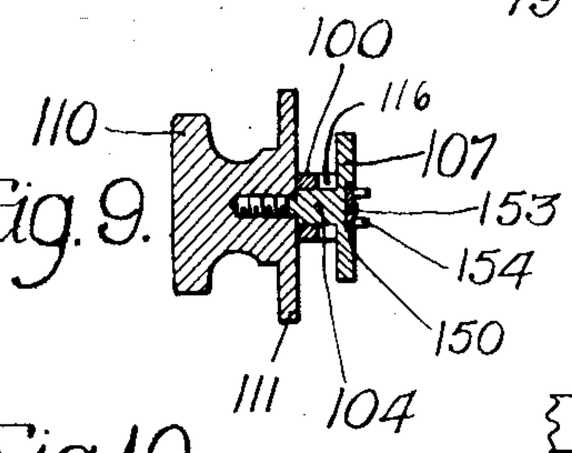


Fig. 8.

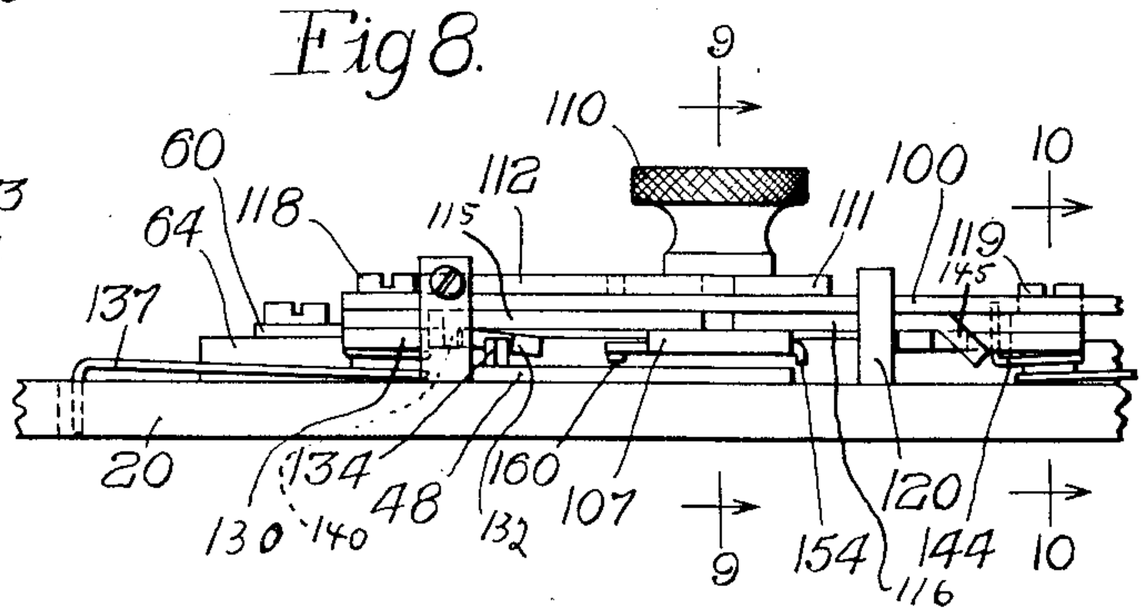


Fig. 10.

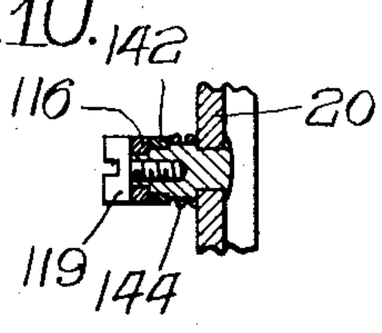
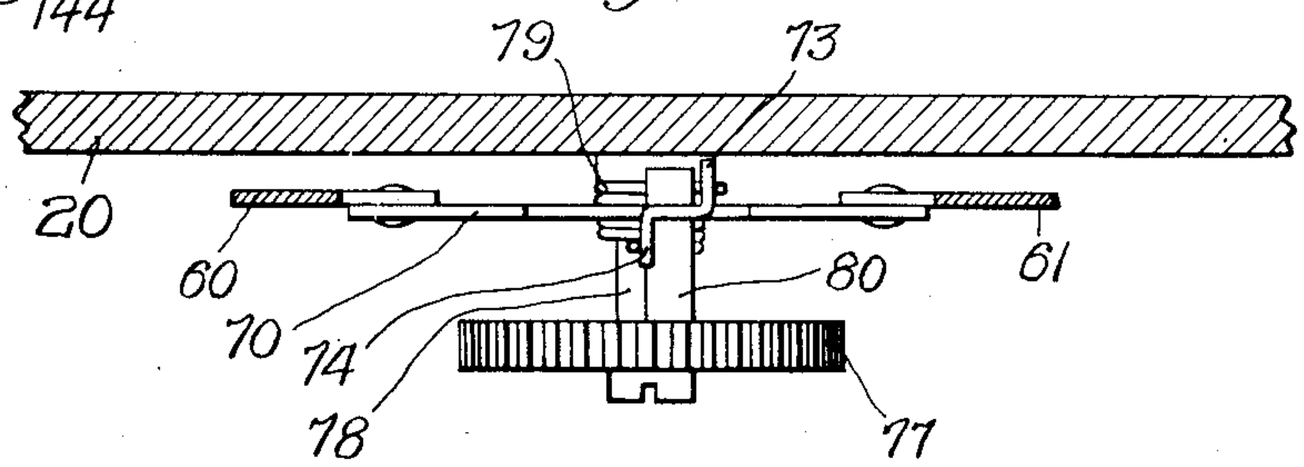


Fig. 11



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3 SHEETS—SHEET 3.

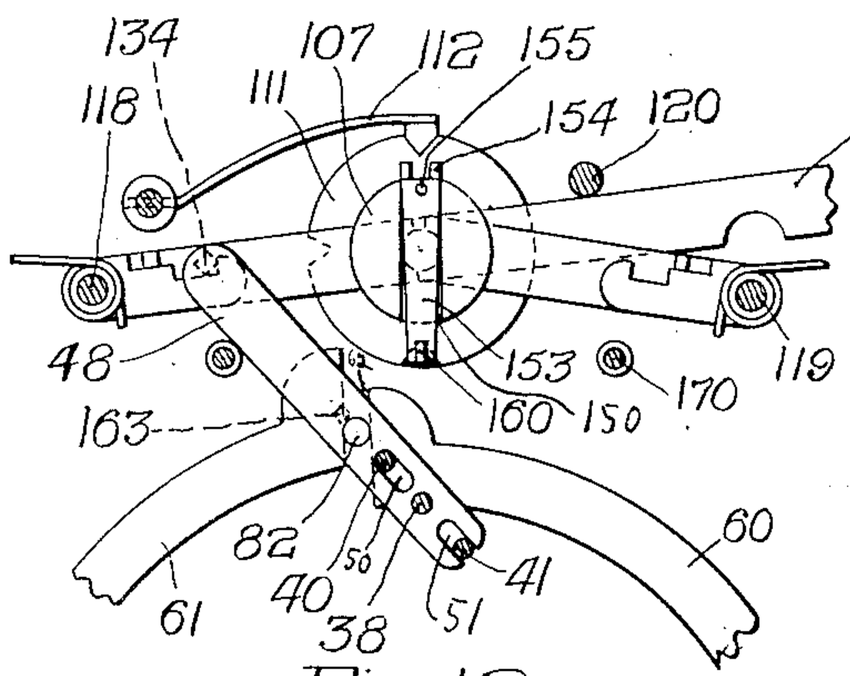

Fig. 12.

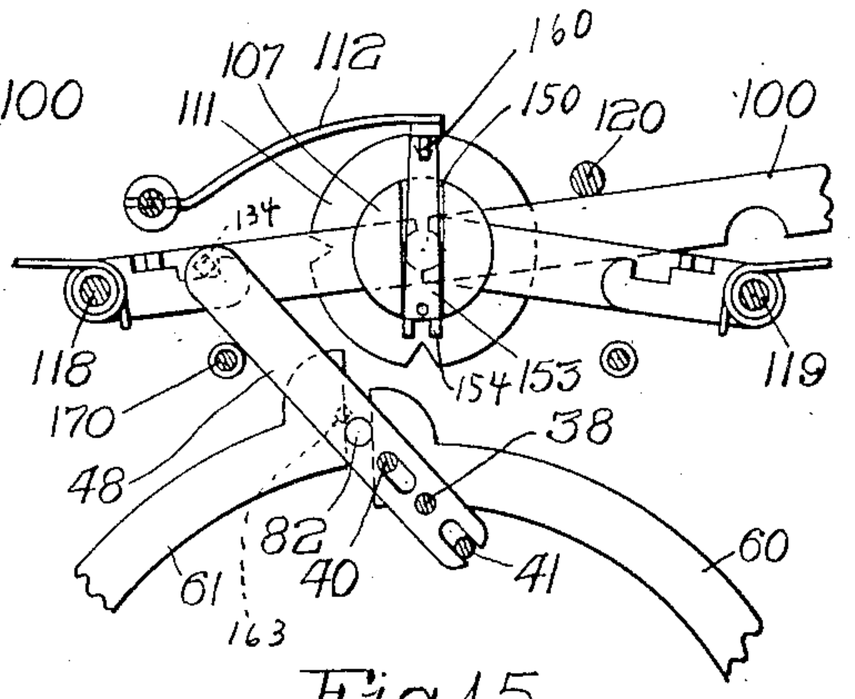

Fig. 15.

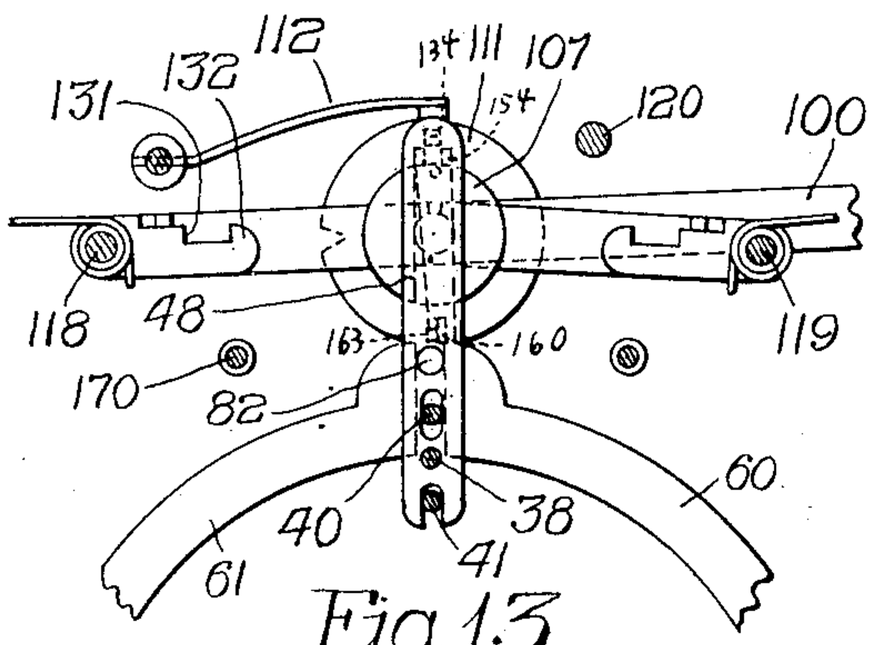

Fig. 13.

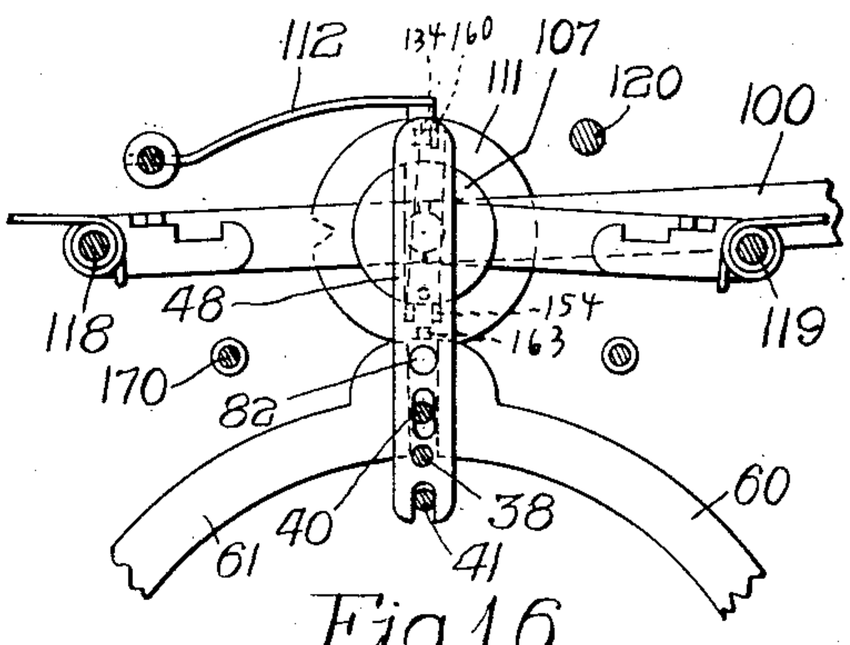

Fig. 16.

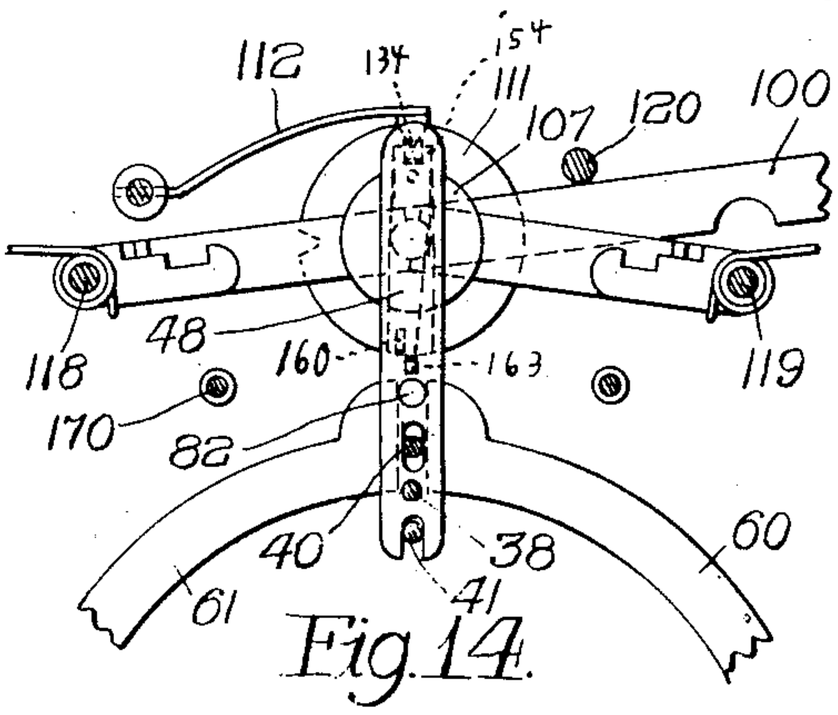

Fig. 14.

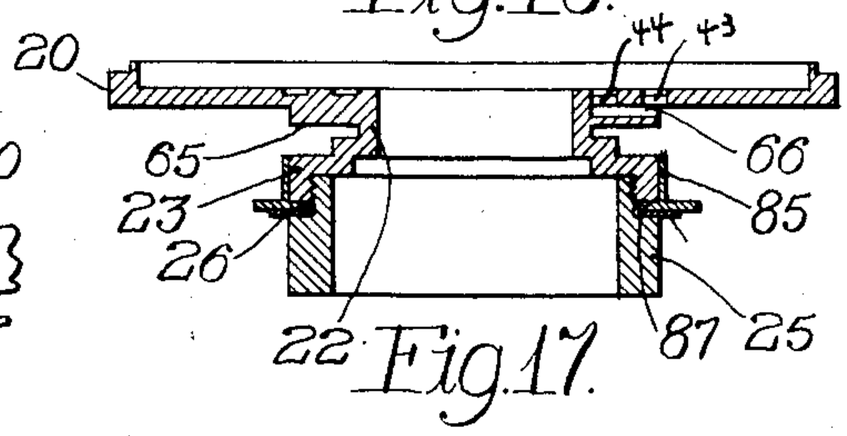

Fig. 17.

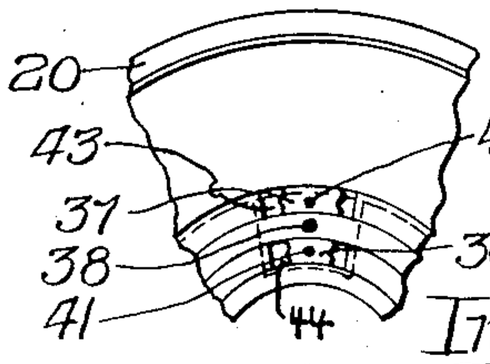

Fig. 18.

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PHOTOGRAPHIC SHUTTER.

1,166,921. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed January 10, 1913. Serial No. 741,363.

To all whom it may concern:

Be it known that I, ALLEN R. McPHEE, a citizen of the United States, residing at 544 Garfield avenue, in the city of Chicago, Cook county, Illinois, have invented new and useful Improvements in Photographic Shutters, of which the following is a specification.

This invention relates to photographic shutters.

Some of the requirements of a photographic shutter are that it must be capable of an extremely short time of exposure; that to as great an extent as possible all parts of the lens should be uncovered at the same time and again covered at the same time in order to obviate the distortion which occurs when a rapidly moving object is photographed with a shutter which exposes different parts of the plate at different instants of time. It is desirable also that the shutter should afford a maximum diameter of clear opening with a minimum total diameter in order that as large a lens as possible may be used in a small camera and the entire diameter of the lens may be uncovered. All of these requirements and others are met in the shutter hereinafter more particularly described and illustrated in the accompanying drawings in which:

Figure 1 is a view of the complete shutter in front elevation. Fig. 2 is a similar view in side elevation. Fig. 3 is a similar view in rear elevation but with the rear cover plate removed. Fig. 4 is a view similar to Fig. 3 but showing the parts in an altered position and with one of the shutter blades removed to better illustrate the parts beneath it. Fig. 5 is a horizontal section on the line 5 of Fig. 4 looking upward. Fig. 6 is a radial section on the line 6 of Fig. 2. Fig. 7 is a radial section on the line 7 of Fig. 2. Fig. 8 is a fragmentary view showing the device in top plan. Fig. 9 is a vertical section on the line 9 of Fig. 8. Fig. 10 is a vertical section on the line 10 of Fig. 8. Fig. 11 is a horizontal section on the line 11 of Fig. 6. Figs. 12 to 16 are all views similar to Fig. 7 but showing the parts in altered relations. Fig. 17 is a vertical axial section through the shutter frame with most of the operative parts removed. Fig. 18 is a fragmentary view of the shutter frame in rear elevation.

As shown in said drawings the complete shutter includes a flat circular plate 20 having a large circular opening through its center and the operative parts of the device are assembled on both sides of this plate as a supporting frame. On the rear side of the shutter plate are placed four broad crescent-shaped disks or shutter blades 32, 32, which are arranged to over-lap the opening through the center of the shutter frame to completely close it; but the blades are pivoted in such manner that by rotating them they may be arranged with their concave margins in a circle of the diameter of the shutter opening to permit free passage of light between them. On the front side of the shutter plate are arranged the actuating devices for rotating the shutter blades, including a driving spring, means for winding it, means for holding the parts stationary against the tension of the winding spring, means for releasing the moving parts, and an escapement device for effecting the proper operation of the parts to perform what are known as "instantaneous", "bulb" and "time exposures". More particularly described, these parts are as follows: The stationary frame part of the device comprises a circular plate or disk 20 having a circular opening through its center. Extending forward from the margin of the center opening is a rim or flange 22 which is enlarged to form a cylinder or barrel 23 for the accommodation of the lens. The lens cylinder is continued forward by means of a detachable ring or cylinder 25, the rear end of which is reduced in diameter and threaded to engage with the internally threaded forward end of the cylinder 23 (Fig. 17). These parts are fitted together in such manner as to provide a groove or recess 26 (Fig. 17) between the front edge of the fixed cylindric part 23 and the shoulder formed between the larger and smaller diameters of the detachable part 25, and in this groove is mounted one of the operative parts of the device, as will be described hereinafter.

A detachable cover plate 30 is fitted upon the rear side of the shutter plate 20, the latter being formed with a slight rim or flange in order to space the two plates apart and form an enclosure in which the shutter blades may operate. The plate 30 has an opening through its center to correspond with the one through the plate 20, and is similarly formed with a cylindric rim or flange around the opening and threaded as indicated at 31 for securing it to the camera. On the back side of the plate 20, surrounding the circular center opening and concentric therewith are cut two shallow circular grooves, one of slightly greater diameter than the other, and in these grooves are laid two flat rings 36 and 37. They are confined in the grooves by four small screws, one of them shown at 38 in Fig. 4, which are equally spaced in a circle between the two rings and secured into the plate with their heads over-lapping the two rings. The four shutter blades are symmetrically distributed about the circular shutter opening and are secured to these rings. Each shutter blade is formed of a thin piece of sheet metal cut approximately circular but with a part of its area cut away in a reentrant arc-shaped curve. At two points through each blade on each side of the point which would be its center if it were an accurate and complete circle are made short slots, the two slots lying in the diameter which bisects the two curves of the blade and extending in the direction of such diameter. Through these slots are inserted screws, 40 and 41, which are secured in the rings 36 and 37 respectively. It is necessary therefore only to provide means for rotating the two rings relatively to each other in order to rotate the four shutter blades about their centers which lie in a circle between the two rings, and it is evident also that by rotating the two rings in opposite directions and through equal angular distances each shutter blade may be caused to rotate without changing the position of its center of rotation, whereby is secured the maximum effective movement of the shutter blades with their minimum total movement. The parts are arranged with the center of rotation of each blade over one of the screws 38, which with their rounded heads space the shutter blades slightly from the surface of the plate 20 and thereby considerably lessen their rubbing friction.

For the purpose of rotating the two rings 36 and 37 one of the screws 40 is made somewhat longer than the others and extends entirely through the ring and, through a curved slot 43, beyond the opposite side of the plate 20; and the screw 41 which is adjacent to it in the inner ring similarly extends through a parallel slot 44. On the front side of the plate 20 is a lever 48 which is pivoted at a point between the two slots 43 and 44 and made with two lengthwise slots 50 and 51 into which extend the two long screws 40 and 41 respectively. The screw 38 which is located between these two long screws is also extended through the plate 20 to form the pivot for this lever. The swinging of this lever backward and forward about its pivot by means of the actuating devices on the front side of the shutter plate 20 rotates the two rings 36 and 37 oppositely and through equal angular distances to rotate the shutter blades.

Referring now to the means for swinging the lever 48: 60 and 61 indicate two curved levers which are pivoted near the lower part of the plate 20 and extend around the cylindric part 22 and approach each other above, their upper ends being extended radially outward to provide two straight surfaces 62 and 63 respectively. The two curved levers are spaced somewhat from the surface of the plate 20 by means of raised bosses 64, 64 which are part of an integral flat ridge 65 surrounding the circular opening through the plate 20. At the top of the shutter plate 20 a deep slot 66 (Fig. 17) is made between the plate and the ridge 65 to accommodate the lower end of the swinging lever 48. The two curved levers 60 and 61 are connected at their lower ends by a connecting link 70 from the opposite sides of which and near its center extend two projections 73 and 74. As here shown these projections are an integral part of the link, being formed by cutting transverse and lengthwise slots near its margin and bending the severed parts at rightangles (Fig. 11). Below the connecting link 70 and mounted on a fixed shaft 76 is a pinion 77 with a long hub 78 about which is coiled the driving spring 79. A crank pin 80 extends from the upper part of this pinion toward the plate 20 and the two ends of the spring 79 are extended on each side of this crank pin to engage with the projections 73 and 74 on the connecting link 70.

By rotating the pinion in one direction the crank pin 80 is engaged with one end of the spring to rotate it correspondingly and cause its opposite end to bear against one of the projections on the connecting link 70; and by rotating the pinion in the opposite direction a corresponding pressure is supplied to the opposite projection on such connecting link; whereby, when the curved levers 60 and 61 are free to move, the effect is to rotate them in the same direction about their pivots and move their upper ends toward the right or the left as the case may be. A pin 82 extends outward from the lever 48 above the shutter opening and is engaged by the ends of the curved levers 60

and 61 in their movement from right to left and vice versa to swing the lever 48 and operate the shutter blades as above described. The pinion 77 meshes with gear teeth 83 on a large gear ring 85 surrounding the lens cylinder 23, such gear ring having an inner flange or ring 87 which enters the groove 26 between the cylindric parts 23 and 25 to confine the ring in place. A radial lever 90 extends from the gear ring 85 for rotating it; and such lever is designed for engagement with a notched plate 92, indicated here diagrammatically merely, which is attached to the shutter plate 20 and appropriately numbered to indicate various settings of the lever 90 which, through the pinion 77, will supply varying degrees of tension to the spring 79 and determine the rapidity of movement of the shutter blades when the parts are released for the performance of an "instantaneous" exposure.

Referring now to the catching and releasing devices and the escapement device for controlling the movement of the curved actuating levers 60 and 61, 100 indicates a lever which is pivoted at one end to the upper part of the shutter plate 20 to one side of its vertical diameter and extends nearly horizontally over the circular lens opening and beyond the circumference of the plate 20 to form a handle or arm for operating the shutter. At a point in the lever 100 where it is intersected by the vertical axial plane of the shutter is made an opening and through such opening extends a short shaft or stud 104 with its inner end enlarged in the form of an integral circular disk 107 and its outer end fixed into a knurled thumb wheel or head 110 which is made integral with a radial flange 111 having three notches in its circumference for engagement with a spring detent 112 for maintaining the circular disk 107 in the desired setting. Between the long lever 100 and the shutter plate 20 are two short levers 115 and 116, the former being pivoted on a screw 118 which is also the pivot point of the lever 100 and the latter being pivoted on a pivot screw 119 which is symmetrically placed on the opposite side of the vertical axial plane of the shutter plate 20. The angular movement of the lever 100 is limited by the screw 119 which is below it, and a stop 120 above it. In the adjacent ends of the two levers 115 and 116 are made curved notches which embrace the two sides of the shaft 104 whereby the upward and downward movement of this shaft in the swinging of the lever 100 is transmitted to the two short levers. At the back side of the lever 115, at its pivoted end, and also pivoted on the pivot pin 118 is a still shorter lever 130 having a notch 131 in its upper edge near its free end and this end beveled or rounded as shown at 132 to form a trigger or catch for engaging a pin 134 which extends from the swinging lever 48. A spring 137 which is coiled about the pivot 118 presses upward on the three levers 100, 115 and 130 and maintains them ordinarily parallel and in adjacent planes; the angular movement of the lever 115 with respect to the lever 100 being prevented by the notched end of the former which embraces the shaft 104; and the upward angular movement of the short lever 130 being limited by a projection 140 from the arm 115. At the pivoted end of the other arm 116 is arranged a short lever or catch 142 similarly pivoted about the pivot 119 and in all respects similar to the catch 130 and symmetrically placed with respect to the vertical axial plane of the shutter. It is similarly engaged by a spring 144 and limited in its movement by a projection 145 from the arm 116. In Fig. 7 is shown the setting of the device for an "instantaneous exposure" and in such case the disk 107 is rotated by means of the knurled wheel 110 into a position where its associated parts, which will be hereinafter described, take no part in the operation and the pivoted lever 48 when released from engagement with one of the catches 130 or 142, is free to swing across to the catch at the other side of the shutter plate 20. This operation is indicated in Fig. 7 where the device is shown with the pin 134 engaged in the notch in the catch 130, and it is evident that a depression of the lever 100, with the two short levers 115 and 116 and the catches 130 and 142, will release the pin and allow it to swing, under the influence of the driving spring 79 and the pressure of the curved arm 61, above the shutter opening and catch in the opposite catch 142; which latter will be depressed by the contact of the pin 134 upon its beveled end sufficiently to permit such pin to engage in the notch. For a subsequent similar operation of the device it is necessary only to engage the winding lever 90 in one of the notches toward the opposite end of the notched plate 92 which will place the other curved shutter arm under tension and upon a subsequent release of the lever 100 permit the swinging lever 48 to swing in the reverse direction and reversely rotate the shutter blades for a similar exposure; the speed of rotation of the shutter blades being determined by the tension placed upon the winding spring 79 through the setting of the gear ring 85 by means of the notched plate 92.

Referring now more particularly to the construction of the circular disk 107 and its related parts which are designed to provide the two kinds of exposure known as a "bulb" and a "time exposure," a wide, shal-

low groove or slot 150 is cut diametrically into the inner face of the disk 107 and in this groove is arranged a lever 153 which is not quite as long as the diameter of the disk. One end of this lever is forked, as indicated at 154, and it is pivoted upon a pivot point 155 very close to its forked end, in a manner permitting its angular movement in the plane of the disk and limited by the sides of the groove in which it lies. A projection 160 extends from its opposite end in a direction normal to the plane of the disk and toward the shutter plate 20. A similar projection or pin 163 extends from the lever 48 and the two projections intersect the same radial plane so that they may be brought into engagement. When the device is set for a "time exposure" as is indicated in Fig. 12 the disk 107 is arranged with the pivoted lever 153 vertical and with its forked end upward and the driving spring 79 is wound by means of the gear and pinion in a direction to apply pressure against the swinging lever 48 tending to swing it toward the opposite catch from the one by which it is held. A depression of the release lever 100 will then release the pin 134 from its catch and allow the lever 48 to swing into a vertical position where it will be arrested by the pin 163 striking the projection 160, which has been lowered by the depression of the lever 100; it being shown in this position in Fig. 13. Such engagement of the two projections 160 and 163 will swing the lower end of the pivoted lever 153 to one side, which is required in order that the lever 48 may assume an exactly vertical position and permit the shutter to open to its fullest extent; and a release of the lever 100 will allow it to rise under the influence of its spring 137 and cause the pin 134 at the upper end of the swinging lever 48 to engage in the fork 154 at the upper end of the swinging lever 153 (Fig. 14)—it being noted that the lever 48 will still occupy a vertical or substantially vertical position notwithstanding the angular movement of the forked lever 153, as the latter is pivoted so near its top end that although its bottom end may be displaced sidewise sufficiently to allow for the width of the projections 160 and 163 and arrest the pin 163 exactly in the vertical plane of its axis, the displacement of its upper end is negligible and it will catch and confine the pin 134 with the lever 48 still vertical. The side pressure of the pin 134 in the fork 154 will however swing the lower end of the lever 153 to the other side of its groove so that when the pin 134 is released by a subsequent depression of the lever 100 the pin 163 will be past the projection 160 and the swinging lever 48 will be free to continue its movement and close the shutter blades. It should be noted also that although the movement of the disk 107 is in an arc about the pivot point 118, this arc is so short that it may be considered as a straight line, and the center of the disk 107 is always substantially in the same vertical plane.

For the operation of the "bulb exposure" as it is known, the disk 107 is rotated through 180 degrees bringing the parts into a position with the forked end of the lever 153 downward, as shown in Fig. 15. With such a setting of the device, and a winding of the spring and a release of the swinging shutter lever 48 the latter will swing into a vertical position and be arrested by the contact of the higher projection 134 with the projection 160 from the then upper end of the lever 153 (Fig. 16); the latter projection being brought into the path of movement of the former by the depression of the disk 107 through the lever 100, as above described. In such operation also the sidewise displacement of the upper end of the pivoted lever 153 will permit the swinging lever 48 to be arrested in an exactly vertical position as is required in order to secure a full shutter opening; and a subsequent release of the operating lever 100 will release the pin 134 and permit it to continue its movement and enter the opposite catch 130 or 142; it being noted that by reason of the difference in length of the two arms of the pivoted lever 153 its forked lower end in such case, with the lever 100 either raised or lowered, will lie above the highest point in the curved path of movement of the pin 163 and will not interfere with the swinging of the shutter lever 48; but will permit it to continue its movement upon the release of the operating lever 100 after its depression to close the shutter, as is required for the operation known as a "bulb exposure."

For the operation of an "instantaneous exposure" the disk 107 is arranged with the pivoted lever 153 in a horizontal position as shown in Fig. 7. In such position the fork 154 on one end of the lever 153 and the projection 160 on the opposite end will both clear both of the projections or pins 134 and 163 on the lever 48 when the lever 100 is either raised or lowered or in any intermediate position, permitting the lever 48 to travel freely upon its release from either side to the other without interruption. With such a setting of the device, and a winding of the spring 79 and a depression of the release lever 100 the pin 134 will be released from its catch and the lever 48 will swing freely the full length of its travel coming to a rest against one of the pins or stops 170, 170, the pin 134 snapping into engagement with the other catch, and during such operation the shutter blades traveling through

their full movement, entirely opening and then closing the shutter; it being noted that in all these cases for each operation of the shutter a separate winding of the spring 79 is required. Such winding is effected by means of raising or lowering the lever 90 from its horizontal or neutral position and it is retained in either a raised or lowered position by its engagement with the notches 92. When the lever 48 is over to the right as viewed in Fig. 1 the lever 90 must be set in one of the notches below the horizontal or neutral position in order to bring pressure to bear through the lever 61 on the pin 82 toward the left. After such exposure has been made the lever 90 must then be set in one of the notches 92 above the horizontal or neutral position thus bringing pressure to bear against the pin 82 through the lever 61 in the opposite direction in which setting the device is again ready for another exposure. It is seen then that after each operation of the device the lever 90 must be set in one of the notches on the opposite side of the horizontal or neutral position from the side in which it is resting after the previous exposure. The speed of an "instantaneous exposure" to a certain extent may be regulated by the tension put on the spring 79. The greater the distance either above or below the horizontal or neutral position that the lever 90 is set the greater the tension on the spring 79 will be and consequently the faster the exposure. It is to be noted however that for obtaining very slow "instantaneous exposures" or for further or more accurately regulating the duration of "instantaneous exposures" any one of the common drags, brakes or cushions now in use may be used in connection with my shutter. For the operation of "time" or "bulb exposures" since speed is not essential the lever 90 is set in one of the notches near the horizontal or neutral position in order to put only a weak tension on the spring 79 and thus lessen the jar and resulting injury to the parts when the lever 48 is arrested in its vertical position.

I claim as my invention:

1. In a photographic shutter, overlapping blades each having a fixed center of oscillation and means for oscillating such blades, such means engaging each blade on opposite sides of its center of oscillation.

2. In a photographic shutter, overlapping shutter blades adapted to oscillate and with their centers of oscillation lying in a circle, an inner and an outer rotative ring, and means for rotating such rings in each operation of the device through equal angular distances and in opposite directions.

3. In a photographic shutter, two rotative rings of unequal diameter, over-lapping shutter blades pivoted to said rings, and means for rotating said rings in each operation of the device through equal angular distances and in opposite directions.

4. In a photographic shutter, a flat plate having a circular opening therethrough, and circular grooves surrounding such opening, rotative rings lying in such grooves, overlapping shutter blades each pivoted to both of said rings, and means for rotating said rings in each operation of the device through equal angular distances and in opposite directions.

5. In a photographic shutter, a swinging shutter lever and means for arresting it in its movement, such means including a lever forked at one end, having a projection at its other end, and pivoted at a point close to its forked end.

6. In a photographic shutter, a supporting plate with a circular opening and curved slots therethrough, and circular grooves surrounding such opening, rotative rings lying in such grooves, projections from such rings through the slots, and a pivoted lever engaging with such projections to rotate the rings.

7. In a photographic shutter, the combination with a supporting plate having a circular opening therethrough and movable shutter blades on one side and a swinging lever for moving such blades, of actuating means comprising curved levers engaging with such swinging lever and surrounding such circular opening, a connecting link connecting such levers, projections from such connecting link, a coiled spring with its ends engaging such projections, a pinion having a crank pin engaging the ends of such spring, and a gear ring meshing with such pinion.

8. In a photographic shutter, a pivoted shutter lever, means for swinging it about its pivot, and means for arresting it exactly in the middle of its movement in either direction, such means including a part on such shutter lever adapted to engage with a stationary part to arrest the movement of the shutter lever, and the part on such lever being adapted to move relatively thereto.

9. In a photographic shutter, the combination with a shutter frame having an opening therethrough, rotative shutter disks adapted to cover such opening, and a swinging shutter lever for actuating such disks, of an adjustable support and a lever pivoted near its end to such support and having a projection adapted for engagement by such shutter lever.

10. In a photographic shutter, the combination with a swinging shutter lever, of an adjustable support, a forked lever pivoted near its forked end to such support and having a projection from its opposite end, projections from said swinging shutter lever

adapted to engage with the fork and the projection from said pivoted lever, and means for reversing the position for said forked lever endwise, and for placing it in an intermediate position.

11. In a photographic shutter, a swinging shutter lever and means for arresting it in its movement, such means including an adjustable member having a groove and a lever lying in such groove and pivoted near one of its ends.

12. In a photographic shutter, a swinging shutter lever and means for arresting it in its movement, such means including an adjustable member with a lever pivoted thereto, such lever having a projection and being pivoted near one of its ends.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses this 4th day of January, 1913.

ALLEN R. McPHEE.

Witnesses:

I. McNAMARA,

JENNIE MILLER.