(No Model.) 3 Sheets—Sheet 1.

P. O. KEILHOLTZ.

ARC LIGHT REGULATOR.

No. 348,977. Patented Sept. 14, 1886.

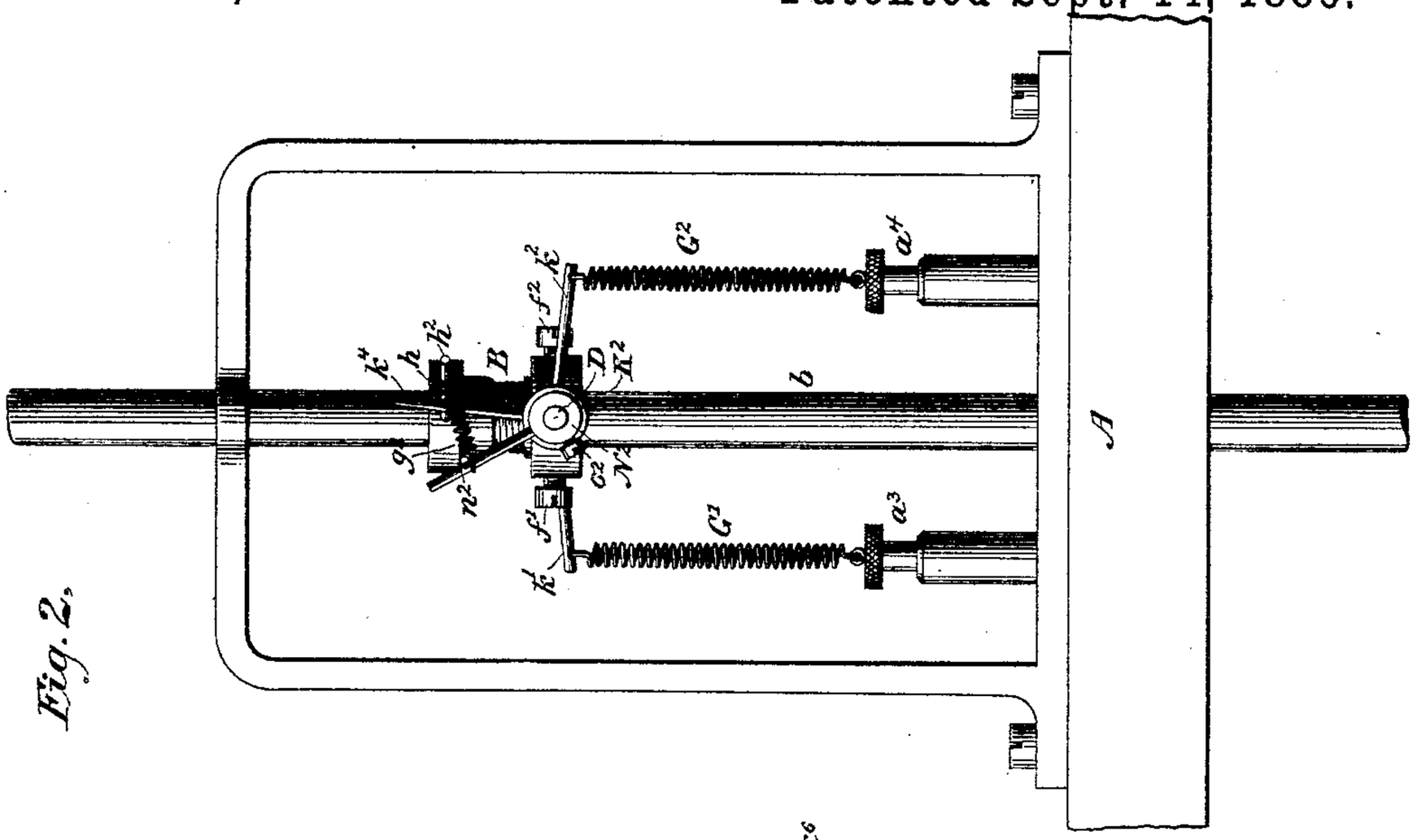

Fig. 2.

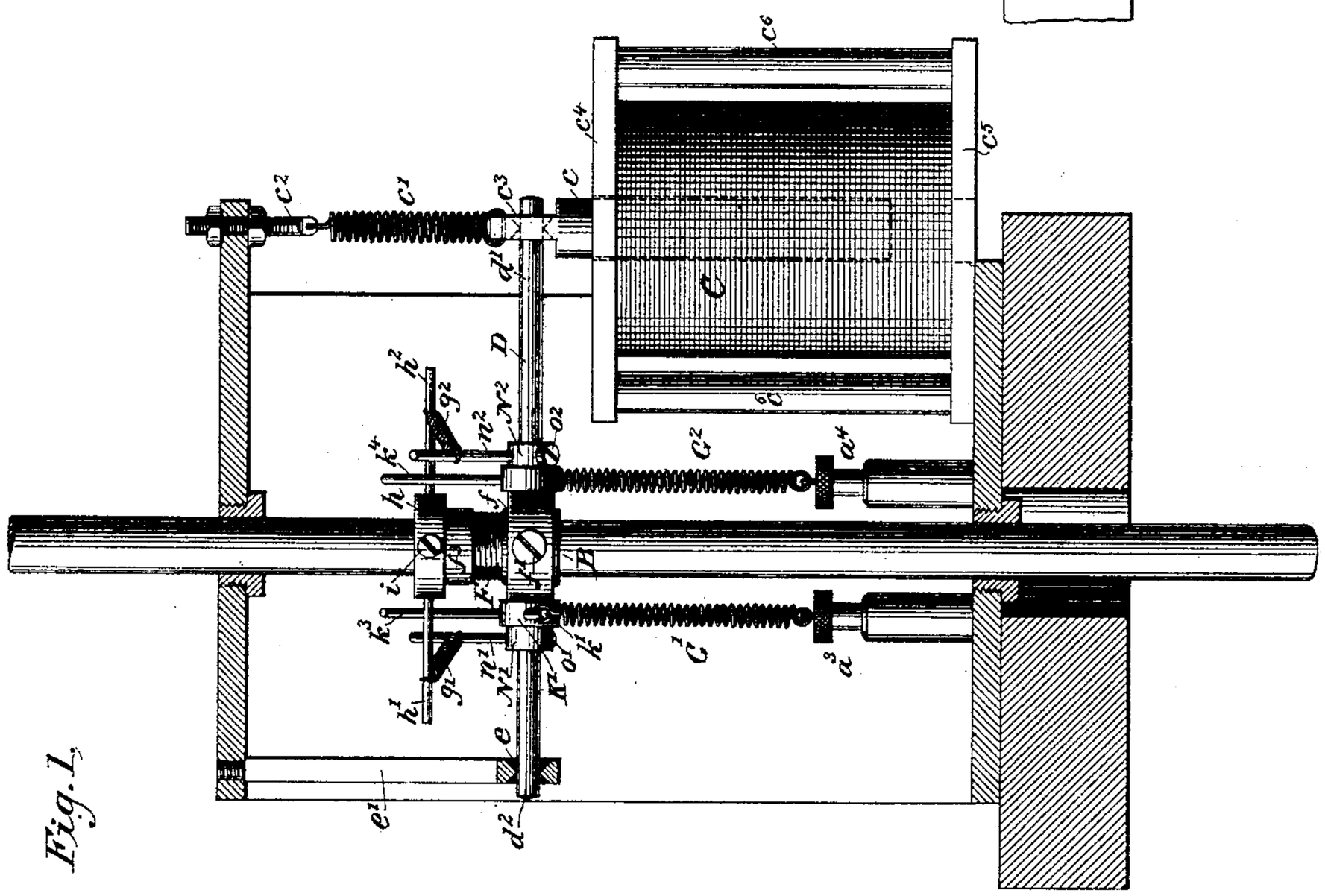

Fig. 1.

Witnesses
Geo. W. Breck.
Carrie E. Ashley

Inventor
Pierre O. Keilholtz,
By his Attorneys
Pope & Edgecomb

(No Model.)

3 Sheets—Sheet 2.

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Fig. 3,

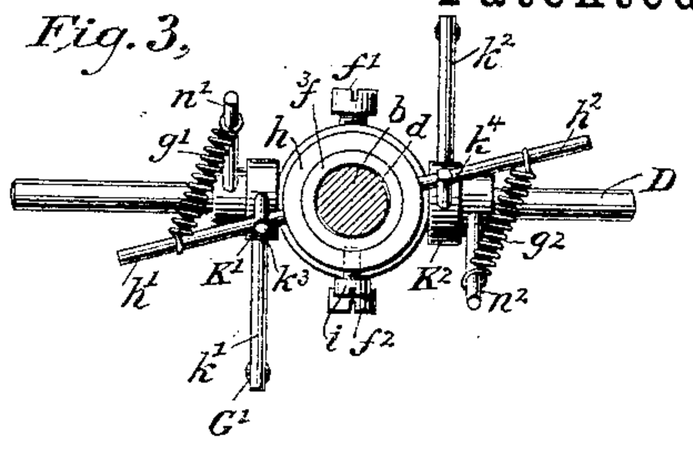


Fig. 5,

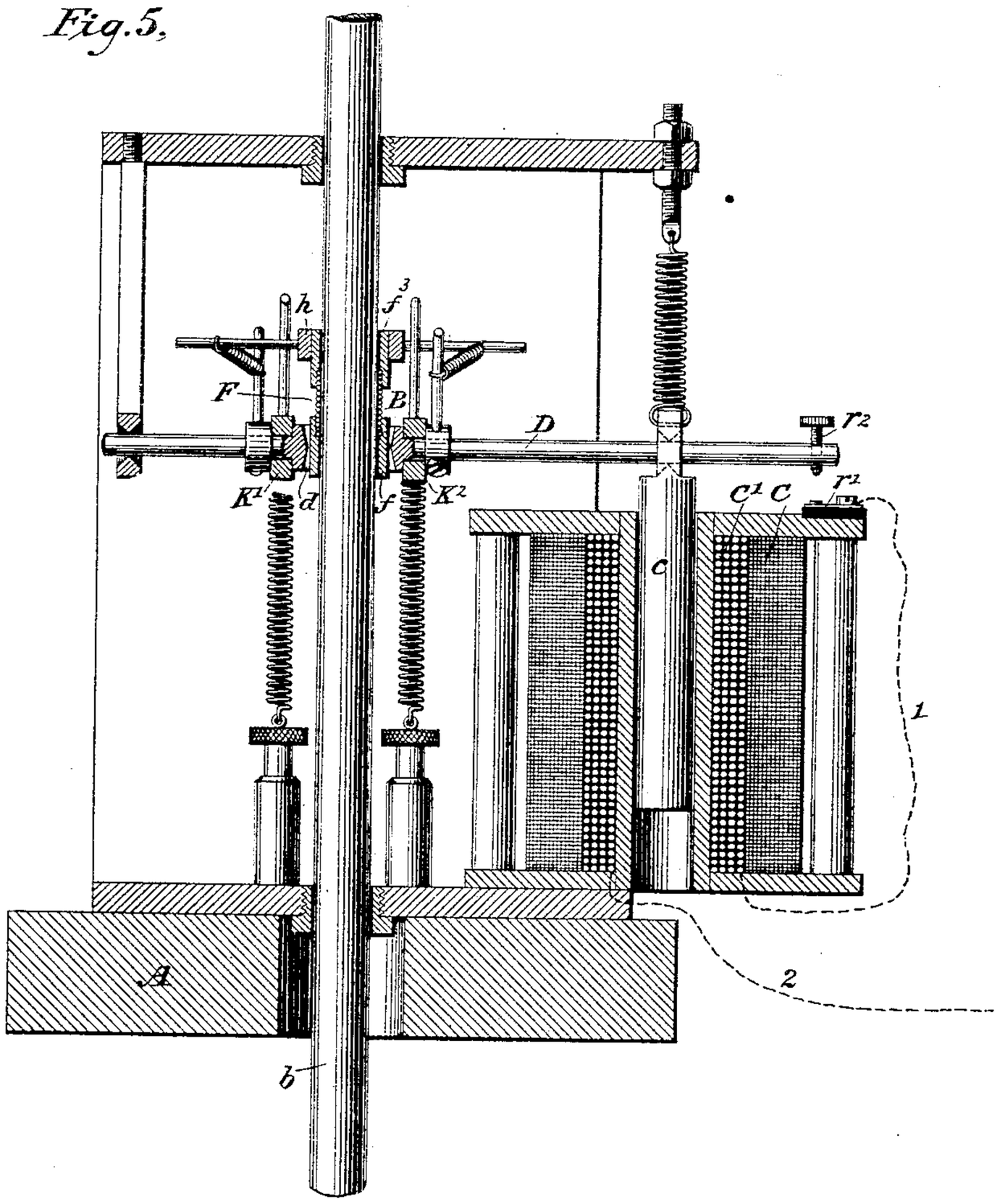
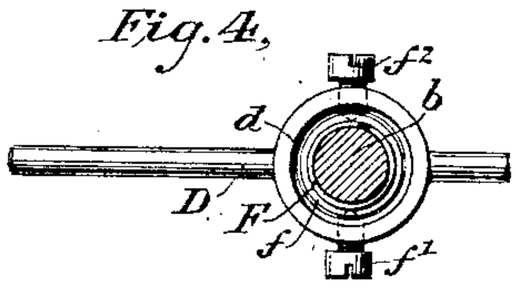


Fig. 4,



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Inventor

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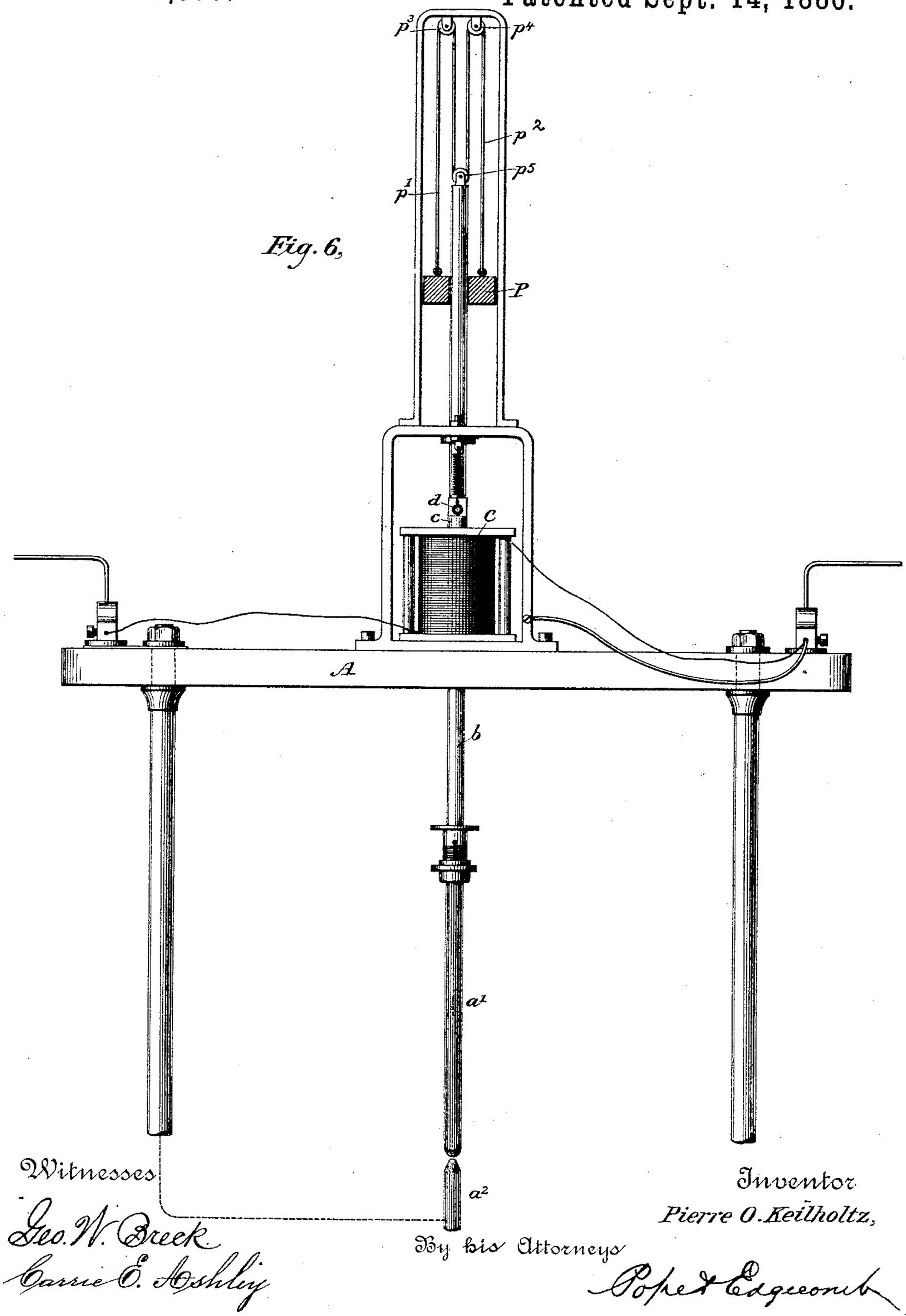
Fig. 6.



Witnesses
Geo. W. Breck.
Carrie E. Ashley

Inventor
Pierre O. Keilholtz,
By his Attorneys
Poole & Edgecomb

UNITED STATES PATENT OFFICE.

PIERRE OTIS KEILHOLTZ, OF BALTIMORE, MARYLAND, ASSIGNOR TO J. FRANK MORRISON, OF SAME PLACE.

ARC-LIGHT REGULATOR.

SPECIFICATION forming part of Letters Patent No. 348,977, dated September 14, 1886.

Application filed November 23, 1885. Serial No. 183,728. (No model.)

To all whom it may concern:

Be it known that I, PIERRE OTIS KEILHOLTZ, a citizen of the United States, residing in Baltimore, and State of Maryland, have invented certain new and useful Improvements in Arc-Light Regulators, of which the following is a specification.

My invention relates to the class of electric lamps, in which the light is produced at the arc formed between two carbon points, one of which is movable with reference to the other.

The object of the invention is to provide a regulator for the movable electrode, in which the separation of the carbons necessary to form an arc is positive and certain, while the approach is very gradual and regulated, in contradistinction to the intermittent movement which is incident to the majority of arc-light regulators heretofore employed.

The fundamental idea of the invention is the employment, as a clutch, of a spiral or coil spring which encircles the holding-rod and which is normally—that is to say, when the lamp is in position—coiled sufficiently tightly to firmly hold the rod. An undue increase in the resistance of the arc, however, causes the spring-clutch to relax its hold, thereby allowing the rod to feed forward the required distance and then be automatically arrested.

The operation of the clutch may be controlled by differential magnets, but preferably by a single-wound magnet, as hereinafter described.

In carrying out the invention it is necessary to so support the clutch that when the rods are brought into contact a separation will occur to form the arc. This is accomplished by supporting the clutch upon a lever which is capable of a movement in the proper direction to feed the carbon under the influence of changes in the strength of a solenoid-magnet included in a shunt around the arc. The current through the solenoid causes the core of the magnet to be drawn into the coil against the tension of a supporting-spring, thus causing an approach of the carbon and a consequent diminution of the current traversing the coils. The core is thereupon withdrawn from the coil slightly by reason of the supporting-spring, thus separating the carbons to form the arc. The second essential is that means be provided for moving one end of the coil-spring with reference to the other for the purpose of lessening or increasing its diameter, accordingly as it is required to clasp or release the rod. An increase of current in the shunt causes the movable core which controls the separation to move the lever, as already stated, and the same movement of this lever occasions a change in the tension of suitable adjustable equilibrium-springs applied to one end of the coil-spring, and serving to hold the latter in the required position for grasping the rod. The movement of the lever in one direction or the other destroys the normal equilibrium, so that the rod may be released or clasped more firmly, accordingly as the lever is moved in one direction or the other.

Coil-springs have heretofore been employed for clutching the carrier-rods of arc-lamps, and I do not make any broad claim thereto, but only in their application, as hereinafter specifically pointed out.

In the accompanying drawings, Figure 1 is a front elevation of such portions of a lamp as are necessary to illustrate the invention. Fig. 2 is a side view of the same. Figs. 3 and 4 illustrate certain details in the construction. Fig. 5 is a transverse section of a modification, and Fig. 6 illustrates a method of suspending the upper-carbon rod.

Referring to the figures, A represents a suitable supporting-frame, and a' and a^2 represent the upper and lower carbons, respectively. The upper carbon, a', is held in a rod, b, which extends through a clutch, B, and through suitable guides in the frame. The movement of the rod b is determined by a solenoid, C, and its movable core c, together with the clutch device B. The coil of the solenoid is of fine wire and included in a shunt around the arc, its respective terminals being connected with the conductors leading to and from the carbons. The movable core c is supported by means of a spring, c', secured to an adjusting-screw, c^2.

Through a suitable opening, c^3, in the upper end of the core there extends one end d' of a lever, D. The other end, d^2, of this lever extends loosely through an opening, e, in a support, e'. It is evident that the end d' of this lever will rise and fall with the core c. The movements thus occasioned are designed to cause a separation of the carbons for forming the arc and also to determine the feed of the

upper carbons, a'. An annular opening, d, is formed in the lever D, and through this the rod B extends. In this annular opening a ring, f, is pivoted by means of two screws, f' and f^2. The ring fits loosely upon the rod and allows its free passage through it. By reason of the pivots or screws f' and f^2, which support the ring, it is capable of preserving a horizontal position, notwithstanding the upward and downward movements of the end d' of the lever D. It should here be noticed also that the ends of the rod D extend loosely through their respective supports, so that it is capable of a slight longitudinal movement relatively thereto, thereby maintaining the opening d in the same vertical line, notwithstanding the tendency to turn upon the end d^2 as a center.

The solenoid-magnet is preferably constructed upon the principle illustrated, consisting of a diamagnetic spool supported at its respective extremities in plates c^4 and c^5 of magnetic material. These plates are united with each other outside the coil C by rods c^6 c^6 of soft iron. The parts are preferably so adjusted that the mass of iron in the rods c^6 is approximately equal to that in the core c. This form of magnet is not, however, essential, and other suitable forms may be adopted in place thereof. A spring, F, has one end securely attached to the ring f. The other end of this spring is rigidly attached to a similar ring or collar, f^3, which also encircles the rod b. It is evident that if this upper ring be turned toward the right hand or the left while the lower ring remains stationary, the coil-spring will be caused to grasp or to release the rod b, which passes through it. For the purpose of determining such movement the position of the ring f^3 is determined by two pairs of equilibrium-springs, G' g' and G^2 g^2. This is accomplished in this instance in the following manner: A collar, h, encircles the ring f^3, and is attached thereto by a set-screw, i. Two arms, h' and h^2, extend from this collar in opposite directions, and the positions of the same may be adjusted by loosening the set-screw and turning the collar upon the ring. The springs G' and G^2 are respectively attached at one end to the support A, by means of suitable adjusting-screws, a^3 and a^4, and the other remaining ends are respectively connected with arms k' and k^2, extending from corresponding hubs K' and K^2. These hubs are loosely mounted upon the rod D at opposite sides of the annular portion f. The spring tends to draw the arms downward and thereby turn corresponding arms or spokes, k^3 and k^4, downward. These spokes respectively bear against the arms h' and h^2, and thus tend in this instance to turn the ring f' in the direction opposite the hands of a watch, and to thereby coil the spring F more tightly upon the rod B. This tendency is counteracted by the corresponding springs g' and g^2, respectively, attached at one end to corresponding rods or arms, h' and h^2, and at their remaining ends to arms n' and n^2, which are respectively attached to supports N' and N^2, carried upon the respective arms of the lever D. The supports N' and N^2 may well serve to hold the hubs K' and K^2 in place. Their positions, and thus the positions of the corresponding arms, n' and n^2, are rendered adjustable by suitable set-screws, o' and o^2. This permits of the adjustment of the tension of the springs g' and g^2. The springs g' and g^2 may be dispensed with in some instances, provided the clutch-spring F has sufficient resistance to disengage itself from the carrier-rod after the tension of the springs G' and G^2 has been removed. Normally the various parts are so adjusted that when a current of the required strength for maintaining the arc is traversing the carbons the core c, and thus the lever D, will be in such position that the separation of the carbons will be maintained and the rod b held at rest. When, however, the arc increases and the resistance thus becomes greater, a greater amount of current will traverse the shunt-circuit including the coil or solenoid C, and thus tend to draw the core c downward. A slight advancement of the electrode a' will thus be occasioned by the movement of the core, and at the same time the tension of the springs G' and G^2 will be relaxed, so that the opposing tension of the springs g' and g^2 will become increased relatively. This will immediately cause the ring e' to be turned slightly in the direction of the hands of a watch, thus relaxing its grasp upon the rod b, which thereupon is allowed to slide forward by reason of its weight. Thereupon the current traversing the arc will increase and that traversing the solenoid decrease, and the lever D will rise, thereby causing the coil-spring to again grasp the rod and hold it firmly.

For the purpose of preventing the rod from acquiring an undue momentum, it may be counterbalanced by a weight, P, which is preferably annular, and surrounds the rod and is supported upon cords p' and p^2, passing over corresponding pulleys, p^3 and p^4, and secured to the upper end of the rod b by passing through a pulley, p^5. The weight P is not always necessary, and it may be desirable to make the rod b hollow, to lessen its weight, especially if the weight P is not employed.

It is evident that various modifications may be made in the method of applying the tension to the clutch-spring and modifying its tension upon the rod without departing from the spirit of the invention. It is designed that the rod, when the carbons have burned out, shall make contact with the lower electrode or the holder, and thus provide a short circuit; but to insure that in case the clutch should for any reason fail to operate, still a short circuit should be formed, I provide an additional coil of coarse wire around the movable core c, as shown at C' in Fig. 5. One end of the coil C' is conducted by a conductor, 1, with an insulated plate or contact-point, r', secured to the support of the coil. An adjustable screw or

contact-point, r^2, is carried by the arm d' of the lever D, and this is designed to make contact with the plate r' when the lever D is drawn downward a sufficient distance. The remaining end of the coil C' is connected by a conductor, 2, with the lower-carbon rod. When, therefore, the rod a' fails for any reason to feed forward, the lever D will be drawn down by the current traversing the coil C until the point r^2 touches the plate r'. A circuit will then be established from the rod b around the arc of the lamp through the coil C'. This is composed of wire of sufficient size to conduct the current without injury. A cut-out is thus formed and injury to the coil C is prevented. When an arc is again formed through the carbon-points, the normal operation of the lamp will be re-established.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, with the carrier-rod of an electric-arc lamp, of a coil-spring surrounding the same, a vertically-movable lever, carrying one end of said spring, and a rotary support for moving the other end of said spring circumferentially, and thereby causing it to grasp and to release said rod, as required.

2. The combination, substantially as hereinbefore set forth, with the carrier-rod of an electric-arc light, of a frictional clutch for the same, consisting of a coil-spring surrounding the rod, a vertically-movable lever carrying one end of said spring, and means for moving the other end of said spring circumferentially with reference to the first-named end, whereby the diameter of the spring is varied.

3. The combination, substantially as hereinbefore set forth, with the carrier-rod of an electric-arc lamp, of a clutch consisting of a coil-spring surrounding the rod, means for moving one end of said coil-spring circumferentially with reference to the other and thereby increasing or decreasing the diameter of the same, and means for moving the same in the direction of its length, substantially as described.

4. The combination, substantially as hereinbefore set forth, of a carrier-rod, a coil-spring surrounding the same, means for holding one end of the wire of said coil-spring in a given radial position, equilibrium-springs applied to the other end of the wire of said coil-spring, and means, substantially such as described, for disturbing the equilibrium between the last-named springs and turning the other end of said coil-spring circumferentially.

5. The combination, substantially as hereinbefore set forth, in an electric-arc lamp, of a carbon-holding rod, a frictional clutch consisting of a coil-spring surrounding the same, a lever supporting said coil-spring, a solenoid included in a shunt-circuit around the arc of the lamp, a core extending within said solenoid and connected with said lever, an adjustable spring tending to withdraw said core from said solenoid, and means for winding and unwinding said coil-spring by the longitudinal movement of said core, and thereby modifying its grasp.

6. The combination, substantially as hereinbefore set forth, in an electric lamp, of a carrier-rod, a coil-spring surrounding the same, means for retaining one end of said spring in a given position relative to said rod, a collar surrounding said rod, to which the other end of said spring is attached, two arms extending from said collar, two arms connected with the support for the first-named end of said spring, springs connecting the last-named arms with the first-named, respectively, and springs acting counter to the last-named springs, substantially as described.

7. The combination, substantially as hereinbefore set forth, in an electric-arc lamp, of a carrier-rod, an electro-magnet having a movable core, a lever having one end connected with said core, a coil-spring surrounding said rod and supported from said lever, a sleeve, also surrounding said rod, to which the remaining end of said spring is attached, one or more springs tending to turn said sleeve axially, one or more counteracting-springs, and means for modifying the relative values of said spring.

8. The combination, substantially as hereinbefore set forth, in an arc-lamp, of a spring surrounding the upper-carbon rod, a movable lever, a gimbaled collar supported in said lever and surrounding said rod, a spring attached to said collar, a second collar surrounding said rod, to which the remaining end of said spring is attached, and mechanical devices, substantially such as described, for turning the last-named collar upon said rod.

9. The combination, substantially as hereinbefore set forth, of a carrier-rod, a lever having an annular opening, through which said rod extends, a collar surrounding said rod, trunnions supporting said collar within said opening, a support for one end of said lever, through which it extends loosely, a solenoid-magnet, through the core of which the other end of said lever extends loosely, a coil-spring attached to said collar, and means for moving said lever, substantially as described.

10. The combination, substantially as hereinbefore set forth, of the rod B, the lever D, having the annular opening through which the rod extends, the spring F, connected with said lever, the collar f^3, the ring h, coupled with said collar, the arms h' and h^2, extending from said collar, the arms k^3 and k^4, turning upon said lever as a center, the springs G' and G^2, tending to turn the last-named arms in opposite directions and to press them against the arms h' and h^2, respectively, the springs g' and g^2, and the arms m' and m^2.

In testimony whereof I have hereunto subscribed my name this 13th day of November, A. D. 1885.

PIERRE OTIS KEILHOLTZ.

Witnesses:

CHARLES R. GALLAGHER,

CHARLES T. CHILD.