(No Model.) 4 Sheets—Sheet 1.

# A. GRAHAM.

## ELECTRIC ARC LAMP.

No. 268,218. Patented Nov. 28, 1882.

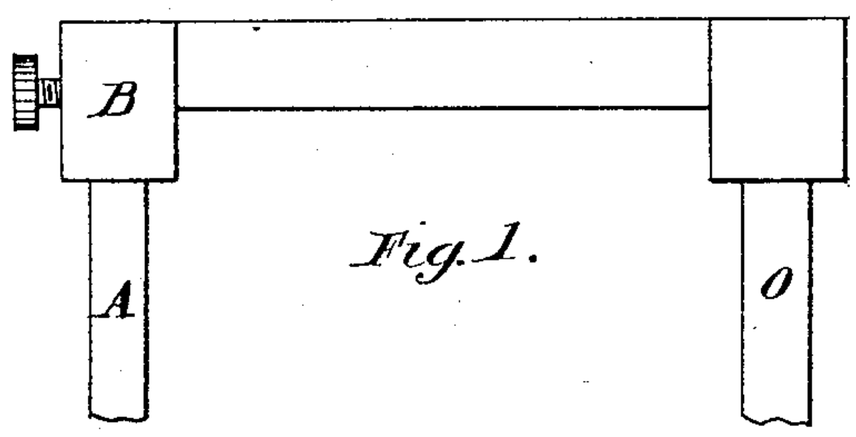
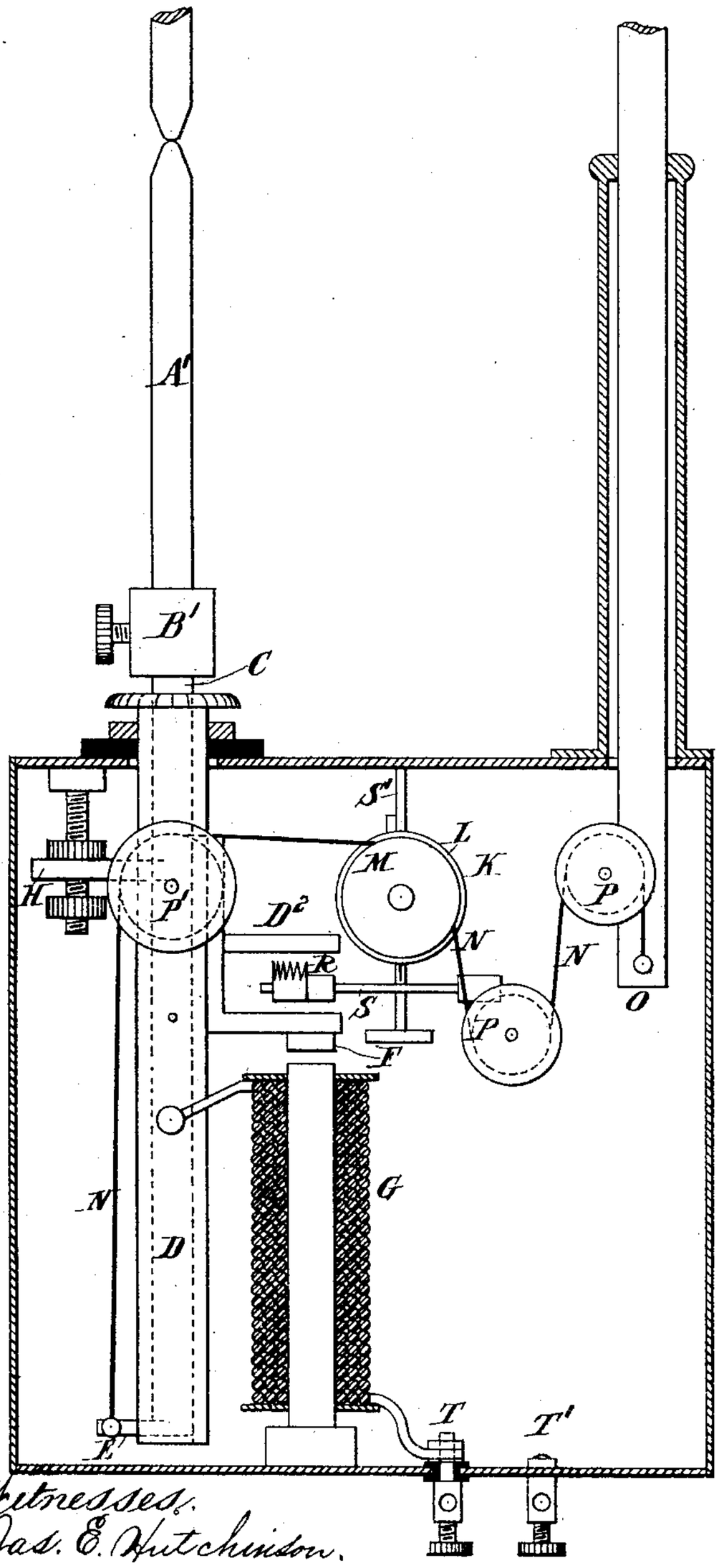
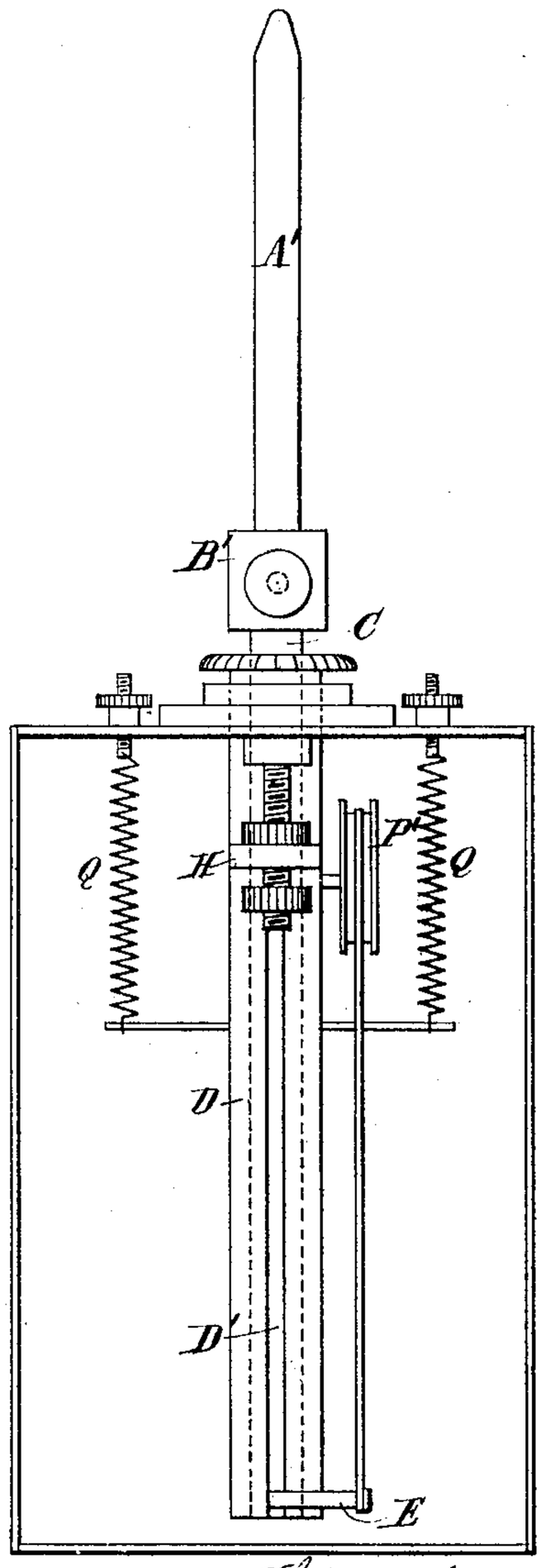



Fig. 1.

Fig. 2.

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By his Attorney,
James L. Norris.

(No Model.) 4 Sheets—Sheet 2.

# A. GRAHAM.

## ELECTRIC ARC LAMP.

No. 268,218. Patented Nov. 28, 1882.

*Fig. 3.*

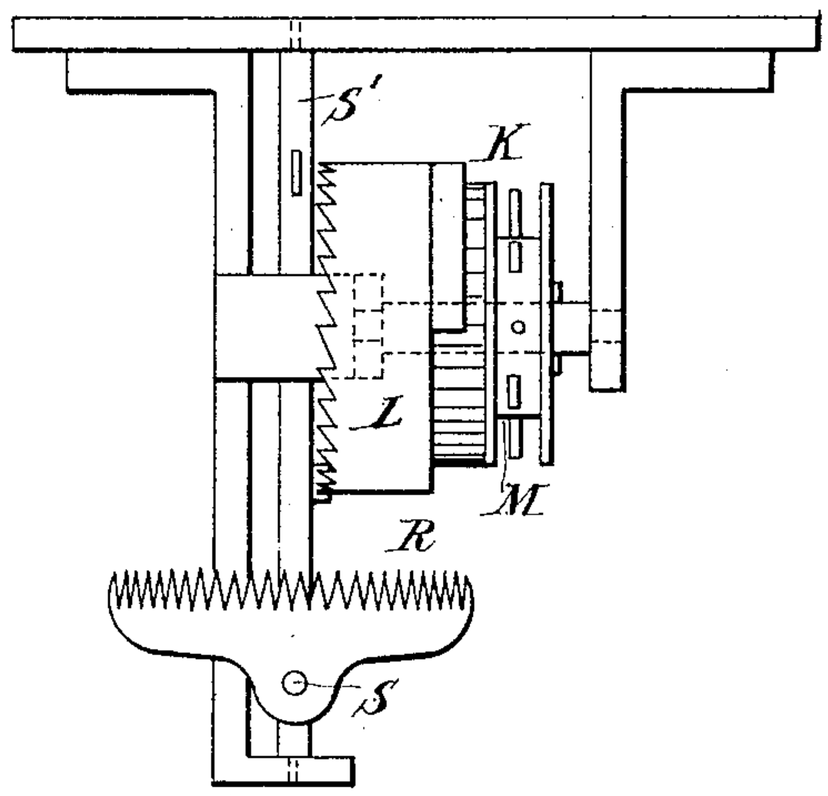
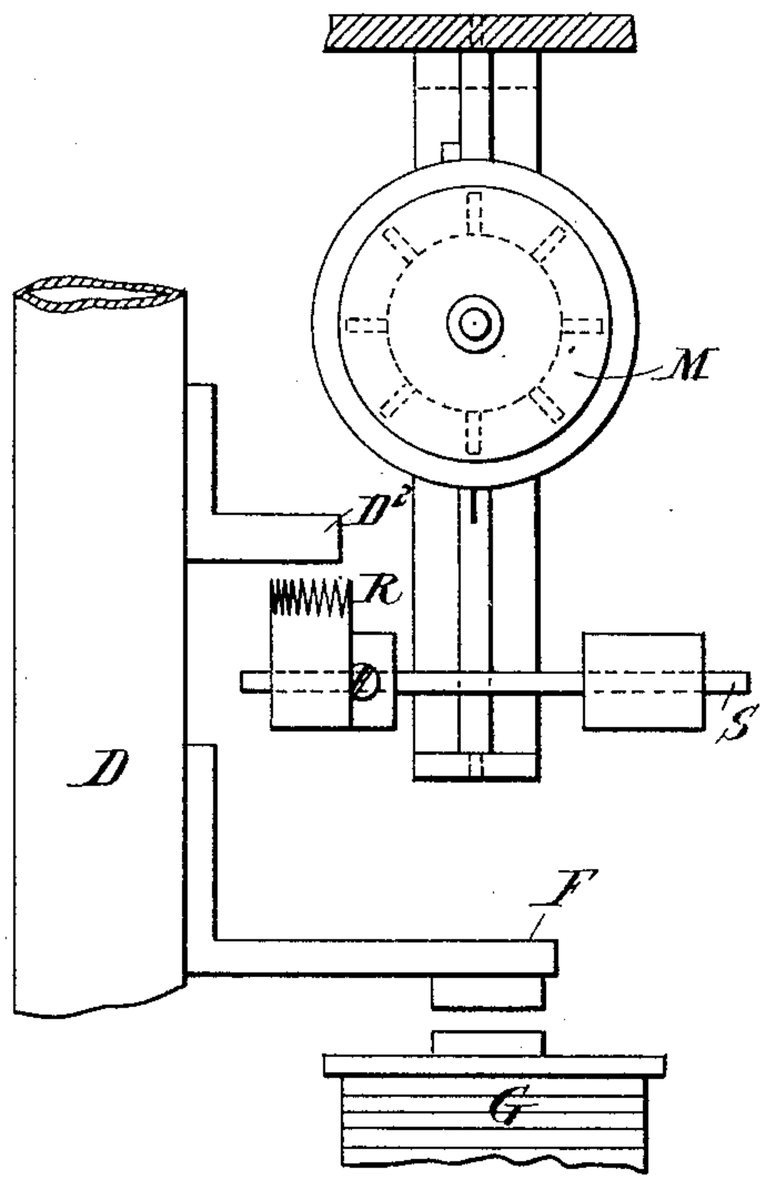
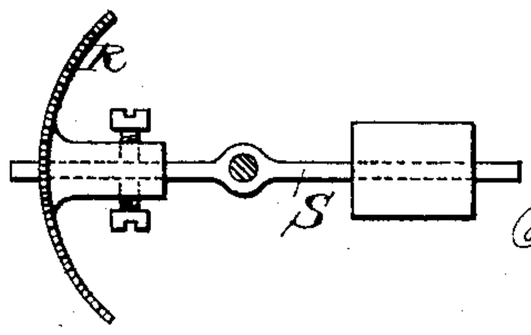



*Fig. 4.*

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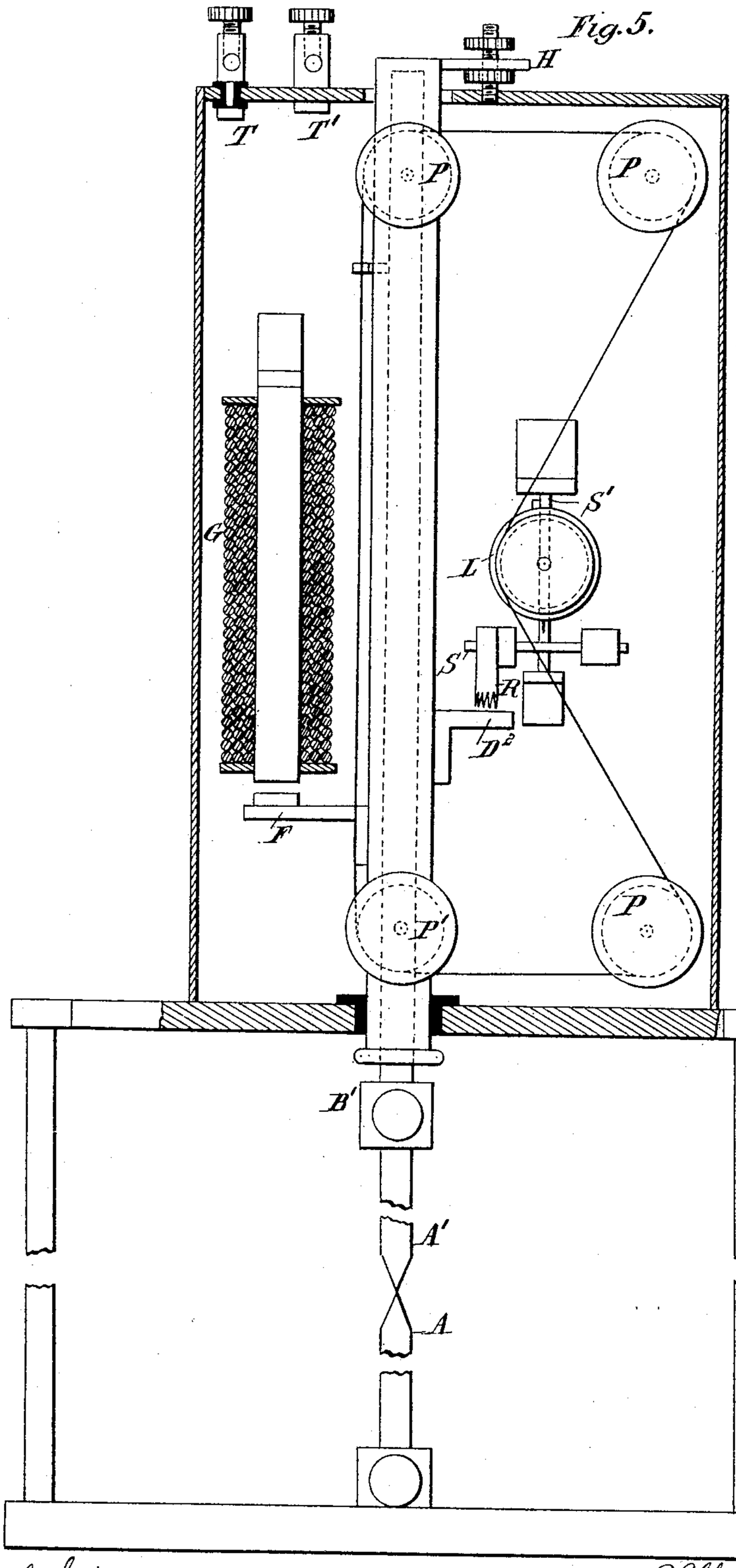
## ELECTRIC ARC LAMP.

No. 268,218. Patented Nov. 28, 1882.

Fig. 5.

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(No Model.) 4 Sheets—Sheet 4.

# A. GRAHAM.

## ELECTRIC ARC LAMP.

No. 268,218. Patented Nov. 28, 1882.

*Fig. 6.*

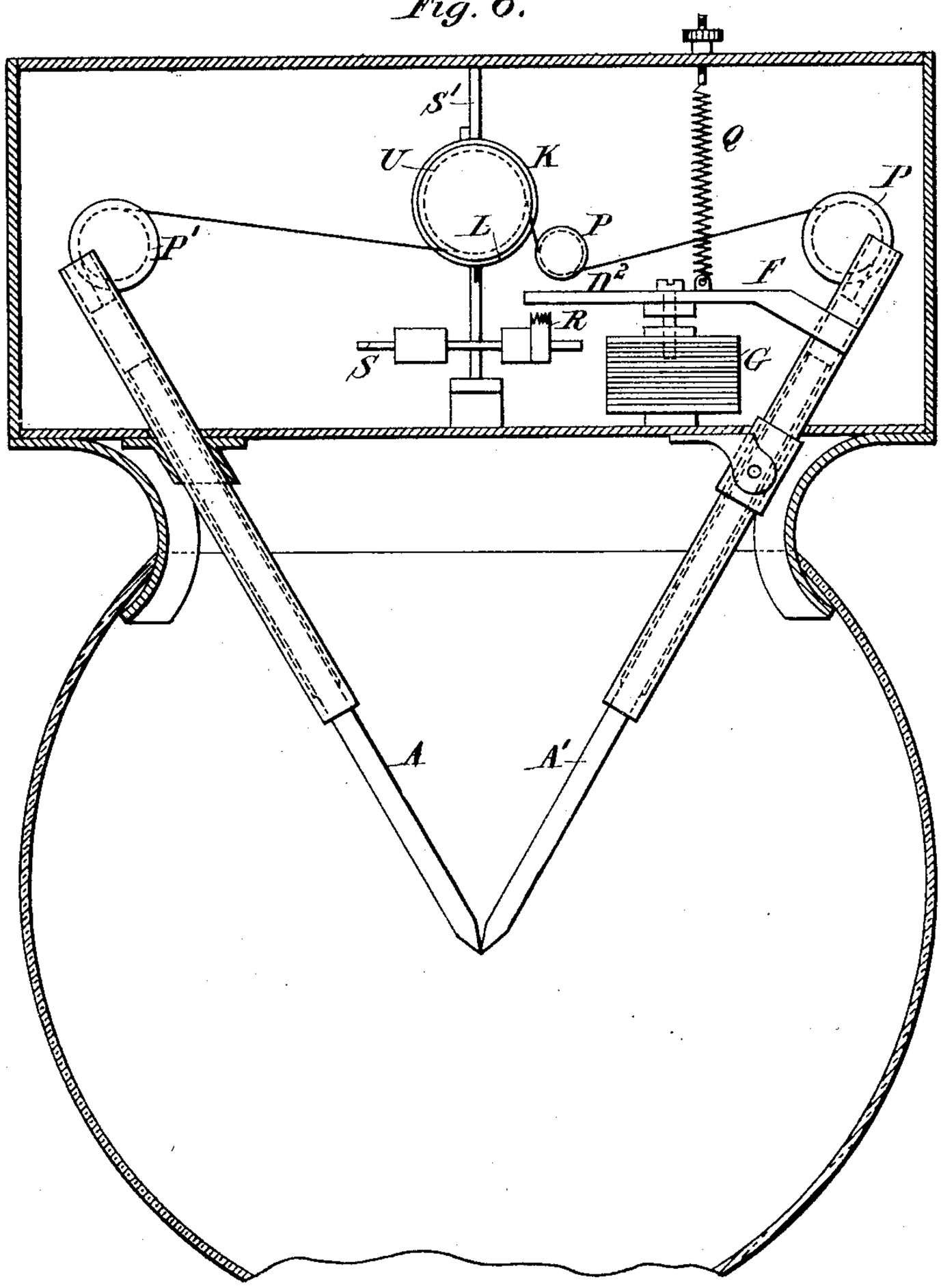
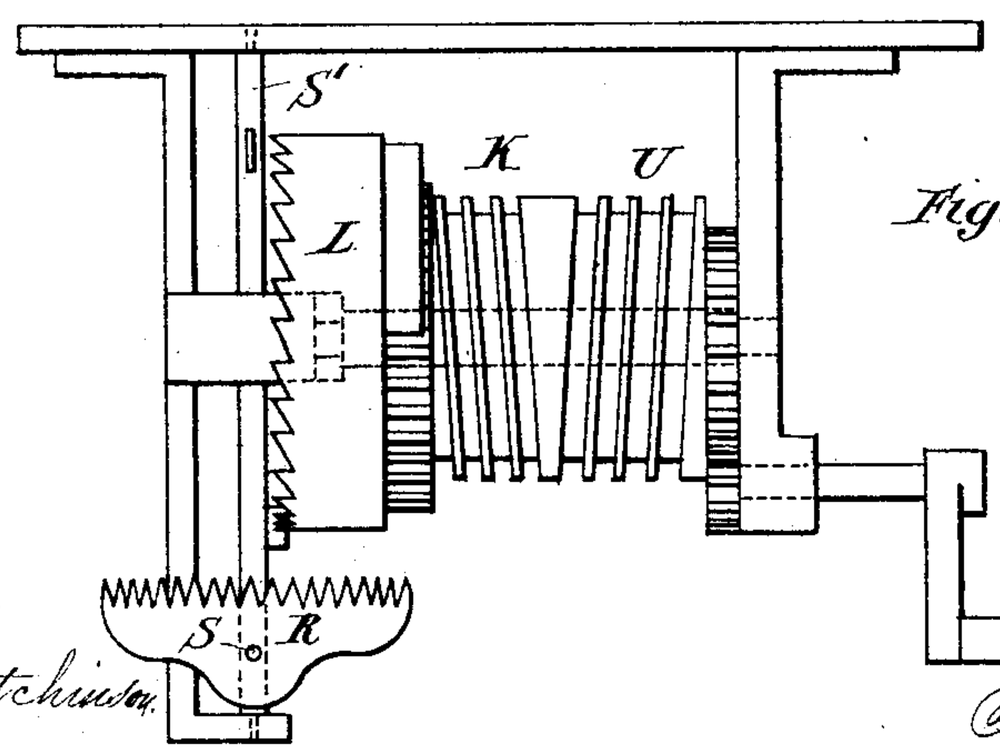



*Fig. 7.*

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# UNITED STATES PATENT OFFICE.

ALFRED GRAHAM, OF LONDON, ENGLAND.

## ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 268,218, dated November 28, 1882.

Application filed July 18, 1882. (No model.) Patented in England March 10, 1882, No. 1,171.

*To all whom it may concern:*

Be it known that I, ALFRED GRAHAM, of London, England, have invented new and useful Improvements in Mechanism for Regulating the Burning of Carbon or other Electrodes in Electric Lighting Apparatus and for Similar Purposes, (for which I have obtained a patent in Great Britain, No. 1,171, bearing date March 10, 1882,) of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to mechanism chiefly designed to be applied to electric lamps or lighting apparatus for regulating the burning of the carbon or other electrodes thereof, and maintaining the arc at its normal length; but the said mechanism may also be employed for similar purposes.

Various contrivances have been adopted by inventors and manufacturers of electric lighting apparatus to obviate the inconvenience arising from irregularity in the burning of the carbons or electrodes, this irregularity being in some lamps sufficiently conspicuous to materially impair the lighting effect, and to counterbalance the advantages arising from the brilliancy and other properties of the electric light. Some of these contrivances have been found to serve the desired purpose to some extent—that is to say, they reduce the unsteadiness or "jumping" of the light; but none of them have proved quite satisfactory, and some of them are so complicated in their construction as to render their maintenance in proper working condition a matter of great difficulty.

Now, my invention is chiefly designed to afford means for obtaining the desired result—that is to say, insuring a practically-perfect regularity or uniformity of the light by the use of mechanism or apparatus which is simple in its construction and not easily liable to derangement.

In the accompanying drawings, Figure 1 represents a vertical sectional elevation of an electric lighting apparatus to which one form of my improved regulating mechanism is applied. Fig. 2 represents a front elevation of part of the same with the front of the casing removed. Figs. 3 and 4 show detached views of this form of regulating mechanism drawn to an enlarged scale. Fig. 5 shows a modification in which the carbons are below the regulating mechanism. Fig. 6 represents a vertical sectional elevation of an electric lighting apparatus in which the carbons come together at an angle or in the form of a V, and having the improved regulating mechanism applied thereto. Fig. 7 represents part of the said mechanism detached.

One form or modification of my improved regulating mechanism is constructed as follows—that is to say, I arrange in combination with the electrodes and their holders an escapement device, such as that known as the "crown," "verge," or "Dutch-clock escapement," for controlling the rotation of a wheel over which passes a chain or cord whose opposite ends are connected to the holders of the two electrodes, the said wheel allowing the chain or cord to pass over it at a slow and uniform rate, governed by the action of the escapement, which, by means of the devices hereinafter described, is alternately stopped and released in such a manner as to act automatically for regulating the burning of the carbons or electrodes and maintaining the arc at its normal length.

In Figs. 1 and 2, A A′ are the carbons or electrodes, held in sockets B B′. The socket B′ is fixed to the top of a metal rod, C, which extends to the bottom of the guide-tube D. This guide-tube is provided with a long slot, D′, Fig. 2, in which the projecting arm E, fixed to the rod C, is free to slide. Attached to the side of the guide-tube D is a piece of soft iron, F, acting as an armature and placed opposite to the pole of the electro-magnet G; or I may use a piece of iron rod acting as a core within a solenoid. The guide-tube D is arranged to move up and down, and this up-and-down movement is limited by means of an adjusting device, H. Fixed to and projecting from the guide-tube D is a pin or knife, $D^2$.

K is an escapement known as the "crown," "verge," or "Dutch-clock escapement," an enlarged view of which is shown in Figs. 3 and 4, and to the arbor of the escape-wheel or crown-wheel L is attached a chain wheel or drum, M, over which is passed a chain or cord, N. One end of the chain or cord N is fastened to the

lower end of the top carbon-holder, O, and the said chain or cord passes thence over a guide pulley or pulleys, P, to the chain-wheel M, which is provided with pins on its periphery to engage with the links of the chain or to the cord-drum, in which case the cord is wound several times round the said drum. From the chain-wheel M the chain N extends over an insulated pulley, P′, carried by a pin or projection upon the guide-tube D, and is secured to the arm E.

The guide-tube D is preferably supported by two spiral springs, Q Q; but in place of this arrangement the armature or core may be attached to a pivoted lever, one end of which is connected to a spring which tends to separate the armature from the magnet, the other end of the said lever being forked and arranged to support the said guide-tube. In this case the pin or knife $D^2$ is carried by that end of the armature-lever which is connected with the spring.

The pin or knife $D^2$ projects toward a pin, or by preference a series of pins forming a comb, R, carried by the cross-arm S of the verge or escapement-arbor S′, and these pins are so arranged that when the magnet overcomes the resistance of the spring or springs the pin or knife $D^2$ is moved into the path of the pin or one of the pins of the comb R, and thereby arrests the movement of the chain-wheel M.

The current is by preference caused to enter the lamp or lighting apparatus by a terminal, T, insulated from the other parts of the apparatus, then to pass through the coils of the electro-magnet or solenoid to the bottom carbon-holder, through the bottom carbon to the top carbon, and thence through the frame to the terminal T′. The armature F being by the passage of the current attracted by the magnet G, the said armature and the guide-tube D are moved downward, and thus the carbons are separated, so that the electric arc is formed between them. When the armature is thus attracted by the magnet the pin or knife $D^2$ is moved into the path of the pin or comb on the verge or escapement-arbor, as above described, and thus arrests the movement of the crown-wheel or escape-wheel L. By using a comb or series of pins the pin or knife $D^2$ is enabled to arrest the movement of the escape-wheel at any portion of an oscillation of the cross-arm S, instead of only at one point in such oscillation. As the carbons burn away the strength of the current is diminished, and the electro-magnet becomes gradually weakened until the armature is pulled off by the action of the spring or springs, and the pin or knife $D^2$ is thus withdrawn from contact with the pin or comb R, thereby releasing the escapement, which will then act in the following manner—that is to say, the weight of the top carbon-holder pulls the chain or cord downward, and the said chain or cord, in passing over the chain-wheel or drum on the crown-wheel or escape-wheel arbor, raises the bottom carbon rod, the rate of movement of these parts being regulated or governed by the oscillations of the verge or escapement-arbor, so that there will be a regular and steady movement of the carbon rods. As the carbon rods approach each other the strength of the electro-magnet is again increased, the armature is attracted, and the pin or comb R is again stopped by the pin or knife-edge $D^2$, the carbons burn again, and the above-described actions are repeated until the carbons are consumed.

It will be obvious from the above description that the employment of the aforesaid device, known as the "crown," "verge," or "Dutch-clock escapement," is an important feature of my invention, and I adapt this device to various forms or modifications of my improved regulating apparatus. For instance, I sometimes adopt an arrangement wherein the top carbon-holder is formed with a rack which gears with a pinion fixed on the side of a chain wheel or drum, from which a chain or cord extends over the wheel on the crown-wheel or escape-wheel arbor to another wheel, which has fixed on it a pinion that gears with a rack on the bottom carbon-holder. The downward movement of the top carbon and carbon-holder causes the movement of the chain or cord and raises the bottom carbon rod at the rate permitted by the escapement, as above described, the two rods approaching each other at an equal rate. When it is desired that one carbon rod or electrode should move more quickly than the other I use pinions of different diameters to gear with the racks on the carbon-holders. The arrangement of the electro-magnet or solenoid and the armature or core in relation to the escapement is the same as that above described.

In the apparatus shown in Figs. 1 and 2 the carbons are above the regulating mechanism; but according to another modification of my invention (illustrated in Fig. 5) I construct a lamp with the carbons below the regulating mechanism. The electro-magnet or solenoid and the armature or core are arranged in connection with the escapement substantially as in the lamps above described; but their position is reversed. The current from the machine or battery enters the electro-magnet coils or solenoid, and passes thence through one carbon-holder and carbon, and thence through the other carbon and its holder to the machine. The armature, when attracted by the magnet, lifts with it the top carbon and places the pin or knife $D^2$ in the path of the pin or comb R, thereby locking the verge or escapement-arbor. When the carbons burn away the power of the electro-magnet is diminished, as above described, and allows the armature to descend and release the verge or escapement-arbor, which then acts, and as the carbons approach each other the strength of the electro-magnet again increases, the armature is attracted, the pin or knife $D^2$ again engages with the pin or comb R and stops the movement of the car-

bons, and the operations are repeated, as above specified.

In Fig. 6 is shown an arrangement of a lamp with the carbons coming together in the form of a V. The carbons are separated by the armature F being attracted by the electro-magnet G, and the pin or knife $D^2$, entering the path of one of the series of pins R, stops the movement of the drum U until the carbons burn away and an adjustment is required. Two chains or cords are employed in this case, and are both attached by one end to the drum U and by the other to the carbon-holders.

I am aware that in an arc-lamp the carbon-holders have been operated by separate chains or cords attached to and wound upon separate drums, the motion of said drums being controlled by a train of gear-wheels governed by an escapement, and I do not claim such a combination of devices, broadly.

What I claim is—

1. In an electric-lamp regulating mechanism, the combination, with the continuous carbon-feeding chain or cord, having each end attached to a movable carbon-holder and passing over suitable pulleys, of a rotary drum having an intermediate portion of said cord or chain in engagement therewith, a stationary escapement arranged to control the motion of said drum, a detent carried by a carbon-holder and arranged to arrest the motion of said escapement, and an electro-magnet arranged to move said carbon-holder, substantially as described.

2. The combination, with the stationary escapement, mechanism arranged to regulate the feed of the carbons, and having the escapement S′, provided with a cross-arm carrying a comb, R, of the carbon-holder carrying the knife $D^2$, arranged to engage with the teeth of said comb, substantially as described.

3. The combination, with a fixed lower carbon-holder and a movable upper carbon-holder, having a pin to which the two ends of a chain or cord are attached, the said chain passing over the pulleys P P′, and over the chain wheel or drum M, of an escapement device adapted to regulate the movement of the said chain wheel or drum, and having fixed upon its cross-arm a pin or a series of pins forming a comb, and a pin or knife carried by the guide-tube D, and adapted to be alternately engaged with and released from one of the said pins by means of the electro-magnet G and its armature F and the weight of the upper carbon-holder, all substantially as shown and described, and for the purposes specified.

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