(Model.)

2 Sheets—Sheet 1.

A. G. HOLCOMBE.

ELECTRIC LAMP.

No. 252,219. Patented Jan. 10, 1882.

Fig. 1.

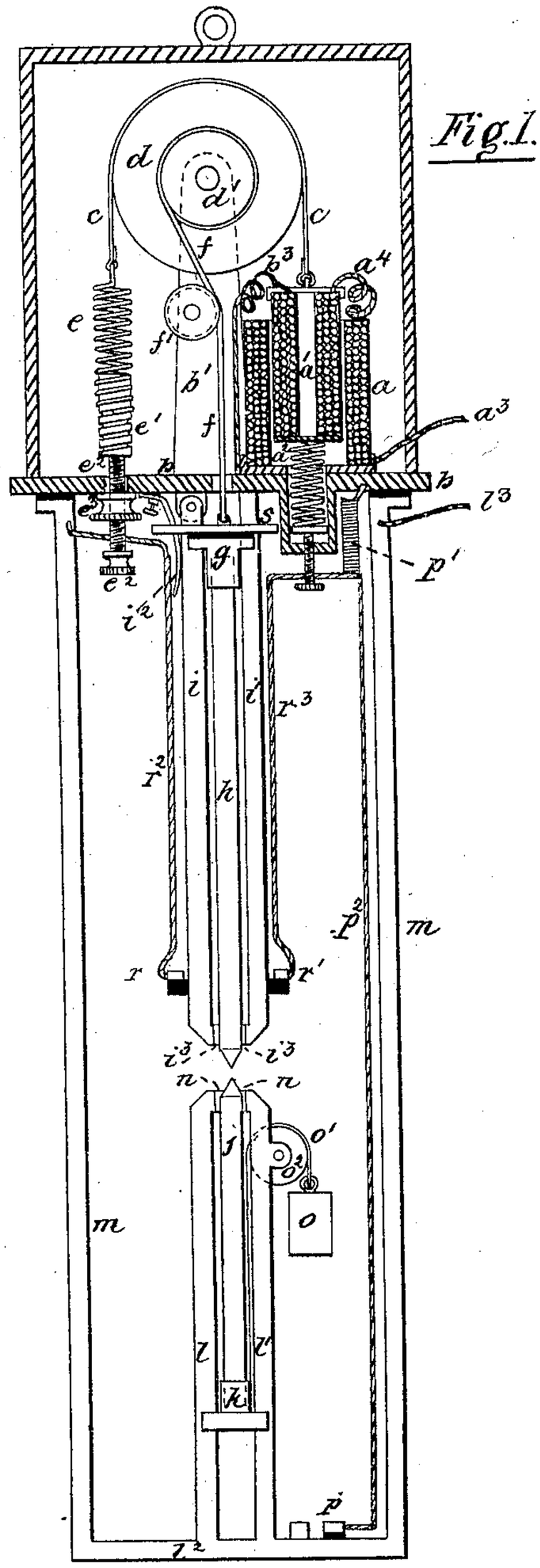


Fig. 2.

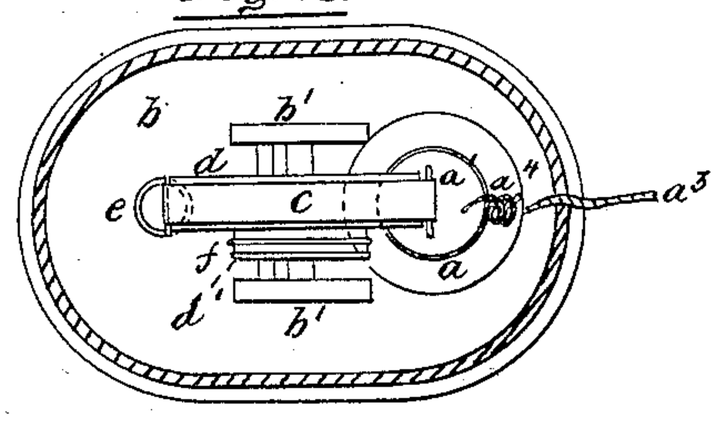
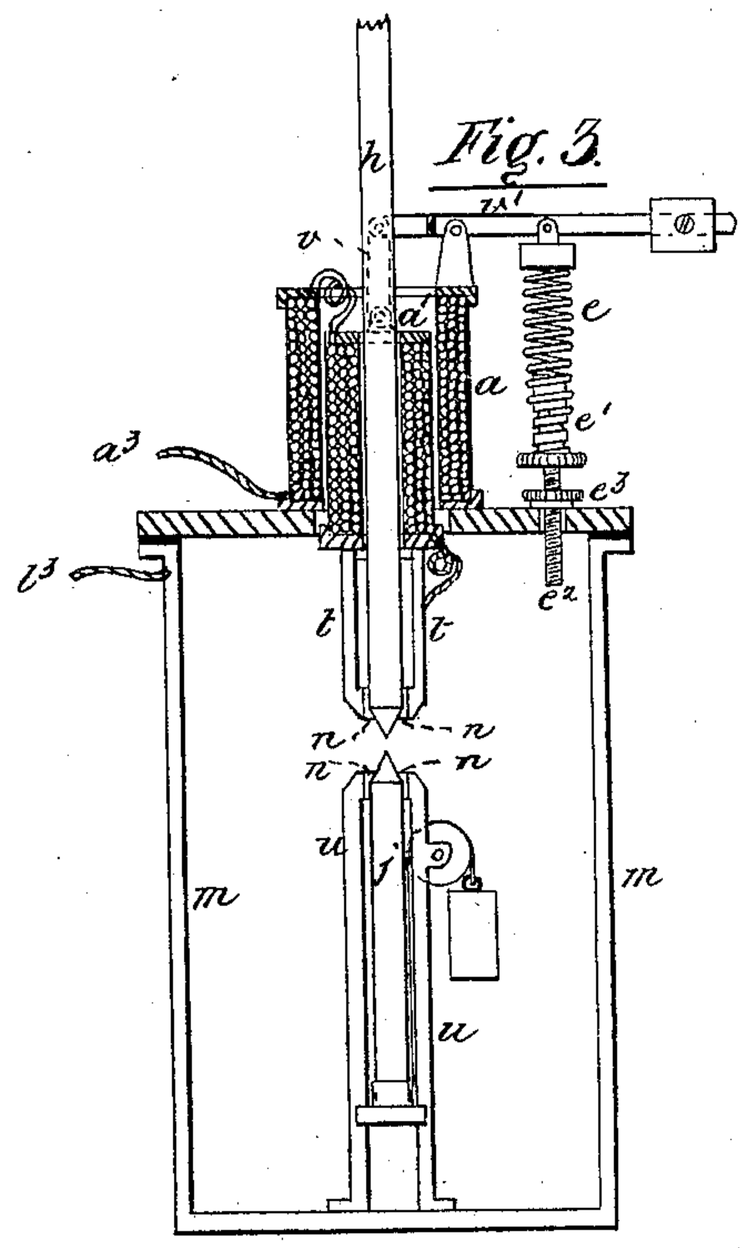


Fig. 3.



Witnesses.
John D. Shedlock
H. F. Williams

Alfred G. Holcombe
Inventor.
per Alfred Shedlock
Atty.

(Model.) 2 Sheets—Sheet 2.

A. G. HOLCOMBE.

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Fig. 4

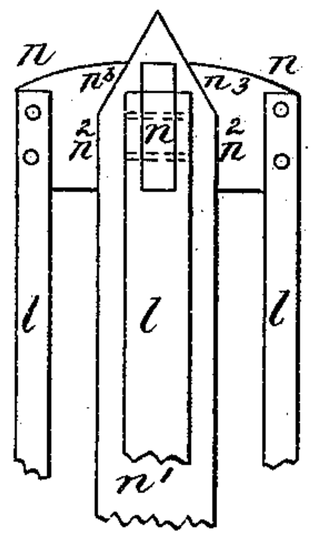
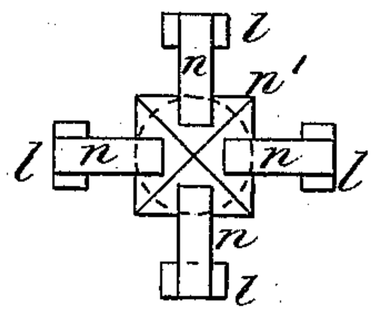


Fig. 5



Witnesses.
H. D. Williams
John D. Shedlock

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Inventor.
per
Alfred Shedlock.
Atty.

UNITED STATES PATENT OFFICE.

ALFRED G. HOLCOMBE, OF GRANBY, CONNECTICUT.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 252,219, dated January 10, 1882.

Application filed April 2, 1880. (Model.)

To all whom it may concern:

Be it known that I, ALFRED G. HOLCOMBE, of Granby, county of Hartford, State of Connecticut, have invented certain new and useful Improvements in Electric-Lighting Apparatus, of which the following is a specification.

This invention has for its object to regulate and maintain the proper arc-distance between the points of carbon rods or other electrodes of electric-light apparatus when an alternating or to-and-fro current is employed to produce the electric arc; and it consists of the combination of two plain coils or solenoids, one fixed rigidly to the frame of the lamp and the other one adapted to move longitudinally in the interior thereof, with a flexible band connected at one end to the moving inside solenoid and at the other end to an adjustable spring, and passing over a pulley attached to a drum from which the upper carbon-holder is suspended; of an automatic switch so arranged and constructed as to cause the current always to pass through the coils or solenoids, and an extra resistance about equal to the resistance of the arc when either or both of the carbons are entirely consumed; and, also, of an improved form of platinum fingers against which the burning ends of the carbons are caused to press by means of a weight or spring or other suitable device, whereby the sudden movements of the carbons due to the sudden breaking away of the parts immediately under the fingers, which as heretofore made bear only at the commencement of the taper ends, allow them to burn away beyond these parts, all of which will be fully hereinafter described by reference to the accompanying drawings, forming part of this specification, in which—

Figure 1 is an elevation, partly in section, of my improvements in electric lamps as applied to a pendent lamp. Fig. 2 is a plan view of the upper part, and Fig. 3 shows a modification of the application of solenoids to electric-light apparatus for utilizing a to-and-fro current. Figs. 4 and 5, Sheet 2, represent respectively an elevation and plan view of my improvement in platinum fingers for retaining the carbons.

In the form of pendent lamp shown in Fig. 1 the outside coil of wire or solenoid, *a*, is secured in a vertical position on the plate *b*, and the coil of wire or solenoid *a'* is placed in the central opening of the solenoid *a*, and it rests on the spring a^2, which is adjusted to just counteract the weight of the solenoid *a'*. The two solenoids *a* and *a'* are wound in the same direction, and they are joined in single circuit by the inner end of the solenoid *a*, being connected to the outer end of the solenoid *a'* by the wire a^4. The inner end of *a'* is then connected to the plate *b* or one of the standards *b'*, so that the current traverses the two solenoids in the same direction at their adjacent ends—that is to say, by looking at them endwise as they are together the current will pass through both of them either in a right or left handed direction, according to whether they are wound right or left handed.

To the upper end of the solenoid *a'* is attached the brake-band *c*, of thin metal or other suitable material. This band passes over the upper surface of the pulley *d*, and to its other end is secured the upper end of the spiral spring *e*. In the lower end of this spiral spring is screwed a rod of metal, *e'*, having formed on it a spiral groove corresponding to the pitch of the spirals of the spring. This rod *e'* may be turned a greater or less distance in the spring *e*, thereby leaving a less or greater length of the spring to be stretched by and to oppose the attractive force of the solenoids *a* and *a'*. The rod *e'* is provided with a screw-stem, e^2, which passes through a hole in the plate *b*, and on the stem e^2 is a thumb-nut, e^3, to regulate the strength of the spring *e*.

The shaft on which the pulley *d* is secured runs in standards *b' b'* projecting upwardly from the plate *b*, and on one side of the pulley *d* is fixed the drum *d'*, around which is wound the cord or chain *f*, the free end of which passes around the guide-pulley *f'*, and thence through a hole in the plate *b*, and is secured to the holder *g* of the upper carbon, *h*. This holder *g* slides up and down on the two guide-bars *i i'*, the one, *i*, of which is pivoted to a stud on the plate *b*, and is pressed toward the other one, *i'*, which is fixed, by means of the adjustable spring i^2, so as to clamp the carbon *h* between the platinum blocks i^3 i^3, secured to the lower ends of the bars *i i'*.

The lower carbon, *j*, is held in a holder, *k*, which slides between the two vertical rods *l l'*, secured at their lower ends to the bar l^2, which

is connected to the plate *b* by means of the rods *m m*. These rods *m m* are so secured to the plate *b* that there is no electric contact between them.

To the upper ends of the bars *l l'* are secured the platinum or other refractory metal fingers *n n*. These are shaped, as shown, so as to bear against the sides of the lower carbon, *j*, and against the commencement of its tapering end. If a round carbon is used, the inside of the fingers *n n* would be grooved to correspond therewith, so as to hold its end in a central position, and with a square carbon I propose to use four fingers, one on each of its sides. The lower carbon is fed upward against the fingers *n n* as fast as it is consumed by means of the counter-weight *o*, attached to the cord or chain *o'*, passing over the pulley o^2, and then secured to the carbon-holder K.

Figs. 4 and 5, Sheet 2, show enlarged views of four platinum fingers, *n n*, having a square carbon-rod, *n'*, held between them; or a round carbon may be held between them, as shown in dotted lines in Fig. 5. The fingers *n n* are secured in the upper ends of the posts or rods *l l* in any suitable manner, and their faces n^2 n^2 are straight and press against the sides of the carbon rods for some distance below the commencement of its taper end, the upper ends, n^3 n^3, of the fingers being so shaped as to press on the taper end of the carbon, preventing it moving through the fingers only so fast as it is consumed. Retention-fingers for electric lamps as heretofore made have been constructed to bear only against the taper end of the carbon, and as the fingers chill the carbon at their points of contact by readily conducting away the heat the carbon burns away below their points of contact. The small pieces of carbon under the fingers, when they are sufficiently reduced for the carbon-feeding device to rupture them, suddenly break away and allow the carbon to feed forward in jumps, causing the light to burn irregularly, whereas by causing the fingers to bear on the carbon some distance below the taper, as shown, the fingers in conducting the heat away do so beyond a point at which the heat of the arc is sufficient to consume the carbon, so that the hottest points under the fingers are immediately under their ends n^3 n^3, thus causing the carbon to feed forward with a regular uniform speed as it is consumed.

p is a block of metal secured to the bar l^2, but insulated therefrom, and it is connected to the resistance *p'*, which is about equal to the resistance of the arc, by the conductor p^2. The other end of the resistance *p'* is connected to the plate *b*. Two other insulated blocks, *r* and *r'*, are secured, one to each of the guide-bars *i* and *i'*, in such position that metallic contact is formed between them by the bar *s*, secured to the upper-carbon holder *g*, (but electrically insulated therefrom,) when the holder falls to its lowest position. The insulated block *r* is connected to one of the rods *m*, and the block *r'* to the resistance *p'*, by means respectively of the conductors r^2 and r^3.

The functions performed by the various parts and the operation of the lamp are as follows: The current enters the solenoids *a* at a^3, and after passing through the entire length of its wire enters the inside solenoid, *a'*, by the wire a^4, and from this solenoid it passes by the wire b^3 to the plate *b*, down the guide-bars *i i'* to the carbon *g*, through the platinum blocks i^3 i^3, and from the carbon *g* to the carbon *j*, said carbons being in contact when the lamp is at rest. From the carbon *j* the current passes through the fingers *n n* and vertical rods *l l'*, bar l^2, rods *m*, and from thence by conductor l^3 back to the electric generator. The two solenoids are so connected together that the current passes in the same direction in their adjacent ends, thus imparting to them the properties of magnets, and so causes the inner one, *a'*, to descend within the outer one, pulling the brake-band *c* onto the pulley *d* with a pressure which is governed by the strength of the spring *e*, the friction between the band and wheel being sufficient to raise the upper carbon, *h*, to form the arc and to hold so until the arc-distance exceeds its proper length, and the current decreasing, the solenoid *a'* releases the brake-band, allowing the pulley *d* to be moved by the weight of the carbon *h*, which is again instantly arrested as soon as the ends of the carbons are the right distance apart to maintain the arc due to the strength of the current, which spacing of the carbons to the current strength is accomplished by adjusting the rod *e'* in the spiral spring *e*. This adjustment of the rod *e'* enables me to put more or less of the spring *e* under tension, which, with the amount of tension imparted to the spring by turning the thumb-nut e^2, enables the attractive force of the solenoids to be so finely balanced as to prevent any excess of movement being given to the carbon. The focus of the light is kept in the same position by the lower carbon, *j*, being pressed against the rigid fingers *n n* by the counter-weight *o*. These fingers are of platinum or other refractory metal and are shaped, as shown, so as to bear on the end of the carbon where the taper-point commences, and a sufficient distance down the sides to prevent the carbons burning away below the parts under the upper part of the fingers, for the metal fingers chill the carbon by carrying away the heat, and by making them bear on the carbon below the distance at which the heat of the arc will consume it, it is compelled to burn gradually and uniformly downward, and so moves between the fingers *n n* at a uniform rate of speed as it consumes, whereas rigid fingers for this purpose as heretofore made have only pressed on the carbon a short distance, allowing it to burn away below the chilled parts immediately under the finger, which chilled parts suddenly give way and so allow the carbon to move by jerks. When the upper carbon is consumed, so that the arc is broken, the insulated bar *s* on the holder *g* falls on the insulated blocks *r r'*, and so places them in electric contact, allowing the current to pass through the

resistance p', after passing through the two solenoids, and so out of the lamp through the rods m. When the lower carbon is consumed, then the counter-weight o falls on the insulated block p and the projection on the bar l^2, placing them in electric contact, which also allows the current to pass through the resistance p', and so out of the rods m.

Either one or both of the carbon switches may be closed by reason of the consumption of the carbons without affecting other lamps or other apparatus in the same circuit, as the current always traverses the two solenoids and the resistance p', which is equal to the resistance of the arc, so the total resistance of the lamp is always the same.

It will be observed that as there is no iron in the regulating mechanism of the lamp to be magnetized the full intensity of the attractive force between the two solenoids is reached instantly upon the current passing through them, and that as their adjacent ends are of the opposite polarity with either direction of the current there will be a continual pull on the solenoid a' in the one direction at whatever speed the change of direction in the current takes place. It is also obvious that with a direct continuous current the same effect will be had as with a to-and-fro current.

In the modification shown in Fig. 3 the inner solenoid, a', projects below the lower end of the solenoid a, and is provided with downwardly-projecting bars t, which are furnished at their lower ends with rigid finger-pieces, against which the upper carbon bears, it being passed down the central opening of the solenoid a' and between the bars t, and can be of any desired length. The lower carbon is pressed against the rigid fingers on the vertical bars u in a similar manner to that just described, the form of the finger on the bars t and u being like those shown in Fig. 1. The solenoid a' is connected by the links v to the bifurcated lever v', on the other side of the fulcrum of which is placed the counter-weight w, adjusted so as to balance the solenoid and partly balance the carbon, if desired. The attractive force of the solenoid is opposed by the regulating-spring e, constructed as hereinbefore explained, but operating by compression instead of tension. The current enters the outer solenoid, a, then passes through the inner one, a', down the rod t to the upper carbon, and through the lower carbon to rods u, and so out of the lamp by the rod m.

It is obvious that any one or more of these various improvements in electric-light apparatus may be used separately or combined in other forms of lamps, and that the two solenoids arranged in the manner shown and described, or in any suitable manner to be mutually attractive, can be applied to other kinds of electric apparatus requiring an active current-regulator where a to-and-fro current is employed.

Having now described my invention and the manner in which it operates, I wish it understood that I do not claim, broadly, means or devices for shunting the electric current by the carbons when a predetermined length of carbon has been consumed, such being shown and described in English Patents No. 740 of 1879 and No. 5,157 of 1879; but

What I claim, and desire to secure by Letters Patent, is—

1. In an electric-light regulator, in combination, a movable solenoid upheld by a spring and located within a fixed solenoid, and a drum from which the upper carbon is suspended, provided with a pulley and a flexible brake-band passing over the pulley, one end of which is connected to the upper end of the movable solenoid and the other end to an adjustable spring, substantially as and for the purpose hereinbefore set forth.

2. In an electric-light apparatus, the combination of the resistance p', the insulated blocks r and r', and the insulated bar s, carried by the carbon-holder g, substantially as and for the purpose hereinbefore set forth.

3. In an electric-light apparatus, the lower carbon counter-weight, o, or its equivalent, in combination with the stud on the frame-bar l^2, insulated block p, and resistance p', substantially as and for the purpose set forth.

4. The refractory-metal carbon-retention fingers $n\,n$ for electric-light apparatus, having the continuous bearing-surfaces $n^2\,n^3$, corresponding to the form of the carbon rod at its straight sides and over a portion of its taper end, substantially as and for the purpose hereinbefore set forth.

5. The carbon-holder g, in combination with the fixed guide i', provided with the contact-pieces i^3, and the pivoted guide-bar i, also provided with a contact-piece, i^3, and operated by the adjustable spring i^2 to press the carbon in the holder g between the two contact-pieces $i^3\,i^3$, substantially as and for the purpose hereinbefore set forth.

6. In combination, the coils or solenoids $a\,a'$, the resistance p', insulated blocks $r\,r'$, and bar s, counter-weight o, or its equivalent, insulated block p, frame-bar l^2, and their connecting-wires, substantially as and for the purpose hereinbefore set forth.

In testimony whereof I have hereunto set my hand this 31st day of March, A. D. 1880.

ALFRED G. HOLCOMBE.

Witnesses:

JOHN D. SHEDLOCK,

H. D. WILLIAMS.