(No Model.) 4 Sheets—Sheet 1.

E. BAUSCH, G. HOMMEL & A. WOLLENSAK.

PHOTOGRAPHIC SHUTTER.

No. 444,083. Patented Jan. 6, 1891.

Fig. 1.

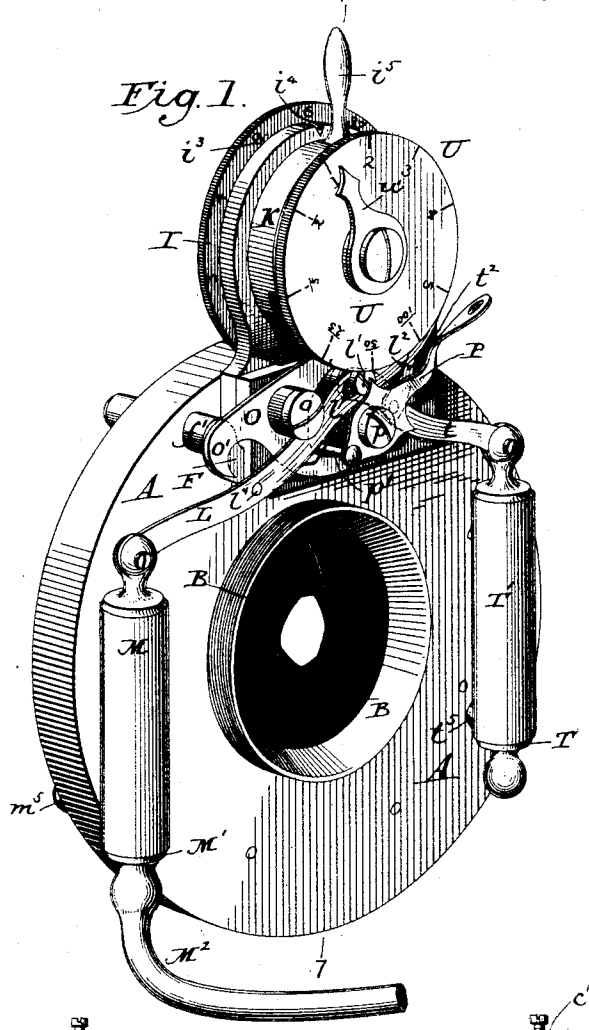


Fig. 2

ON LINE 2 -2

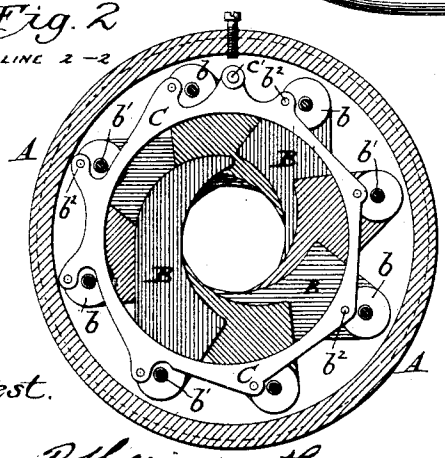
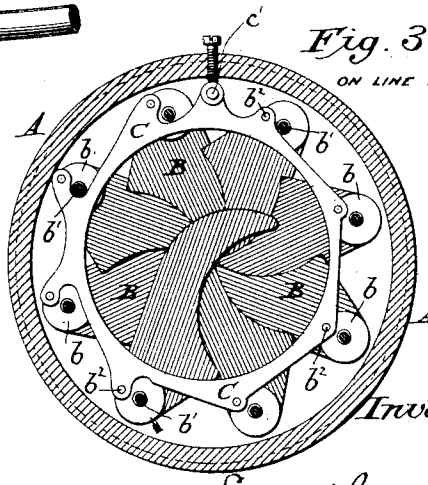


Fig. 3.

ON LINE 2 -2



Attest.

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F. Janly Elmore.

Inventor.

Edward Bausch

George Hommel

Andreas Wollensak

By Phil T. Dodge Atty

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Fig. 4.

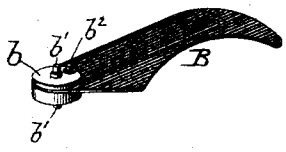


Fig. 5.

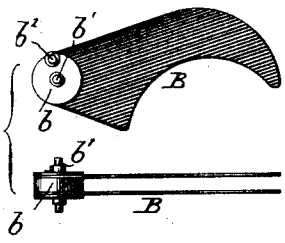


Fig. 6.

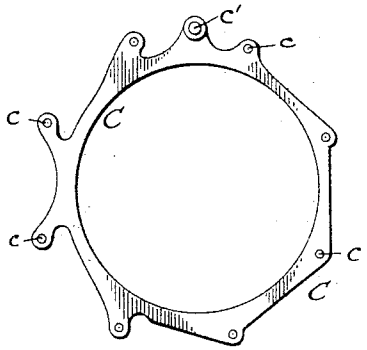


Fig. 7

ON LINE 7–7

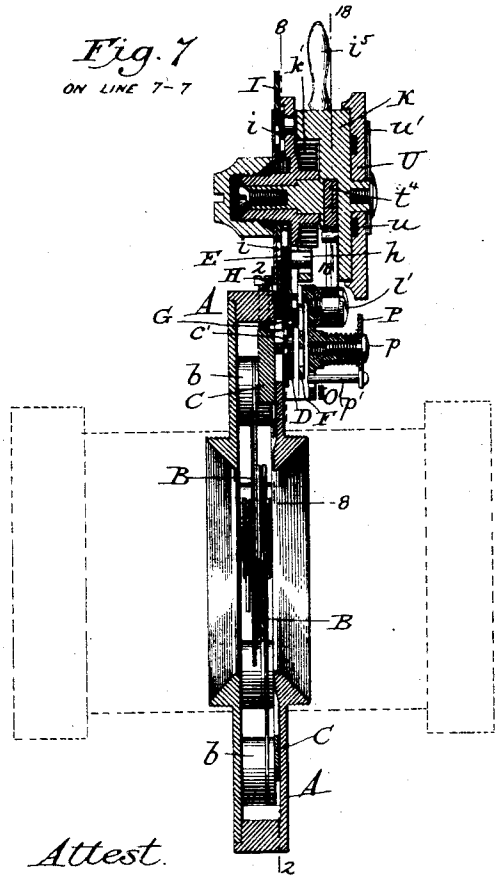
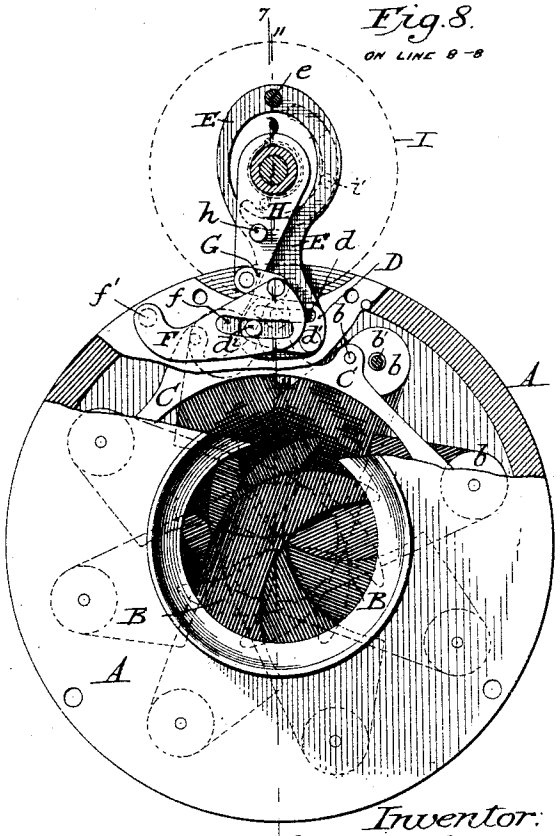


Fig. 8.

ON LINE 8–8



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PHOTOGRAPHIC SHUTTER.

No. 444,083. Patented Jan. 6, 1891.

Fig. 9.

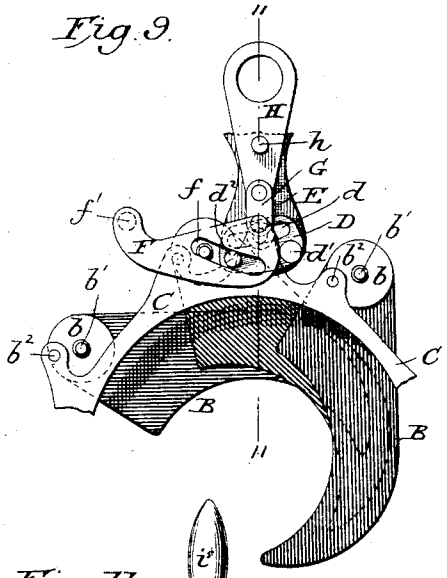


Fig. 10.

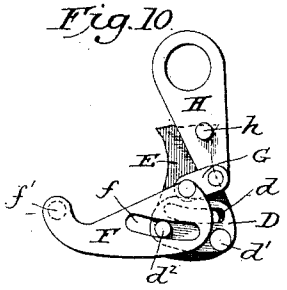


Fig. 12.

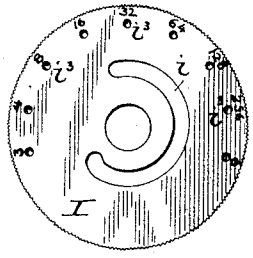


Fig. 11

ON LINE 11—11

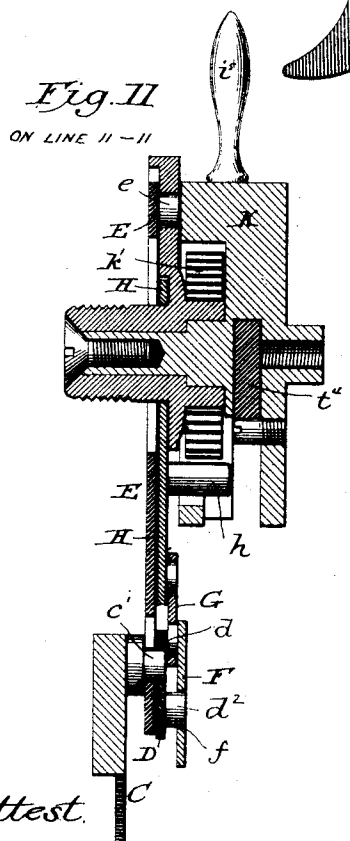


Fig. 14.

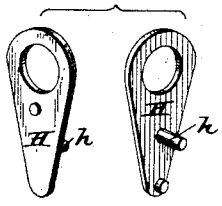
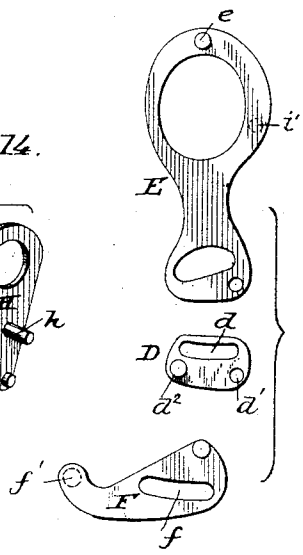


Fig. 13.



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(No Model.) 4 Sheets—Sheet 4.

E. BAUSCH, G. HOMMEL & A. WOLLENSAK.

PHOTOGRAPHIC SHUTTER.

No. 444,083. Patented Jan. 6, 1891.

Fig. 15.
ON LINE 18—18

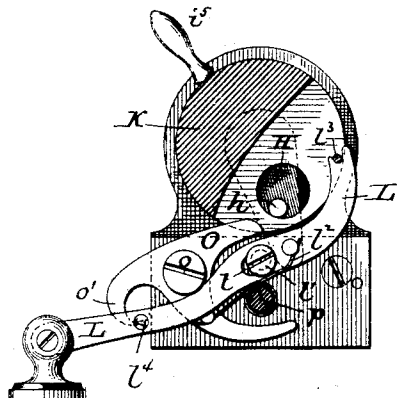


Fig. 16.
ON LINE 18—18

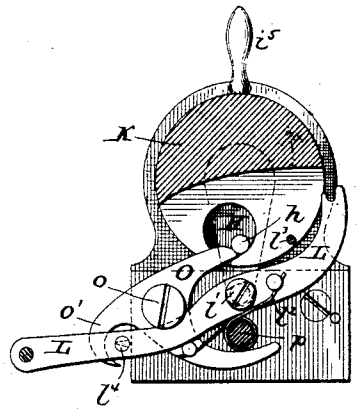


Fig. 19.

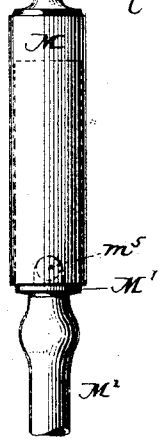


Fig. 17.
ON LINE 18—18

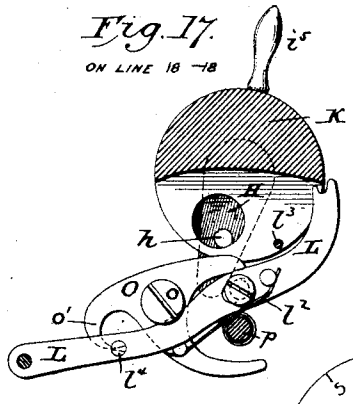


Fig. 18.
ON LINE 18—18

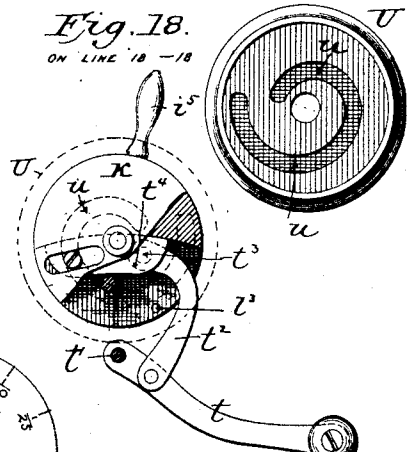
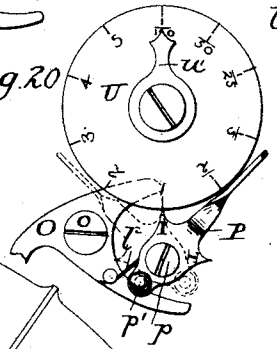
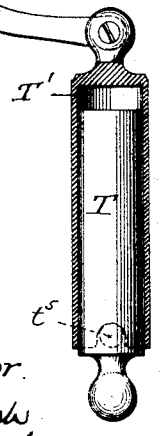


Fig. 20





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UNITED STATES PATENT OFFICE.

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PHOTOGRAPHIC SHUTTER.

SPECIFICATION forming part of Letters Patent No. 444,083, dated January 6, 1891.

Application filed July 2, 1890. Serial No. 357,469. (No model.)

To all whom it may concern:

Be it known that we, EDWARD BAUSCH, GEORGE HOMMEL, and ANDREAS WOLLENSAK, of Rochester, in the county of Monroe and State of New York, have invented certain Improvements in Photographic Shutters, of which the following is a specification.

This invention relates to that class of devices which consist, essentially, of a series of leaves or blades grouped around a central opening and pivoted at their outer ends in such manner that by swinging inward and outward they will vary the size or completely close the aperture, whereby they are adapted to serve as shutters and as adjustable diaphragms.

The object of the invention is to provide an improved manner of mounting and operating the pivoted blades, as will hereinafter more fully appear.

In the accompanying drawings, Figure 1 is a perspective view of the improved shutter. Figs. 2 and 3 are transverse vertical sections on the line 2 2 of Fig. 7, showing the manner in which the blades are mounted and the reciprocating ring by which they are immediately operated. Fig. 4 is a perspective view of one of the blades. Fig. 5 is a side and an edge view of the double blade. Fig. 6 is a view of the ring by which the blades are operated in unison. Fig. 7 is a vertical central cross-section through the shutter on the line 7 7 of Figs. 1 and 8. Fig. 8 is a section on the line 8 8 of Fig. 7, looking rearward, and showing the devices for transmitting motion to the blade-operating ring and for adjusting the same to vary the size of the aperture. Fig. 9 is a similar view with the parts in a different position. Fig. 10 is a detailed view of parts shown in the preceding figures. Fig. 11 is a vertical cross-section, on a larger scale, on the line 11 11 of Figs. 8 and 9. Fig. 12 is a view of the disk or snail-wheel for controlling the size of the aperture. Fig. 13 is a view showing disconnected from each other several of the parts shown in Figs. 8 to 11. Fig. 14 is a view showing in perspective from opposite sides another of the parts shown in Fig. 8. Figs. 15, 16, and 17 are sections on the line 8 8 of Fig. 7, showing the action of the trip devices by which instantaneous or time exposures are secured, as required. Fig. 18 is a cross-section on the line 18 18 of Fig. 7, illustrating particularly the pneumatic brake or retarding device by which the opening and closing movements of the shutter may be protracted for predetermined periods. Fig. 19 is a rear face view of the cam or disk for controlling the length of the exposure. Fig. 20 is a face view showing the details of the devices for setting the shutter for time or instantaneous exposures, as required.

Referring to the drawings, A represents a flat circular shell or case having a central aperture therethrough. This case may be fitted into and made a part of the lens-tube in the usual manner, as indicated in Fig. 7, or it may be adapted for application in front or in rear of the lens, as preferred. The case is constructed, as shown, with parallel front and rear walls or plates, between which there exists an annular space communicating with the central opening and adapted to receive the wings or blades B. These blades, usually eight in number, (but the number of which may be varied,) consist each of a thin plate of steel, celluloid, aluminium, or other suitable material of a form such as shown in Fig. 4, fixed at one end to a supporting-hub b, having on opposite sides central pivots or journals b' and on one side a crank-pin b^2. These blades have their journals mounted at equal distances apart in the walls of the case near its outer edge in such manner that the blades overlap at their inner edges. Their form and arrangement are such that as they are turned inward and outward around their pivots their inner overlapping edges will serve to close the central aperture by which the light passes through the lens to a greater or less extent. When swung outward they leave the aperture unobstructed; but as they swing inward they gradually reduce the aperture, as shown in Fig. 2, until finally in their inner-

most positions they completely close the same. The marginal form of the blades may be varied at will, provided only they are adapted to open and close the aperture and to present in their various adjustments a substantially circular opening between their inner edges. As the blades are lapped one upon another around the series, it follows that the first and the last blade will stand at some distance apart. In order, therefore, to prevent the possibility of the leakage of light between the closed blades, one of them is constructed in duplex form—that is to say, with two parallel blades—as shown in Fig. 5, adapted to embrace the remainder of the series between them. By thus closing the aperture at one point from both sides and having the double blade close at its end over the center of the aperture it is possible to completely exclude the light when the shutter is closed.

In order that all the blades in the series may be operated simultaneously and equally with a slight expenditure of power, they are connected by an operating-ring C, having a series of holes *c* to receive the crank-pins of the blades, as shown in Figs. 2 and 3. A slight sliding motion of this ring in one direction effects the opening of the blades, while a return movement causes them to close. In practice it is found that by thus connecting the blades to a reciprocating as distinguished from a rotating ring they may be operated by the application of slight force.

The blades and the ring constructed as above may be operated by hand or by automatic mechanism of any suitable character without departing from the limits of this invention; but an operating mechanism in which an actuating-spring is combined with tripping devices under the control of the operator is preferred and will now be described.

The operating-ring is provided, as shown in Fig. 6, with a rigid top arm having a lateral stud c', which (see Figs. 7 to 13) enters a slot *d* in a link D, pivoted at d' to a fixed adjustable arm E. The link D carries at its free end a stud d^2, which enters a slot *f* in an arm F, mounted on a fixed pivot at f'. The arm F is connected by a link G to the vibrating end of an arm H. As the arm H moves to and fro, right and left, it acts through the link G, after the manner of a toggle, to swing the arm F upward and downward. The arm F in turn swings the link D upward and downward, and the latter raises and lowers the ring C, attached to the blades. Thus it is that the movement of the arm H in one direction has the effect of opening and closing the shutter.

The arm F is moved always the same distance; but in order that it may open the blades to a greater or less extent, according to the size of the aperture required, the connections are so made that although the extent of motion of the arm F is unchanged it will transmit a greater or less motion to the link D and its connections. This is effected by pivoting the link-supporting arm E at its upper end at *e*, so that it may swing to the right and left. As it is carried to the left, carrying with it the link D, the pin d^2 on the latter is moved along the slot *f* toward the center of the operating-arm F, so that it is carried by the arm through a shorter arc. If, on the contrary, the arm E is carried to the right, the stud d^2 of the link will approach the outer end of the operating-arm F and receive therefrom an increased movement.

The adjustment of the arm E to regulate the size of the aperture is effected by a rotary disk I, having therein an eccentric slot *i*, as shown in Fig. 12, which receives a stud i', projecting from the lever E, so that as the disk is turned it will move lever E to the right or left, as the case may be, and hold it in position. It will of course be understood that during the operation of the parts the lever E is at rest and affords a fixed fulcrum for the link D.

In order that the operator may quickly adjust the disk I to give apertures of definite sizes, it is provided on its outer edge with a series of graduations i^3, as shown in Fig. 1, and the supporting-frame provided with a notch i^4, with which the graduations may be brought in register. The graduations should represent the sizes of the aperture in relation to the focus of the lens with which the shutter is used.

Passing now to the devices through which the shutter-operating arm H and its connections are driven, attention is directed particularly to Figs. 1, 7, 8, and 11, in which K represents a hollow drum or hub mounted to turn on a central pivot concentric with the arm H and containing a coiled spring k', one end of which is fixed to the drum and the other to the frame or axis, so that it tends constantly to turn the drum to the right. The drum is recessed, as shown in Fig. 15, and the arm H provided, as shown in Fig. 14, with a stud *h*, which enters the recess. When, therefore, the drum is turned to the left by means of the handle i^5 thereon, it causes the arm H to swing to the right to the position shown in Figs. 10 and 15, thereby closing the shutter. When the drum is released, it is turned by the spring to the right, and in so doing swings the shutter from the position shown in Fig. 15 to the left to the position shown in Fig. 8, causing it by this movement through the link and intermediate parts to open and again close the shutter.

The devices for controlling the rotation of the drum and the motion of the shutter will now be described.

Referring to Figs. 1, 15, 16, and 17, L represents a lever or detent provided with a longitudinal slot *l* to receive a fixed pivot l', on which the lever may turn and also slide endwise to a limited extent against the pressure of a

spring l^2, which urges the lever constantly to the left. At its right extremity the lever is provided with a notch to engage a stud l^3, fixed on the rotary drum. When the drum is turned to the left against the tension of the spring, so as to close the shutter and set the same for action, the lever engages the stud, as shown in Fig. 15, and holds the parts in position. The lever L is connected at its opposite end to a closed tube or cap M, fitting over the upper end of a tube M′, connected by a flexible tube M^2 to an elastic bulb or other air-forcing device M^3, so that when the bulb is compressed the air, lifting the cap M, causes it to turn the lever L on the pivot l, thereby disengaging the lever from the stud on the drum and allowing the latter to turn under the action of the spring, so as to open and close the shutter, the parts moving from the positions shown in Fig. 15 to those shown in Fig. 17.

It will be observed that the above action secures an automatic opening and closing of the shutter by a single action. In order to effect what are known as "time exposures," by opening the shutter and then closing the same at the will of the operator by an independent action a forked lever O is mounted on a fixed pivot o in such manner that when turned down to the position shown in Fig. 17 it will be wholly inactive, but that when turned upward at one end to the position shown in Fig. 16 its end will stand in the path of the stud h on the shutter-operating arm H. If the shutter-operating devices are released when the stop-lever O is in this position, the stud h on the swinging arm H will encounter the end of the lever O, as shown in Fig. 16, and arrest the parts in position to hold the shutter open. In order to trip this stop-lever O and permit the closing of the shutter when required, the lever L is provided on its rear face with a stud l^4 to act upon the downwardly-turned end o' of the lever O. As the drum is turned to the left in setting the shutter, its stud l^3 rides against the upturned end of the lever L on the inside toward the notch and causes the lever L to move endwise on its pivot, so that its stud l^3 assumes, primarily, a position to the right of the end o' of lever O. When, therefore, the lever L is first operated to release the drum and open the shutter, the stud l^3 clears the lever O, leaving the latter at rest in position to meet the stud h. When, however, the lever L is permitted to fall on relaxing the bulb, its stud l^4 falls below the end o', and at the same time the lever is urged to the left by the spring l^2, so that the stud l^4 lies beneath the end of the stop-lever, as shown in Fig. 17. When, therefore, the lever L is operated a second time by means of the bulb, its stud l^4 trips the lever O out of engagement with the stud h, thereby releasing the parts, so that the shutter continues its movement from the open to the closed position. Thus it is that the shutter is opened by the first action of the bulb and held in an open position and finally closed by the second action of the bulb.

When instantaneous instead of time exposures are required, it is necessary to lock the lever O in an inoperative position. This is effected, as shown in Figs. 1 and 20, by a small lever P, mounted on a fixed stud p and provided with an arm or pin p', which acts against the lower arm of the stop-lever O, as shown in Fig. 17. When this lever is set in the position shown in said figures, it holds the stop-lever out of action, so that for the time being the shutter-operating devices are controlled solely by lever L. When the lever P is turned to the left, as shown in dotted lines in Fig. 20, it releases the stop-lever O, which is urged upward to an operative position by one end of the spring l^2.

The foregoing parts by themselves constitute a complete operative shutter for both time and instantaneous exposures. It is desirable, however, to provide a shutter with means for retarding or slowing the movement of its parts, and this whether the shutter is released by a single or a double action of the bulb. To this end the shutter is combined with a retarding device having two marked peculiarities: first, capacity to have the extent of its movement in proportion to the movement of the shutter increased or diminished at will; second, capacity to have the leverage through which the motive devices act upon it varied at will.

The resistant or retarding device proper consists, as shown in Fig. 18, of a plunger T and of a closing tube or cap T′, arranged to slide thereover, the parts being fitted in such manner that the air may escape slowly by leakage between them. The cap is connected to one end of a lever t, mounted on a fixed pivot t'. The connecting-link t^2 is pivoted at one end to the lever t and attached at the opposite end by a crank-pin t^3 to a slide t^4, fitted to move transversely—that is, diametrically—within the rotary spring-actuated drum. As the drum revolves, it imparts motion through the intermediate connections to the cap T′, the movement of which is resisted by the air confined therein. As this air can escape but slowly, the movement of the cap is retarded accordingly. By moving the slide t^4 the distance between the crank-pin and the center of the drum by which it is carried may be increased or diminished. The effect of increasing the throw of the crank is not only to increase the length of movement of the cap T′, but also to lessen the leverage with which the motive spring acts through the drum upon the cap. Consequently the increase in the throw of the crank-pin is followed by an increase in the time required for the movement of the shutter, first, because less force is applied upon the cap, and, second, because the cap is required to move through a greater distance and to expel a larger volume of air. The adjustment of the crank-pin is

effected by means of a rotary disk U, mounted to turn on the axis of the drum at its front and provided in its rear face with an eccentric groove *u*, which engages a stud on the slide t^4, so that by turning the disk U in relation to the drum the crank-pin is moved inward and outward, and thus the speed of the shutter varied.

In practice it is found possible to nicely and accurately graduate the time of exposure from the hundredth part of a second or less to a period of five or six seconds. In order that the operator may adjust the parts definitely for any required time of exposure, it is proposed to provide the face of the disk at its outer edge with graduations representing time in seconds and fractions of seconds and to mount on the fixed axis of the drum a pointer *u'*, in connection with which the graduations are to be read.

While we have shown a retarding device in the form of a cylinder and plunger, it is to be understood that any other equivalent device depending upon friction or air-compression may be substituted. It is also to be understood that retarding devices such as are herein described are applicable not only to the particular form of shutter herein shown, but to the various other shutters now known in the art in which movable blades are employed, since the action of the retarding devices is not dependent upon any peculiar construction of the shutter.

In order to permit an easy action of the parts and avoid unnecessary joints, the plunger T of the retarding devices and the cylinder M' of the trip devices are connected to the frame by horizontal pivots t^5 and m^5, so that they may tip to the right and left in order to adjust themselves to the changing position of the caps with which they operate.

Having thus described our invention, what we claim is—

1. An annular body, a series of blades grouped around the center of the body and pivoted at their outer ends, and a sliding as distinguished from a rotary ring connected to and operating the series of blades, substantially as shown.

2. The annular body, the series of overlapping blades grouped around the central opening and individually pivoted at the outer end and each provided with a crank-pin, and the ring mounted on the crank-pins and having a reciprocating as distinguished from a rotary motion, said members combined for joint operation.

3. In a photographic shutter, a series of inwardly and outwardly swinging blades grouped around a central opening and pivoted at their outer ends, one or more of said blades being double or slotted that it may embrace or close over both sides of the remaining blades, and thus prevent the leakage of light at the center.

4. In combination with the pivoted blades and their actuating-ring C, the link G and arm H to move the ring, the drum and spring to move the arm, and a detent to hold the drum, whereby the rotation of the drum by the spring effects the opening and closing of the shutter.

5. In combination with the pivoted blades and their actuating-ring C, the slotted pivoted ring-operating arm D, the arm E, by which arm D is sustained and adjusted, the swinging arm F, and the link G and arm H to operate the other parts, whereby the shutter may be adjusted to open to a greater or less extent, as demanded, without changing the movement of the primary operating devices.

6. In a photographic shutter, the vibratory spring-actuated operating-arm H, link G, lever F, and lever D, operated by lever F and connected with the shutter proper, in combination with the pivoted arm E to sustain and adjust lever D and the rotary cam-plate I to adjust arm E, whereby the rotation of plate I is enabled to determine the extent to which the shutter opens.

7. In combination with its actuating-spring, the shutter-operating spring with a stud or stop pin, the turning and sliding lever or detent L to engage and hold the drum, the spring acting on said lever to cause its engagement, a pneumatic device to disengage said lever, the stop-lever O to arrest the drum in an intermediate position and hold the shutter open, and a spring acting on the stop-lever, whereby the lever L is enabled to hold the shutter when closed and set for action, and also enabled to actuate the stop-lever and permit the closing of the shutter.

8. In combination with the spring-actuated shutter-operating drum, the sliding and swinging detent-lever, and the stop-lever O, the device to hold the stop-lever out of action when instantaneous views are required.

9. The shutter-operating drum and its controlling lever or detent L, in combination with the pneumatic trip device connected at one end to the lever and mounted on a pivot that it may swing to follow the movement of the lever.

10. In combination with shutter-blades and motive devices to open and close the same, a retarding device and intermediate adjustable connections adapted to vary at will the distance of movement of the retarding device in relation to the distance of movement of the blades, whereby the speed of the blades and the time occupied by them in moving a certain distance are made variable and dependent upon the distance traveled by the retarding device.

11. In a photographic shutter, shutter-blades and a motor for operating the same, in combination with a movable brake or retarding device and an adjustable connection whereby the leverage upon the retarding device to move the same may be increased or diminished, whereby the speed of the shut-

ter may be modified without adjusting the retarding device proper or changing the force exerted by the motive devices.

12. In combination with a photographic shutter provided with a motor-spring, a crank-pin of variable throw connected with the shutter, and a retarding device consisting of a plunger and piston, substantially as described, connected with the crank-pin.

In testimony whereof we hereunto set our hands, this 19th day of June, 1890, in the presence of two attesting witnesses.

EDWARD BAUSCH.
GEORGE HOMMEL.
ANDREAS WOLLENSAK.

Witnesses:
HENRY BAUSCH,
W. DRESCHER.