(No Model.) 3 Sheets—Sheet 1.

E. GRAUERT.

ELECTRIC ARC LAMP.

No. 305,175. Patented Sept. 16, 1884.

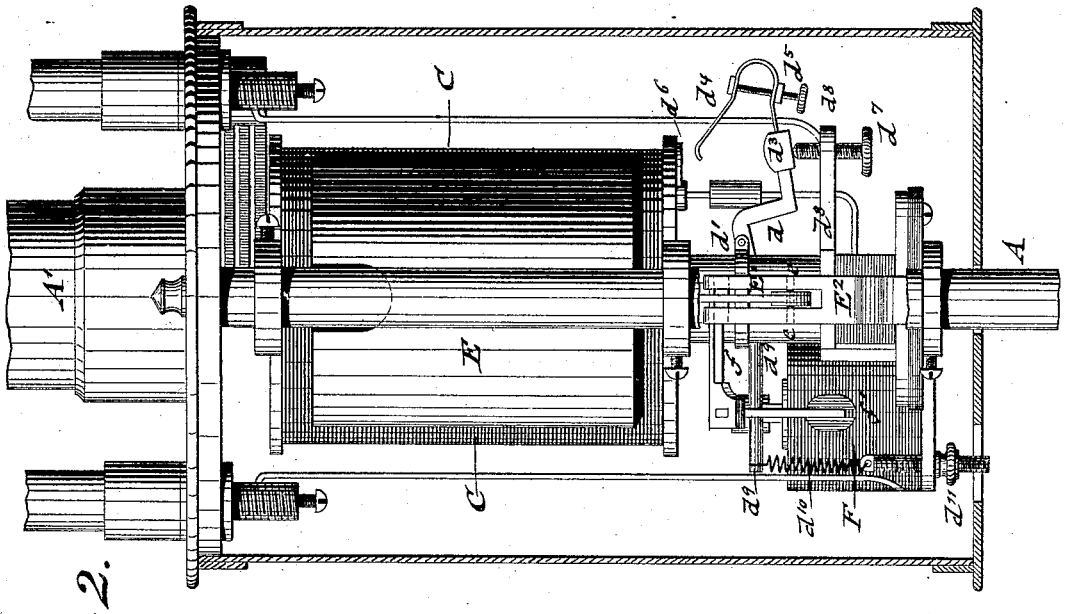

Fig. 2.

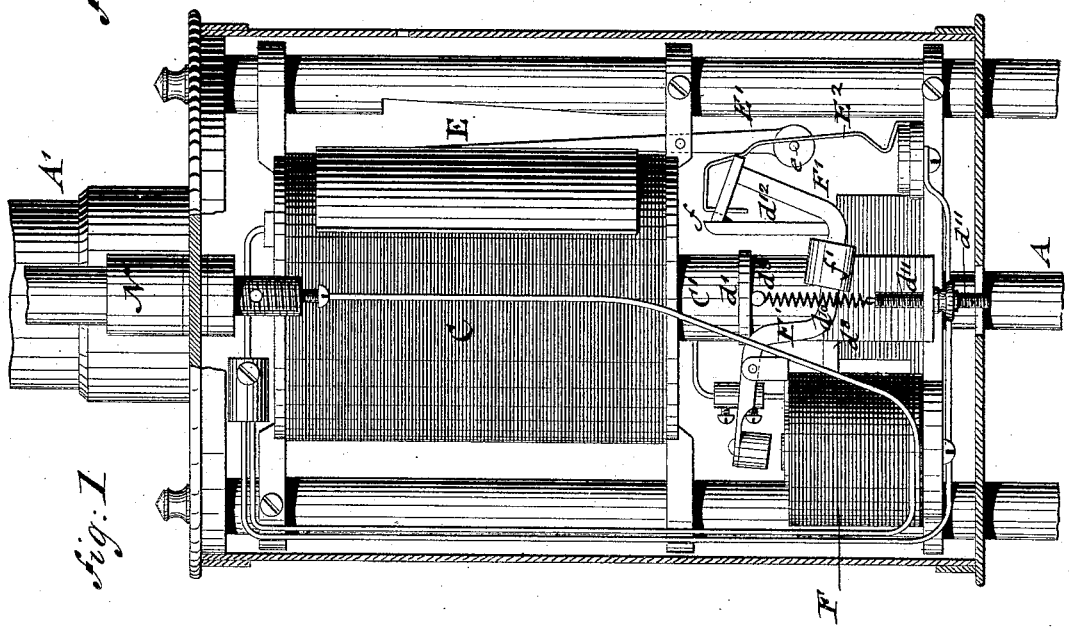

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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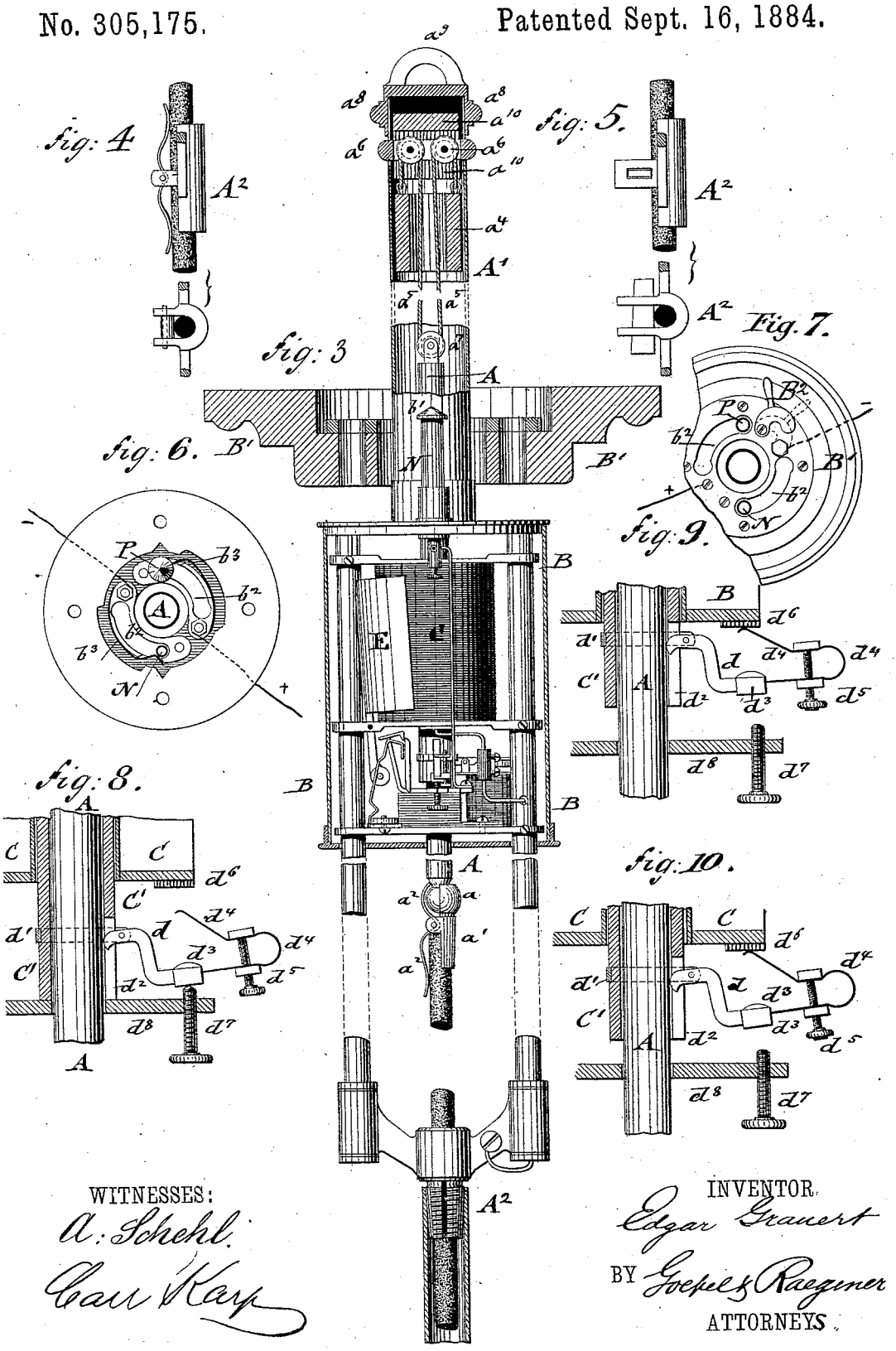

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(No Model.) 3 Sheets—Sheet 3.

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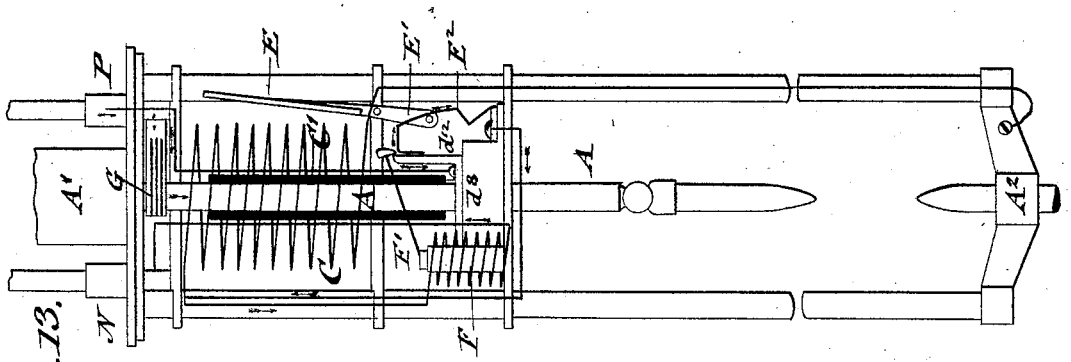

Fig. 13.

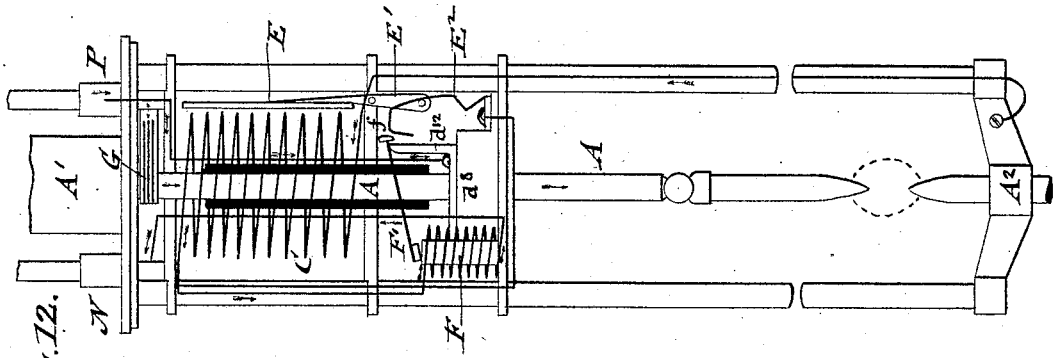

Fig. 12.

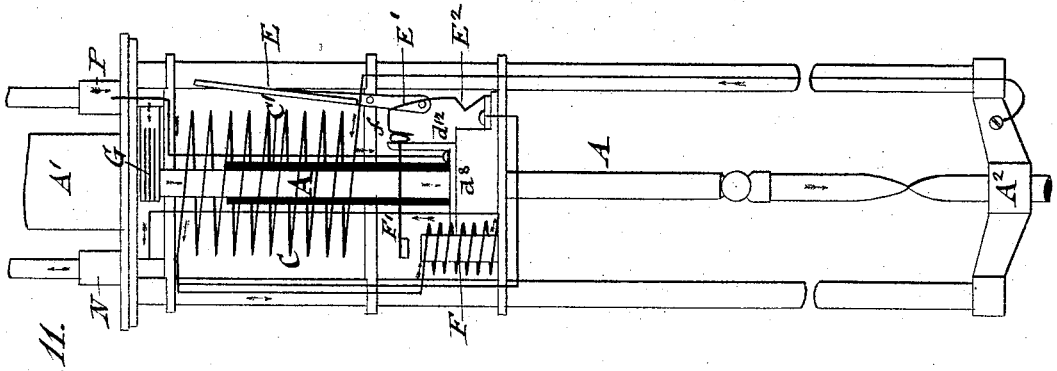

Fig. 11.

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UNITED STATES PATENT OFFICE.

EDGAR GRAUERT, OF NEW YORK, N. Y.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 305,175, dated September 16, 1884.

Application filed June 8, 1883. (No model.)

To all whom it may concern:

Be it known that I, EDGAR GRAUERT, of the city, county, and State of New York, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

This invention has reference to certain improvements in electric-arc lamps of that class in which a solenoid with a vertically-movable hollow core is employed, that serves, in connection with suitable mechanism, to raise or lower the upper-carbon holder.

The invention consists, essentially, of a main solenoid having a hollow core inclosing the upper-carbon holder, and means by which the same is either raised, retained, or dropped.

It consists, secondly, of means for short-circuiting the lamp by a vertical side armature of the main solenoid, an oscillating contact-spring, an auxiliary solenoid and its armature-lever, which latter has a wedge-shaped insulating-arm that breaks the contact of said spring with an upright post; and it consists, further, of certain details of construction, as will more fully appear hereinafter, and finally be pointed out in the claims.

In the accompanying drawings, Figures 1 and 2 represent, respectively, a front and a side elevation of my improved electric-arc lamp, the inclosing-casing being shown in section. Fig. 3 is a rear elevation of my improved lamp, the upper part being shown in section. Figs. 4 and 5 represent detail views and sections of modified forms of the lower-carbon holders. Figs. 6 and 7 are a top and a bottom view of the means by which the lamp is suspended. Figs. 8, 9, and 10 are details showing the different positions of the hollow core of the main solenoid as caused by the action of the current. Fig. 11 shows a diagram of the lamp in a state of rest preparatory to being started. Fig. 12 is a diagram of the lamp, showing the course of the current at the moment when the arc is established; and Fig. 13 is a diagram of the lamp when the carbons have burned out to such an extent that the arc cannot be formed.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the upper-carbon holder, which consists of a tube that is provided at its lower end with a ball, a, semi-socket a', and a friction-spring, a^2. The upper carbon is supported between the friction-spring a^2 and the lower part of the semi-socket a', as shown clearly in Fig. 3. The upper-carbon holder A is balanced by a hollow cylindrical weight, a^4, suspended by a cord, a^5, that passes over fixed pulleys a^6 on the upper part of the cylindrical casing A′, and over a pulley, a^7, at the upper end of the carbon-holder A. The casing A′ is extended to such a height above the lamp-casing B as is required for the lifting of the upper-carbon holder A in applying thereto a new carbon pencil. The balancing of the upper-carbon holder A facilitates the ready insertion of a new carbon by lifting the carbon-holder up into the casing A′, which is closed at the upper end by a screw-cap, a^8, having a hook or eye, a^9, by which the lamp may be suspended from posts or otherwise when burning in the open air. When the lamp is to be used inside, it is readily attached by means of fixed posts N and P at the top of the lamp-casing B to a circular support, B′, applied to the ceiling. The support B′ has arc-shaped slots b^2, with enlarged portions at one end for the entrance of the enlarged heads b' of the posts N and P. The lamp is then turned on its axis, so that the posts N and P pass along the arc-shaped slots b^2 until they arrive at the opposite ends of the same, where they are engaged by the bent ends of the retaining-springs b^3, as shown clearly in Fig. 6. The lamp is thereby suspended in rigid position from the ceiling, while it may be readily detached by releasing the posts from the retaining-springs b^3, returning the posts N and P to the enlarged ends of slots b^2, and then withdrawing the posts from the slots.

The support B′ of the lamp is provided with a switch, B^2, (shown in Fig. 7,) which, when placed into contact with the terminals of the line-wires, forms a metallic connection between them and conducts the current along one of the springs b^3, Fig. 6, to the post P, then through the lamp, and finally along the post N and the second spring b^3, back to the source of electricity. When the contact of the switch B^2 with the terminal wires is interrupted the lamp is cut out. The lamp can then be read-

ily removed and a new one inserted in case of any irregularity or interruption in the working of the lamp.

The lower-carbon holder may be constructed in different ways, so as to facilitate the insertion of the carbons without removing any parts thereof. One form is shown in Fig. 3, in which a split and threaded socket is shown that is tightly applied to the lower carbon by a tube screwing over the same. In Figs. 4 and 5 modified forms of the lower-carbon holder are shown, which consist, respectively, of a semi-cylindrical socket or cheek, which is pressed upon the lower carbon by means of a clamping-spring applied to brackets of said cheek, as shown in Fig. 4, or of a cheek with side brackets and a transverse locking-wedge, as shown in Fig. 5. By releasing the socket or cheek of the lower holder, A^2, a new carbon may be readily inserted and firmly held in position. The upper carbon is held by the friction of the semi-cylindrical socket a' at one side and of the spring a^2 at the other side, so as to be always directly above the lower carbon.

The lamp mechanism proper is arranged at the inside of the cylindrical casing B. It consists of a main solenoid, C, through which the upper-carbon holder is passed, and of a hollow cylindrical core, C′, of soft iron. The hollow core C′ is raised or lowered by the increase or decrease of the current passing through the solenoid C in the usual well-known manner. To the core C′ is applied a regulating mechanism, which consists of a lever, d, that is fulcrumed to a brass ring, d', secured to the lower end of the core C′. The inner rounded off end of the lever d enters through a vertical slot, d^2, at the lower end of the hollow core C′, so as to engage the upper-carbon holder A. The outer end of the lever d is provided with a weight, d^3, and with a bent spring, d^4, which spring first extends outwardly and then inwardly, and which is provided with a tension-regulating screw, d^5. The upper free end of the spring d^4 forms contact with a glass plate, d^6, attached to the bottom of the solenoid C when the core C′ is raised by the action of the current. A set-screw, d^7, is applied below the balance-weight d^3 to a fixed horizontal bracket-plate, d^8, said set-screw lifting the lever d, so that its end clears the carbon-holder A whenever the core C′ is lowered far enough to produce the contact of the weight d^3 and set-screw d^7. As the inner end of the fulcrumed lever d is rounded off, it is obvious that the upper-carbon holder can be moved freely downward through the core, or the core moved in upward direction along the carbon-holder, without interference by the lever d. The dropping of the core C′, however, is prevented, as the weight d^3 causes the lever d to press instantly upon the upper-carbon holder. If the lamp is at rest, the core C′ rests upon the fixed bracket-plate d^8, and the balance-weight d^3 of the lever d on the set-screw d^7, as shown in Fig. 8, whereby the outer end of the lever d is lifted somewhat and its inner end released from the carbon-holder, so that the same can be raised or lowered in the core without the least interference. When a current passes through the solenoid C, the core C′ is lifted and drawn in upward direction away from the bracket-plate d^8. The core C′ moves along the suspended and balanced upper-carbon holder A without engaging the same until the spring d^4 of the lever d is brought in contact with the glass plate d^6, whereby a pressure is exerted upon the lever d, which causes it to press against the carbon-holder A. As the magnetic attraction of the solenoid on the core is stronger than the pressure of the spring d^4 on the lever d, the core C′ is drawn up still farther until the pressure of the lever on the lower-carbon holder is increased to such an extent that the core carries the carbon-holder along, as shown in Fig. 9. This causes the separation of the carbon points and the establishment of the voltaic arc between them, as shown in Fig. 12. With the increasing distance and resistance between the carbon points, the influence of the current on the core is weakened, so that it sinks down with the carbon-holder in the position shown in Fig. 10. The spring d^4 touches then the glass plate d^6 but slightly, and the core and carbon-holder respond immediately to the variations of the current in the solenoid C, so that the lamp performs its work in a uniform and regular manner until the carbons are consumed. During the regular functioning of the lamp the core never reaches that position again which it had assumed at the beginning of the operation. (Shown in Fig. 9.) The lifting of the core to that extent can only take place when the carbon points either approach closely to each other, which, however, does not occur often; but even if it should be the case, the increased influence of the solenoid on the core overcomes instantly the spring of the lever, so that the core and carbon-holder are lifted, and an arc of proper size is re-established. During the regular functioning of the lamp, the spring d^4 recedes only then from the glass plate d^6, when the resistance of the arc becomes too great, so that the core and carbon-holder descend until the solenoid draws up the core again, leaving the carbon-holder in its position until the spring d^4 forms contact again with the glass plate d^6, when the carbon-holder is also raised again, and so on. The core C′ is provided, at a point diametrically opposite to that at which the lever d is arranged, with a pin, d^9, that is connected by a spiral spring, d^{10}, with an adjustable screw-post, d^{11}, as shown in Figs. 1 and 2, by means of which the proper distance between the carbon-holders is regulated. The core C′ and the lifting-lever d are shown in Fig. 8 in a position of rest when the lamp is thrown out of action. In Fig. 9 the core is lifted to its full extent at the moment when the current passes through the car-

bons and forms the arc, while in Fig. 10 the positions of the core and lever are when the lamp is in regular working equilibrium. When the upper carbon is burned entirely and the carbon-holder A is at its lowest position, the balancing-weight a^4 has arrived immediately below the pulleys a^6. To insert a new carbon it is first necessary to release the lever d from the upper-carbon holder, for which purpose a short additional downward motion of the carbon-holder is required, by which the core is brought back to its position of rest, as shown in Fig. 8, and the lever d released therefrom. This downward motion of the carbon-holder is accomplished by means of a centrally-recessed or forked weight, a^{10}, that rides on the transverse supporting-bars of the pulleys a^6, as shown in Fig. 3, and extends downward at both sides of the same far enough that the balance-weight a^4 may abut against the lower end of the same, and by lifting it admit the upward passage of the balancing-weight a^4 until stopped by the pulleys a^6. By this arrangement the downward motion of the carbon-holder has been rendered possible, so that the lever d is released and the core C′ dropped down on the bracket-plate d^8. The carbon-holder A can now be pushed up to its full extent and a new carbon inserted into its clamping-socket without the least difficulty.

At one side of the solenoid C is arranged a vertical concavo-convex armature, E, which is attached to a lever, E′, fulcrumed to one of the supporting-lugs of the bottom plate of said solenoid C. The lower end of said armature-lever E′ is connected by laterally-extending pins e with a slotted spring, E^2, the upper downwardly-bent end of which forms contact with the laterally-extending arm f of a fulcrumed armature-lever, F′, of an electro-magnet, F, which latter forms, with the spring E^2 and the armature-lever F′, a device for short-circuiting the lamp. When the lamp is in operation, the vertical armature E is drawn against the solenoid C, and the spring E^2 drawn back by the pins e e, so that a large separating-space is formed between the upwardly-extending post d^{12} of the bracket-plate d^8 and the downwardly-bent end of the spring E^2. The armature of the short-circuiting solenoid F is attracted at the same time, and thereby the lateral wedge-shaped arm f of insulating material of the armature-lever F′ raised above the post d^{12} and spring E^2. The armature-lever F′ is further provided with an adjustable weight, f', for producing the quick dropping of the lever F′ at the proper moment. If the resistance of the arc increases by the burning off of the carbon points, or for any other reason, the exterior armature, E, of the main solenoid C will recede slowly from the same, and thereby the contact-spring E^2 will be gradually brought closer to the post d^{12}. If the resistance between the carbon points increases to such a point that the arc is at the point of being interrupted, then the armature E is dropped entirely, the contact-spring E^2 brought into contact with the vertical post d^{12}, and the current short-circuited, whereby the dropping and momentary contact of the carbon points take place. The short-circuiting device serves thereby to prevent the entire interruption of the arc, and as a means for regulating it. The short-circuiting solenoid F retains its armature up to the last moment, as the balance-weight f' is not heavy enough to separate the armature from the core, even in case of weak currents; but if the current should be intentionally interrupted at any point of the circuit, both the armature E and the armature of the solenoid F would be instantly released. As the insulating-arm f of the armature-lever F′ has a shorter distance to pass through than the contact-spring E^2, and as the armature-lever, being weighted, moves with greater speed than the contact-spring, which is governed by the lever-arm E′ of the slowly-receding armature E, the insulating beveled arm f will be interposed between the contact-spring E^2 and the vertical post d^{12} before the former can touch the latter, whereby they are separated from each other. The speed of the armature-lever F′ is regulated by the adjustable balance-weight f', so that thereby the proper working of the lever is secured.

The course of the current in my electric-arc lamp is as follows: When no current passes through the lamp, the carbons are in contact, the hollow core is at its lowest position, and the armature-lever of the short-circuiting solenoid dropped, so as to separate the contact-spring E^2 and post d^{12}, as shown in Fig. 11. At this moment, when the lamp is placed into circuit, the current passes from the binding-post P, and is then partly conducted through a spring contact-brush, G, to the upper-carbon holder A, and partly through a branch wire that is connected directly to the bracket-plate d^8, as shown in Figs. 11, 12, and 13. This branch wire serves, however, simply as a safety device for the purpose of guarding against any irregular working of the contact-brush G. From the upper-carbon holder A and the upper carbon the current passes to the lower carbon and lower-carbon holder, and from the same along one of the supporting-rods of the lamp in upward direction and through the main solenoid C, then through the short-circuiting solenoid F, and finally to the binding-post N and the line-wire, as shown clearly in Fig. 12. The arc is thereby established, the current flowing as described, while the proper size of the arc is kept up.

From the wire that connects the solenoid C with the short-circuiting solenoid F a branch wire is conducted to the binding-screw and the contact-spring E^2 of the short-circuiting device.

If the lamp should be extinguished for any reason the short-circuiting device is called

into action, and the current passes then from the binding-post P to the bracket-plate d^8, vertical post d^{12}, contact-spring E^2, along the branch wire, solenoid F, and binding-post N to the line-wire, as shown by arrows in Fig. 13, so that the lamp is cut out without interrupting the regular working of the remaining lamps in the same series.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In an electric-arc lamp, the combination of the main solenoid C, an interior hollow core, C′, an upper-carbon holder, A, within the core, means whereby the upper-carbon holder is suspended and balanced, and a lever mechanism applied to the core, said lever mechanism being provided with means for engaging or releasing the carbon-holder, substantially as set forth.

2. In an electric-arc lamp, the combination of a main solenoid, C, hollow core C′, upper-carbon holder A, passing through the said core, fulcrumed and weighted lever d, having an adjustable spring, d^1, glass contact-plate d^6, and regulating set-screw d^7, substantially as set forth.

3. The combination of the main solenoid C, interior hollow core, C′, upper-carbon holder A within the core C′, an oscillating armature, E, at the side of the main solenoid, armature-lever E′, having laterally-projecting pins e e, contact-spring E^2, engaged by said armature-lever, short-circuiting solenoid F, weighted armature-lever F′, having a lateral arm, f, of insulating material, and bracket-plate d^8, having a vertical contact-arm, d^{12}, substantially as set forth.

4. The combination of the main solenoid C, vertical armature E, located at the side of said solenoid, contact-spring E^2, engaged by the lever E′ of said armature, bracket-plate d^8, having a vertical arm, d^{12}, short-circuiting solenoid F, weighted armature-lever F′, having a laterally-extending insulating-arm, f, that is interposed between the contact-arm d^{12} and spring E^2, or lifted clear of the same for short-circuiting, substantially as set forth.

5. The combination of the main solenoid C, interior hollow core, upper-carbon holder A, lever mechanism applied to the core for engaging or releasing the carbon-holder, means for balancing the upper-carbon holder, and a forked movable top weight that is lifted by the balance-weight of the upper-carbon holder, so as to release the latter from the lever mechanism of the core for inserting a new carbon pencil, substantially as specified.

6. In an electric-arc lamp, the combination of the upper-carbon holder A, having a spherical terminal, a ball-shaped semi-socket, a a', applied to one side of the carbon, and a centrally-hinged clamping-spring, a^2, applied to the other side of the carbon, substantially as described.

7. In an electric-arc lamp, the combination of the lamp-casing B, binding-posts N and P, having enlarged heads b', fixed annular support B′, having guide-slots b^2, and binding-springs b^3 b^3, substantially as set forth.

8. In an electric-arc lamp, the combination of lamp-casing B, binding-posts N and P, having enlarged heads b', fixed annular support B′, having guide-slots b^2 b^2, retaining-springs b^3 b^3, and a pivoted switch, B^2, by which the lamp is thrown in or out of circuit, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in the presence of two subscribing witnesses.

EDGAR GRAUERT.

Witnesses:
PAUL GOEPEL,
CHAS. G. WILLING.