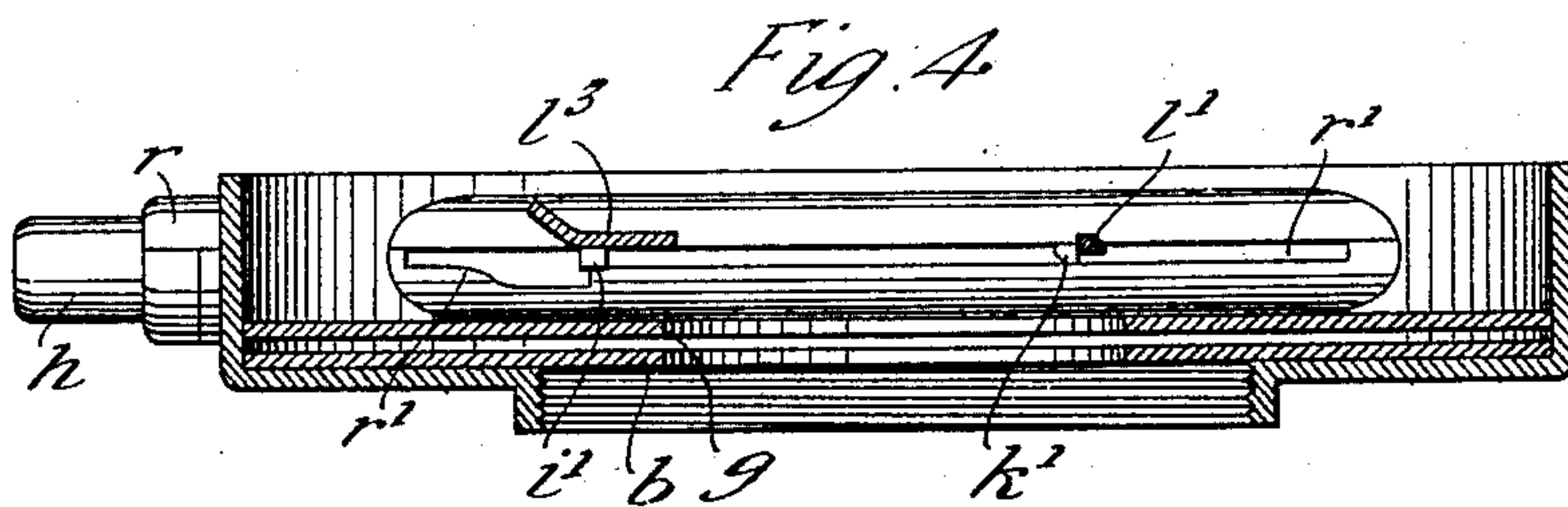
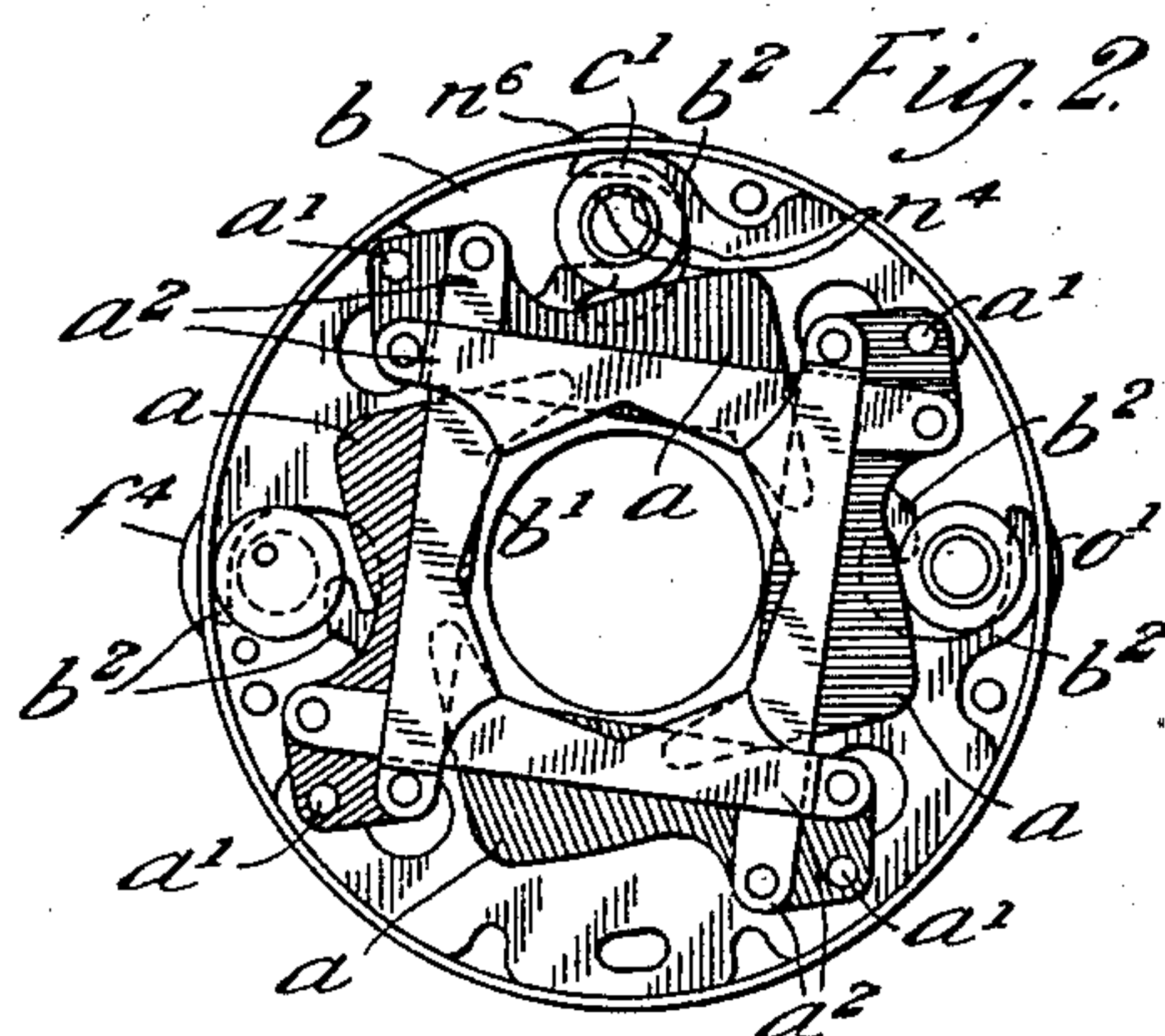
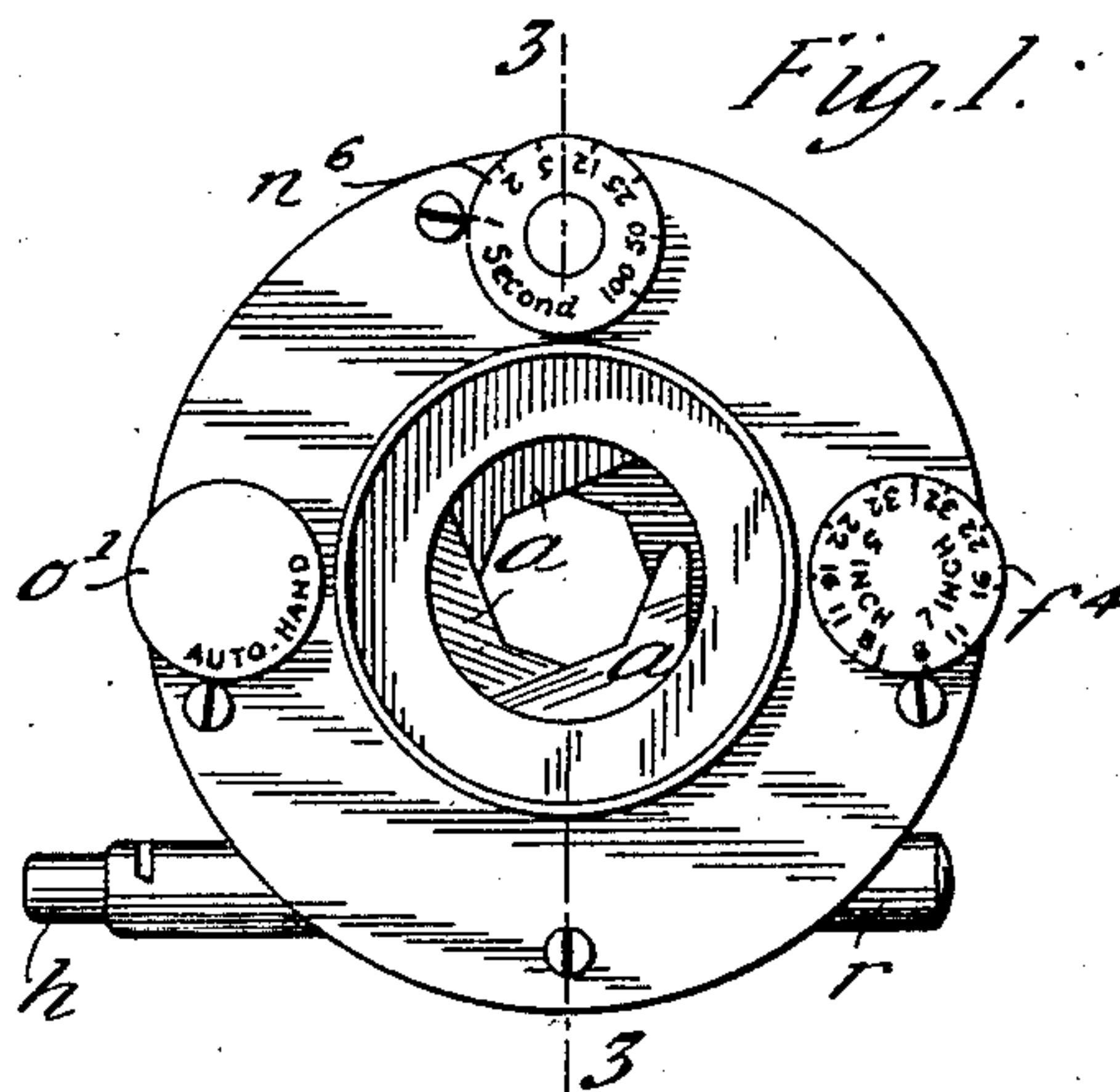


W. TAYLOR.
 PHOTOGRAPHIC SHUTTER.
 APPLICATION FILED APR. 25, 1904.

908,355.

Patented Dec. 29, 1908.

2 SHEETS—SHEET 1.



Witnesses

Robert Connett,
 Esq.
 Charles Kesler

Inventor

William Taylor
 By James L. Norris.

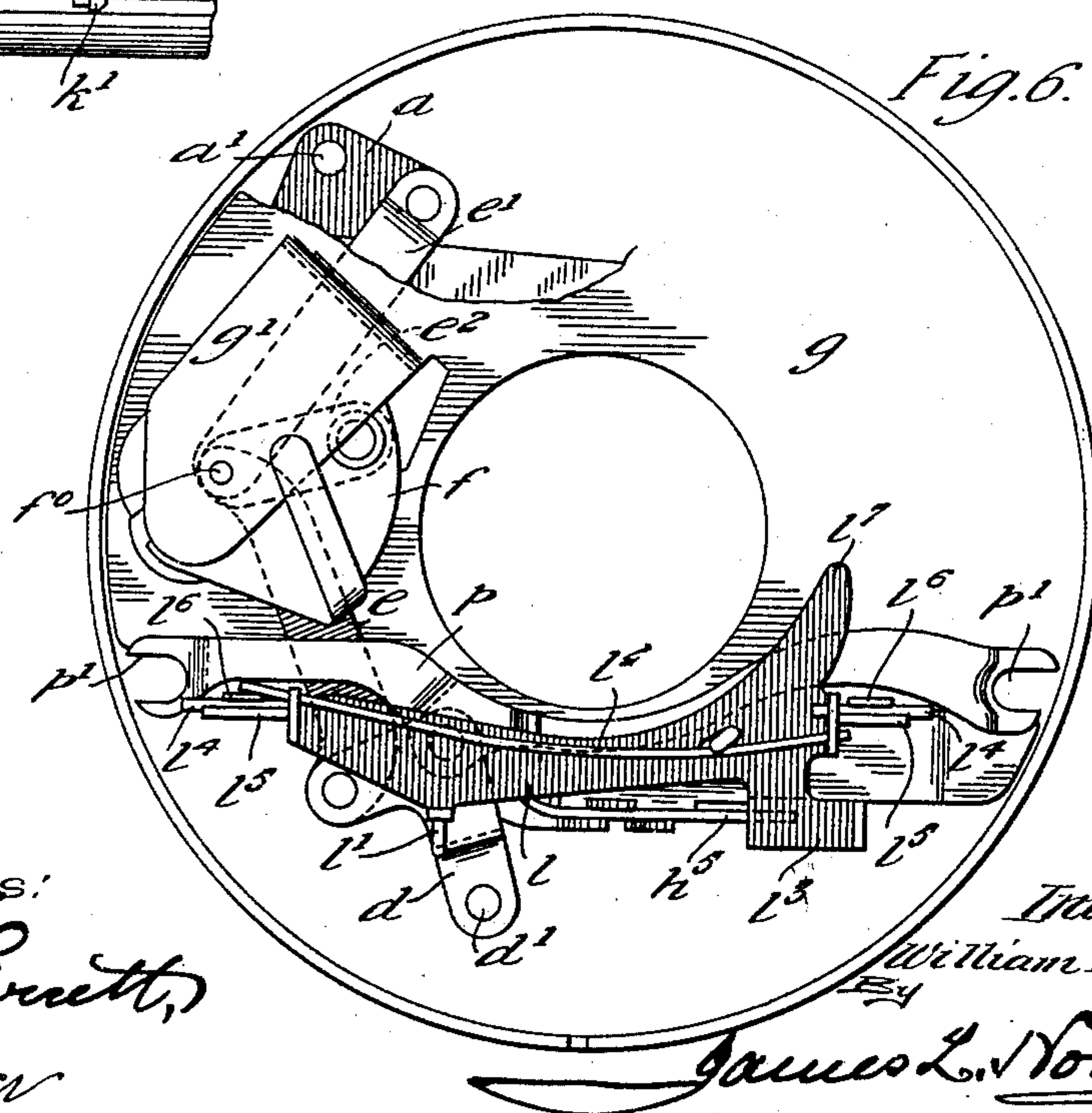
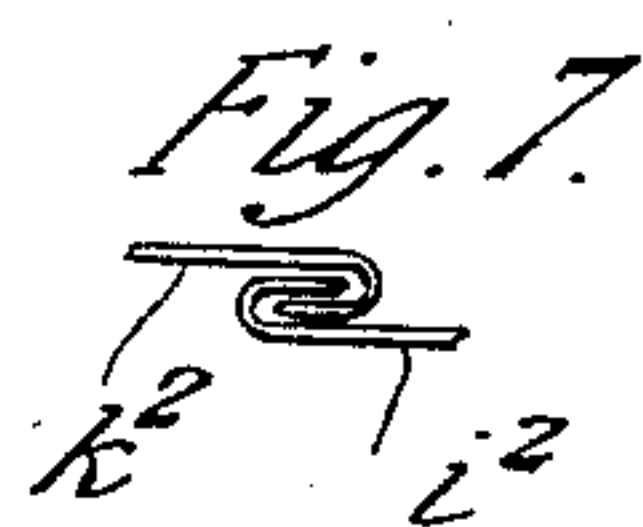
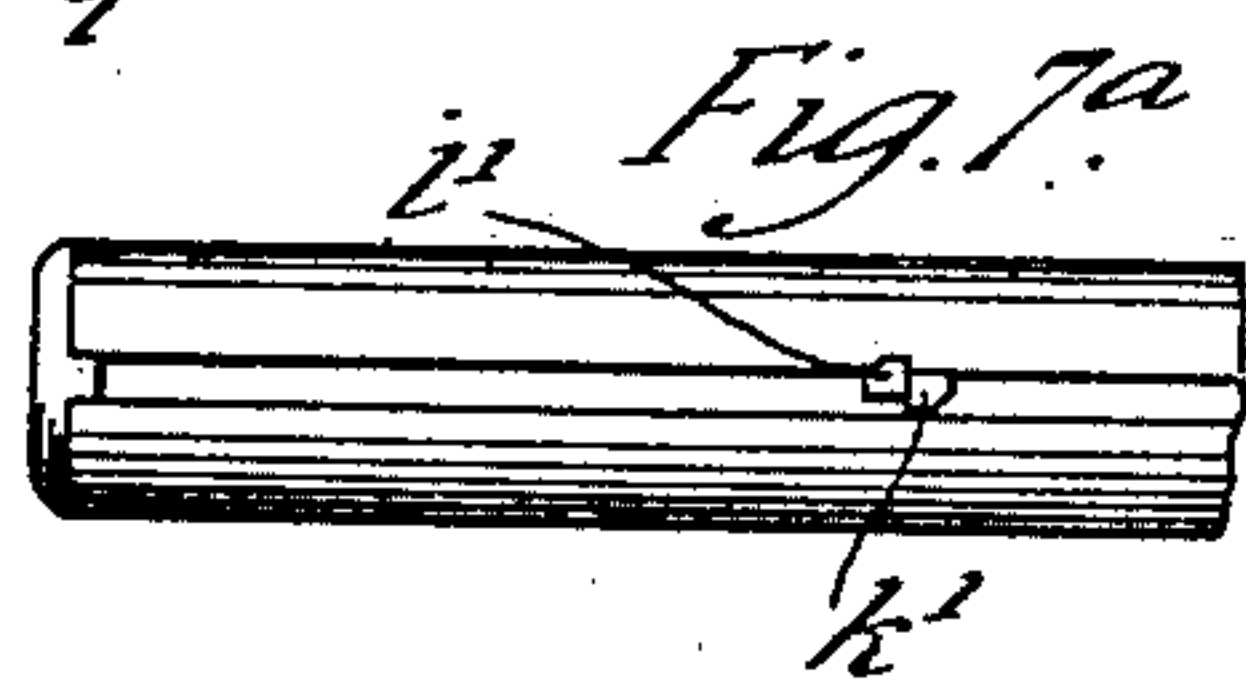
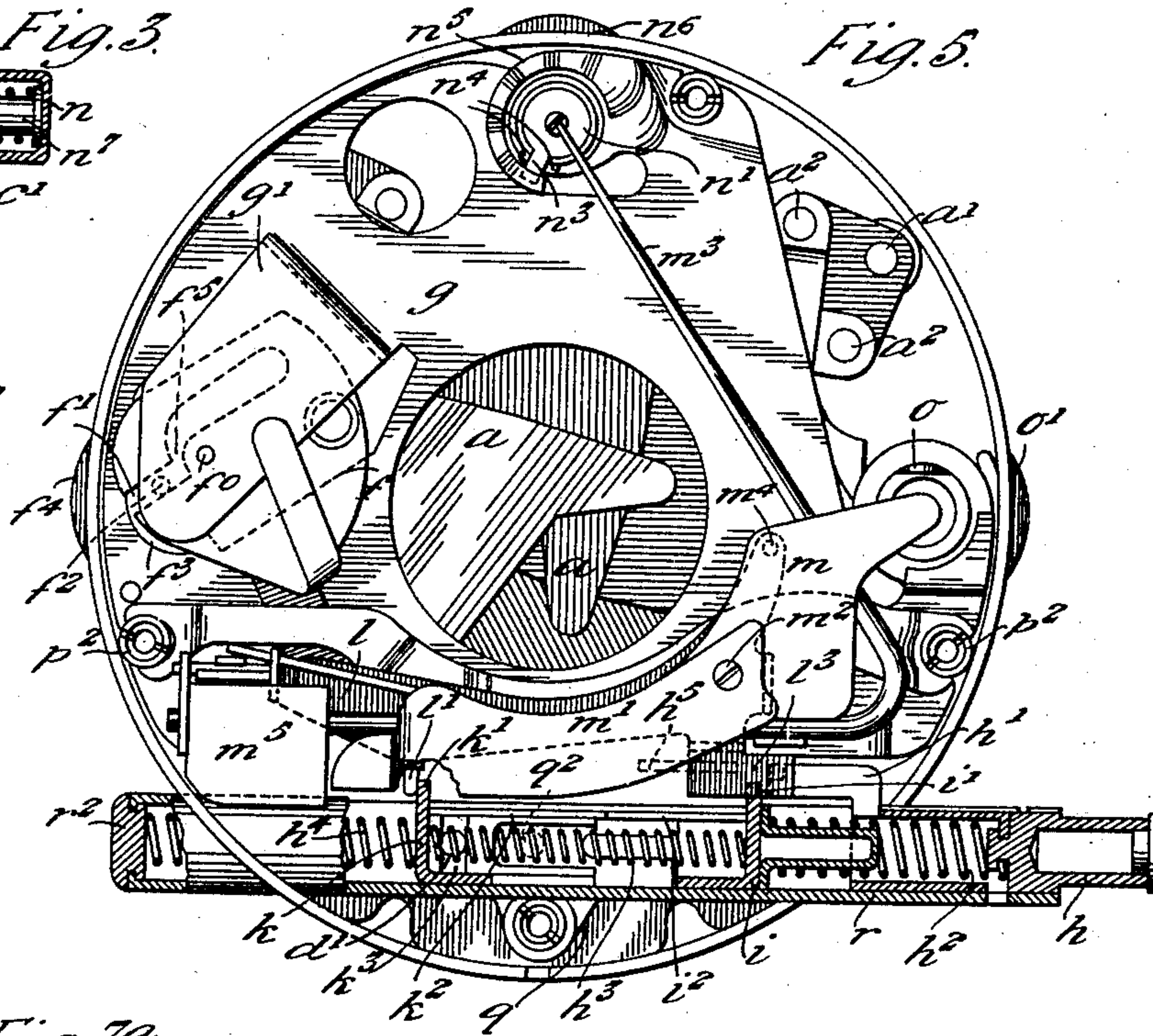
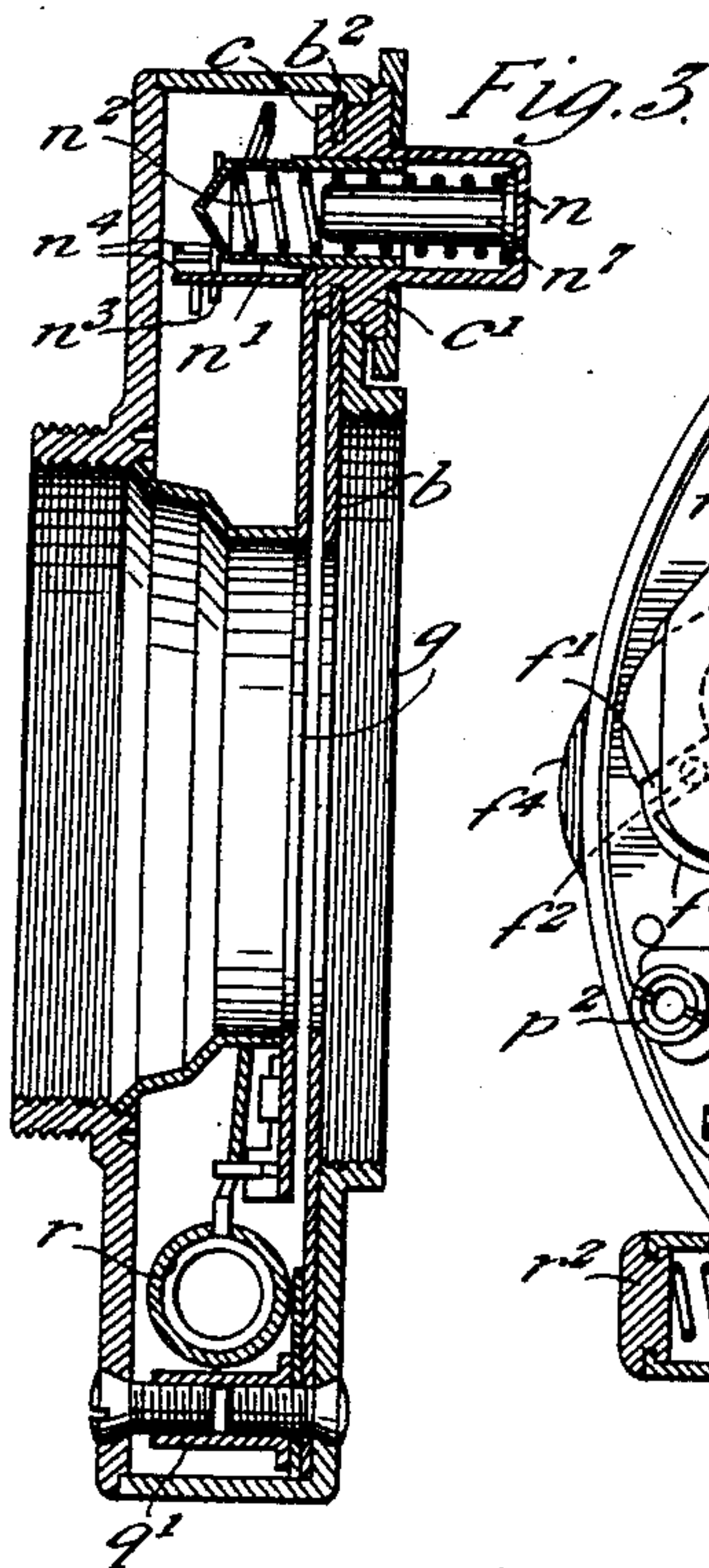
Atty.

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908,355.

Patented Dec. 29, 1908.

2 SHEETS—SHEET 2.



Witnesses:
 Robert Emmett,
 Charles Hesler

Inventor
 William Taylor
 James L. Norris.

UNITED STATES PATENT OFFICE.

WILLIAM TAYLOR, OF LEICESTER, ENGLAND.

PHOTOGRAPHIC SHUTTER.

No. 908,355.

Specification of Letters Patent.

Patented Dec. 29, 1908.

Application filed April 25, 1904. Serial No. 204,826.

To all whom it may concern:

Be it known that I, WILLIAM TAYLOR, a subject of the King of Great Britain and Ireland, residing at Stoughton Street Works, Leicester, in the county of Leicester, England, have invented certain new and useful Improvements in Photographic Shutters, of which the following is a specification.

This invention relates to mechanism for operating the shutters of photographic cameras adapted either for time exposures, the duration of which is determined by the actual manipulation of the operator, or for instantaneous exposures, the duration of which is determined by the actual manipulation of the operator, or for instantaneous exposures, the duration of which is automatically governed.

The time of exposure of photographic shutters has been controlled in two ways, first by varying the rate of opening and closing, the second by opening and closing quickly and varying the time during which the shutter remains fully open. In the latter class the time during which the shutter remains fully open is generally controlled by the escape of air into a pneumatic cylinder, and also in such cases the pneumatic cylinder is used as a buffer to arrest the movement of the shutter when it opens and to delay its closing for a time which can be varied by varying the leakage of the pneumatic cylinder or by varying the amount of movement of its piston.

According to the present invention a spring separate from the motor spring is used to operate the timing device and the strength of this time spring may be adjusted so as to get a definite exposure for a given amount of movement of the pneumatic piston of the timing device. At the same time the timing piston is relieved of the shock due to arresting the motion of the shutter, and its motion being controlled more by leakage of the air and less by its elastic action, accurate timing of short intervals is thereby improved.

To improve further the accuracy of timing of short intervals, the pneumatic timing cylinder is arranged so that the movement of the piston tends to compress the air, and also the cylinder is made of variable capacity and is adjusted to have very small capacities for very short intervals.

The invention also includes an improved construction of shutter diaphragm and this, together with the improved motor, setting, releasing and timing mechanisms which co-operate to produce these results, are hereinafter more specifically described with reference to the accompanying drawings in which—

Figure 1 is a front elevation of the shutter; Fig. 2 is a back elevation with the cover and other parts removed to show the method of linking the diaphragm leaves; Fig. 3 is a section on line 3—3 of Fig. 1, with parts omitted; Fig. 4 is a section at right angles to that of Fig. 3 showing the stop and bracket plates and the driving or motor part of the apparatus; Fig. 5 is a sectional plan showing practically all the various parts in proper relation, except the linkage between the motor part and the diaphragm, this being shown in plan in Fig. 6; Fig. 6^a is an end view of the hinge of the controlling gate and Figs. 7 and 7^a other details hereinafter described, Figs. 3, 4, 5, 6, 6^a, 7 and 7^a being drawn to an enlarged scale.

The diaphragm of the shutter consists of a number of leaves *a* connected by pivots *a*¹ at one of their ends with the stop plate *b* and equally spaced thereon. The front or aperture edges of the leaves are made with a reentrant angle so that each leaf constitutes two sides to the diaphragm aperture as shown in Fig. 1. The value of the reentrant angle, if equal angles are used, is given by the expression $\frac{n-1}{n} \times 180^\circ$ where *n* is the number of leaves in the diaphragm. Such a diaphragm forms a polygonal aperture having twice as many sides as there are leaves. A diaphragm of four leaves might be arranged to form a regular octagonal aperture for the position of the leaves which would give what might be considered the normal aperture; or it might alternatively be arranged to form a regular octagon in two positions which may be equidistant on either side from the normal aperture position.

Each of the leaves is linked to the two adjacent leaves by means of crossed links *a*² pivoted one on either side of and equidistant from the pivot *a*¹ on which it turns, the said links having their ends connected one with another to form a closed series so that the motion imparted to one leaf is communicated

equally and simultaneously to the others. The leaves are superimposed on each other in regular order on the flat stop plate b , which has a central aperture b' and is arranged to
 5 fit inside the case so as to be rotatable therein about the common axis of the diaphragm and stop plate apertures.

The stop plate b has a number of fingers b^2 which are slightly bent upwards to give them
 10 a spring action and which are adapted to engage under shoulders or flanges c on the bosses c' of external adjusting dials, so that the dials may be assembled and held in place by inserting their bosses through holes in the
 15 case and turning the stop plate so that its fingers engage beneath the flanges.

The diaphragm is operated through a series of pivoted links so arranged that although the extent of the motion of one end
 20 of the series remains constant that of the other can be varied continuously from an equal amount down to as small an amount as may be desired. It is the latter end of the series which is pivotally connected with one
 25 of the leaves of the diaphragm while the former is connected with a part of the operating mechanism which has a constant range of motion. The motion is communicated from the operating mechanism or motor to one
 30 arm of a lever d , the other arm of which is connected through a pair of links $e e'$ with one of the leaves a of the diaphragm. The junction pivot of the links $e e'$ has one end of another link e^2 pivoted thereon, the other end
 35 being pivoted on the outer end of an arm or sector plate f . The sector plate f is pivoted at f^0 at its center on and supported from a bracket g' extending from the bracket or crown plate g and has a radial slot f' in which
 40 engages a pin f^2 eccentrically mounted on a disk f^3 which can be rotated on its central axis from outside the case by means of an adjustment dial f^4 . The slot is preferably formed with a narrow extension f^5 for the
 45 purpose of providing a spring action on the pin f^2 to take up wear of the parts in contact. On turning the dial f^4 the eccentric pin f^2 travels along the slot in the plate f , which is thus rotated on its axis and therefore alters
 50 the position of the outer or fixed pivot of the link e^2 about which as center the junction pivot of the three links rotates. The effect of varying the position of this point is to vary the direction of motion of the junction pivot
 55 of the three links, and thus to vary the ratio of the motion transmitted through the links to that of the prime mover, and by this means the shutter can be set to open and close to any desired extent within the limits
 60 imposed by the apparatus.

Since one complete turn of the dial f^4 will cause the plate f to move through its full range in both directions the two halves of the dial may be utilized for two separate scales
 65 of different values for use respectively with

two lenses of correspondingly different focal lengths. A further adjustment of the aperture may be provided for by making the stop plate b rotatable within small limits, so that
 70 by turning it in one direction or the other, and with it the pivots of the diaphragm leaves, the aperture will be increased or diminished, since the point of the leaf to which the link e' is pivoted is relatively a fixed
 75 point.

The operating motor is contained in a slotted tube or guideway r , which passes through holes in the rim of the case and is preferably held frictionally so as to be adjustable longitudinally and rotationally, but
 80 is finally secured in a fixed position therein. Projecting from one end of the tube is a push pin or push piece h by which the mechanism is set in motion, and which has a rib h' extending through the slot r' in the tube. The
 85 slot at this part is widened to allow partial rotation of the push rib, and the end of the slot is narrowed by an upward slope of the lower edge, so that when the push is returned to its normal longitudinal position along the
 90 tube by means of the returning spring h^2 it is constrained also to return to a normal angular position. This rotation might also be accomplished by torsional action of the spring.

When the push is pressed inwards it com-
 95 presses the spring h^2 and at the same time the rib h' encounters a pin i' projecting through the slot from one of a pair of pistons $i k$ working in the tube and which may be termed respectively the motor piece and the setting
 100 piece. These pistons are urged away from each other by means of a compressed spring h^3 to an extent which is limited by a link connecting the two. As shown in Fig. 5, this link is constituted by a pair of rods or wires
 105 $i^2 k^2$ extending inwardly from the pistons $i k$ respectively, their inner ends about midway between said pistons being hook-shaped to engage one with the other as shown in Fig. 7. The second piston k has also a pin k' project-
 110 ing through the slot r' and adapted to engage with a stop l' on a controlling gate or controlling frame l . When so engaged and the push h is pressed, the piston i is pushed forward and the spring h^3 is further compressed
 115 between the pistons. As soon as the stop l' is made to release the pin k' , the piston k is driven forward by the compressed spring h^3 through a definite distance which is determined as above described, at the same time
 120 compressing against a cap r^2 on the further end of the tube another and weaker spring h^4 , which serves afterward to return the pistons to their normal positions. There is a transverse slot k^3 in the piston k in which engages
 125 a pin d' which projects from the lever d through an opening in the tube r , and by which motion is transmitted to the shutter.

The controlling gate l may be arranged to slide in a suitable guide, but is preferably
 130

mounted on hinges, the axis of which is parallel to the tube r , and is urged by a spring l^2 so that when the push is in the idle or starting position a projecting wing l^3 on the gate 5 bears gently down on the pin i' of the piston i while the stop l' is in position, just in front of the pin k' of the piston k . When the push is pressed the pin k' is urged to over ride the stop l' , the two being suitably shaped for 10 this object as shown in Fig. 7^a, and therefore to depress the gate. This, however, is prevented by the wing l^3 of the gate bearing on the pin i' until the latter has been moved along by the push h under the wing l^3 so as to 15 clear it. The pin k' then opens the gate and escapes from the stop, and the piston k makes its outward movement and opens the shutter. The wing l^3 of the gate now engages behind the pin i' and obstructs its return, but the rib h' of the push pin, having 20 been depressed by the wing of the gate, is no longer in position to obstruct the pin i' and may be released, when it will be returned by the spring h^2 to its normal position. When the push is again pressed, the rib h' which on 25 the first occasion passed over a spring urged catch piece, which may be the free end of a wire spring h^5 , is now deflected by the wing l^3 to pass under the catch piece. The rib h' in 30 passing under the catch piece wedges it up against the wing of the controlling gate, which is therefore raised, thereby freeing the pin i' and allowing the spring h^4 to return both pistons together to their normal or 35 starting position and thus closing the shutter.

The pivots l^4 on which the controlling gate is hinged, are held in V-shaped channels or grooves in the spring plates l^5 against the surface of flat plates l^6 as shown in Fig. 6^a, the 40 ends of the pivots projecting beyond the ends of the plates. This construction enables the pivots to slide along their bearings for the purpose of admitting the controlling gate which is pivoted on the two inner ends, 45 and also a second frame m which is hinged on the outer ends of the pivots, and is preferably balanced about its pivot axis by means of a suitable counterpoise m^5 .

One end of a spring m' is fixed to the frame 50 m by a set screw m^2 , by means of which the set of the spring may be adjusted, while the other end which is free, extends towards the piston k and is bent down so as to engage with and be raised by the pin k' when it is 55 driven forward as above described. The frame m is thus turned on its hinges and brings the end of a finger m^3 on the opposite side of the hinges downwards on the end of a piston n' of a constant leakage pneumatic 60 cylinder n . When the piston has been depressed by this finger to nearly the end of its range, an adjustable screw stop m^4 in the frame encounters a rearward projection l^7 of the controlling gate situated on the same 65 side of the common axis of the two parts and

depresses it, thus raising the wing l^3 of the gate, the edge of which acts as a stop for the piston i , when the shutter is open, and thereby allowing the pistons to be instantaneously returned to their starting position and 70 the shutter closed.

The pneumatic piston n' is returned to its starting position by means of a light coiled spring n^2 conveniently placed inside the piston which is made hollow to receive it. A 75 pin n^3 projecting from the piston is arranged to move in vertical guides n^4 attached to the cylinder n , and is pressed upwards by the spring n^2 against a cam surface n^5 encircling the piston. By rotating a dial n^6 situated 80 outside the case and attached to the cylinder n , the piston is also rotated and the pin n^3 traverses the cam surface. By this means the piston can be made to project more or less from the cylinder and thus its range of 85 motion varied. The more the piston projects the earlier does the finger m^3 of the hinged frame come into contact with it, and therefore the longer is the time before the frame reaches the position at which it actu- 90 ates the controlling gate.

The capacity of the cylinder may be reduced and its action rendered more certain, especially for the shorter exposures, by inclosing within the hollow timing piston and 95 within the spring n^2 a core piece n^7 secured to the cylinder cap, the arrangement being such that the air capacity of the cylinder is a minimum when the device is set for timing the shortest exposure, and increases for increased 100 time of action.

By means of a scale on the dial the pneumatic retarding or timing device may be set to give any required exposure in automatic 105 working of the shutter. Another cam o having a dial o' projecting outside the case is provided as a stop by which the hinged frame may be rendered inoperative when the shutter is to be used for hand or time 110 exposures.

The cam o may conveniently be formed on the leaky cylinder of a pneumatic check, the piston of which is pressed upwards by a light spring against the hinged frame m . This 115 arrangement serves both to control the impact of the finger m^3 with the timing piston and also to return and hold the frame and the check in a fixed starting position.

The spring m' on the hinged frame, in addition to performing the function already 120 described, by its pressure on the pin k' of the piston k prevents the latter from being brought up at the end of its stroke with a jar or shock, and thus prevents jumping of the shutter. The adjusting set screw m^2 on this 125 spring may also be used for adjustment in conjunction with the pneumatic timing piston. It may, for example, be used to adjust the time required for the motion of the piston through its extreme range to some defi- 130

nite amount, say one second. For an exposure of 1/50th of a second, the timing piston might be set in its lowest operative position, and the adjustment made by means of the adjustable screw stop m^4 in the hinged frame m . Intermediate exposures would then be determined by the position of the pneumatic timing piston, and a timing dial scale constructed accordingly.

10 In addition to the various adjustments already set forth, means is also provided for adjusting the axis of the junction pivot of the links e, e', e^2 , to coincide with the axis of the sector plate f . This is done by placing
15 the fulcrum pivot of the lever d on a bar p having forked ends p' which are clamped under pillars p^2 to the crown plate. The movement permitted by the forked ends of the bar when unclamped enables the junction pivot of the links e, e', e^2 , to be adjusted
20 as may be required.

The adjustment of the tube r may be provided for by means of a dowel plate q adjustably clamped to the case by means of a
25 screw pillar q' , and having dowels q^2 fitting in recesses in the wall of the tube r .

The operation of the various parts of the mechanism has been fully described in connection with these several parts, but the operation of the apparatus as a whole may be
30 briefly stated as follows: The apparatus may be used either for timed exposures or for so-called instantaneous exposures. In the former case the dial o' is turned to the
35 position in which it renders the hinged frame m inoperative. On pressing the push h once, the spring between the two pistons, that is between the motor piece and setting piece, is compressed and the pin k' on the piston k
40 thus urged to override the stop l' on the controlling gate l , which, however, it is prevented from doing until the pin i' has been moved by the push h clear of the wing l^3 on the starting gate, whereupon the piston
45 k is shot forward through a definite distance, and by means of the linkage previously described opens the leaves of the diaphragm. The return of the pistons is prevented by the engagement of the wing of the controlling
50 gate in rear of the pin i' until on releasing the push h and pressing it again, the catch piece h^5 is urged by the rib h' of the push to lift the wing of the controlling gate, thus freeing the pistons and enabling them
55 to be returned to their starting positions by the spring h^4 , and the leaves of the diaphragm close.

When the shutter is to be used for instantaneous or automatic exposures the
60 dial o' is turned to free the hinged frame m and the seconds dial n^6 turned to give the required exposure. Pressing the push h once operates as already explained to open the diaphragm, the parts being then left in such
65 a position that the shutter remains open.

In this case, however, the forward movement of the piston k to open the shutter has actuated the hinged frame m so that when, after a time determined by the setting of the
70 retarding device n , the adjustable screw stop m^4 on the frame engages the controlling gate and depresses it to raise the wing l^3 , the pistons i, k are thereby automatically released and the shutter closed.

Having thus described the nature of this
75 invention and the best means I know of carrying the same into practical effect, I claim:—

1. Apparatus for operating photographic shutters comprising a driving spring for
80 opening the shutter, a detent for holding it open, mechanism operating to withdraw said detent, and a second spring separate from the driving spring and set in operation
upon the shutter being opened, to actuate
85 the said mechanism, substantially as described.

2. Apparatus for operating photographic shutters, comprising a driving spring, mechanism actuated thereby to open the shutter,
90 a detent adapted to hold the shutter open, mechanism operating to withdraw said detent, and a second spring separate from the driving spring operating to actuate said
mechanism, said second spring and detent
95 being made operative upon the opening of the shutter, substantially as described.

3. Apparatus for operating photographic shutters, comprising a driving spring, a motor piece actuated thereby, a setting piece, a
100 detent controlling said motor piece and setting piece, means for setting the said driving spring, and means operating as soon as the setting of the driving spring is completed to
displace the said detent to release the motor
105 piece and lock the setting piece, substantially as described.

4. Apparatus for operating photographic shutters, comprising a push piece, a guide way, a setting piece and a motor piece movable in said guideway, said setting piece being
110 adapted to be displaced by the push piece, a link connecting said setting piece and motor piece to limit their relative displacement, a driving spring adapted to be set by the displacement of the setting piece, and means
115 for locking the setting piece and releasing the motor piece, substantially as described.

5. Apparatus for operating photographic shutters, comprising a motor piece, a manually operated setting piece linked to said motor piece, a driving spring interposed between the said motor and setting pieces,
120 means preventing the movement of the motor piece during the setting movement of the setting piece, means preventing the return of the setting and motor pieces, and means controlling the release of the said pieces substantially as described.

6. Apparatus for actuating photographic
130

shutters, comprising a setting piece and a motor piece movable in guides, a link connecting said motor and setting pieces to limit their relative displacement, a compression spring between said motor and setting pieces, means for advancing the setting piece to further compress the said spring, a detent placed to hold the motor piece during said movement of the setting piece, and means for returning the setting and motor pieces to their normal positions, substantially as described.

7. Apparatus for actuating photographic shutters, comprising a push piece, a setting piece, a motor piece, and a pivoted controlling frame having projections cooperating with the said push piece, setting piece and motor piece, substantially as described.

8. In apparatus of the character herein described, a releasing spring set upon opening the shutter, a pivoted controlling gate operating to prevent closure of the shutter, and a pivoted frame reacted upon by the said spring to displace said controlling gate, and release the shutter, substantially as described.

9. In apparatus of the character herein described, a releasing spring set upon opening the shutter, a pivoted controlling gate operating to prevent closure of the shutter, a pivoted frame reacted upon by the said spring to displace the controlling gate and release the shutter, and an adjustable retarding device cooperating with the said pivoted frame to vary the interval elapsing between the opening of the shutter and its release, substantially as described.

10. In apparatus of the character herein described, a pneumatic timing device for determining the period during which the shutter remains fully open, comprising a leaky cylinder, a piston movable therein under the action of the shutter releasing mechanism to compress the air within the cylinder, means for reducing the impact of the shutter releasing mechanism with the movable piston and means for varying the capacity of the cylinder, substantially as described.

11. In apparatus of the character herein described, a detent operating to prevent closure of the shutter, a movable frame operating to displace said detent, a retarding device cooperating with said frame, and a pneumatic check operating to reduce the impact of the said movable frame with the said retarding device, substantially as described.

12. In apparatus of the character herein described, a setting piece, a push piece adapted to displace the setting piece longitudinally, a detent adapted to prevent the return of the said setting piece and to displace the said push piece rotationally, and a spring catch piece cooperating with the said push piece to displace the detent and release the setting piece, substantially as described.

13. In apparatus of the character herein described, a setting piece and a motor piece, a link connecting said pieces to limit their distance apart, a spring operating to keep said pieces at a fixed distance apart, a second spring set by the movement of the motor piece and operating to return said motor piece and setting piece to normal positions, substantially as described.

14. In apparatus of the character herein described, a setting piece, a push piece adapted to displace said setting piece longitudinally, and means operating to deflect the said push piece out of the return path of the setting piece, substantially as described.

15. In apparatus of the character herein described, a push piece, a guide way constraining the movement of said push piece, said guideway being formed to allow partial rotation of said push piece, and means operating to return said push piece to its starting position in the guideway, substantially as described.

16. In apparatus of the character herein described, a casing, a guide tube adjustably secured in said casing, and a push piece, a setting piece, a motor piece, and cooperating springs all contained within said guide tube, substantially as described.

17. In apparatus of the character herein described, a diaphragm comprising a plurality of pivoted leaves, each formed on its inner edge with a reentrant angle to contribute two sides to the diaphragm aperture, and a closed series of links connecting said leaves to move them simultaneously, substantially as described.

18. In apparatus of the character herein described, motor mechanism, a diaphragm, a pair of links connecting said diaphragm with the motor mechanism, and means for directing the motion of the junction pivot of said pair of links, substantially as described.

19. In apparatus of the character herein described, motor mechanism, a diaphragm, a pair of links connecting said diaphragm with the motor mechanism, a third link pivoted at one end on the said pair of links at their junction pivot, and means for varying the position of the other end of the third link, substantially as described.

20. In apparatus of the character herein described, a diaphragm, a motor piece, a pair of links pivoted together and connecting the diaphragm with said motor piece, an arm pivotally mounted in the frame coaxially with the junction pivot of the said pair of links when the shutter is closed, a third link having one end pivoted eccentrically on said arm and its other end pivoted to the pair of links coaxially with their junction pivot, and means for rocking said arm about its pivot axis, substantially as described.

21. In apparatus of the character herein described, a retarding device operating to

vary the time during which the shutter re-
mains fully open, comprising a constant
leakage pneumatic cylinder, a hollow piston
operating to compress the air in the cylinder
5 during the working stroke, and a core piece
within the said cylinder adapted to vary the
capacity thereof, substantially as described.

In testimony whereof I have signed my
name to this specification in the presence of
two subscribing witnesses.

WILLIAM TAYLOR.

Witnesses:

A. PIERCE,
H. PETTY.