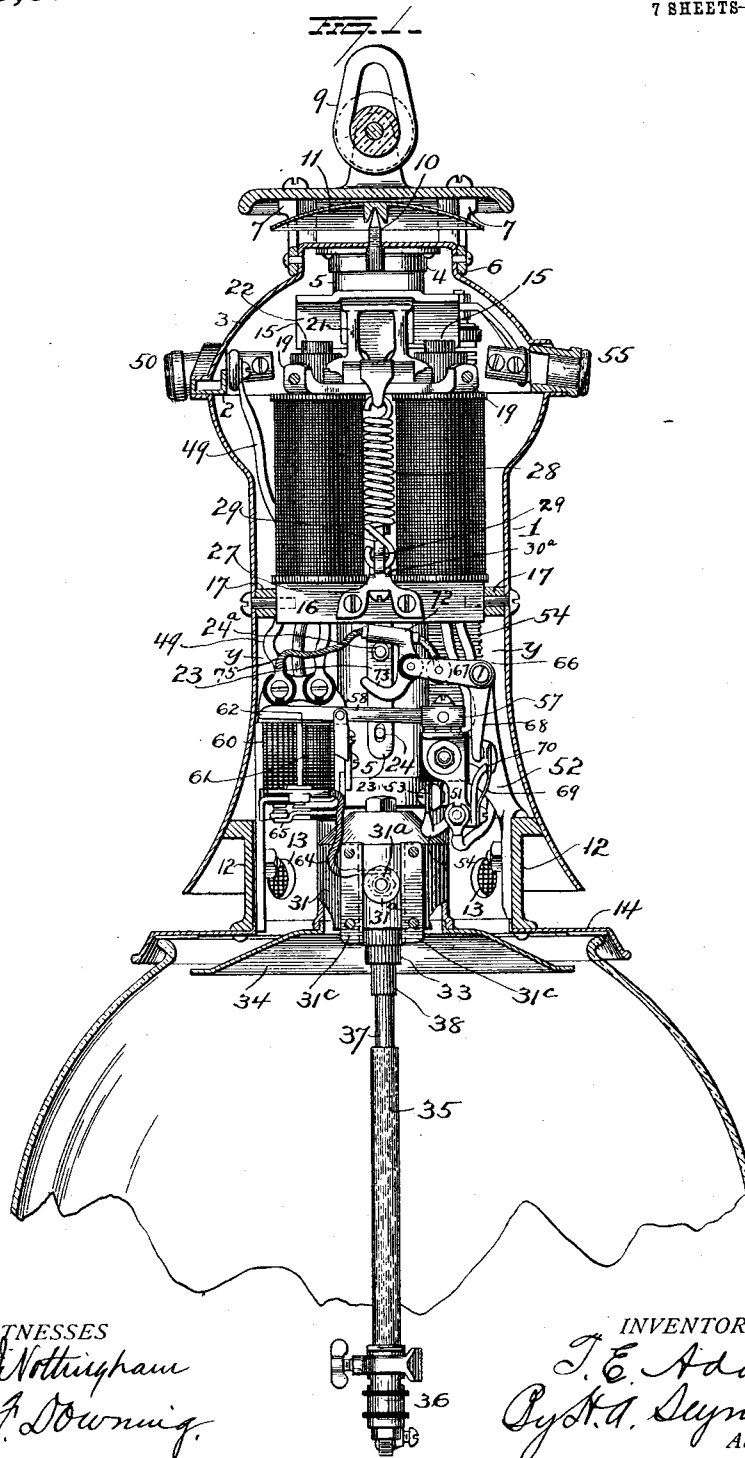


T. E. ADAMS.
ELECTRIC ARC LAMP.
APPLICATION FILED APR. 5, 1910.

1,058,515.

Patented Apr. 8, 1913.

7 SHEETS—SHEET 1.



WITNESSES
E. Nottingham
G. J. Downing.

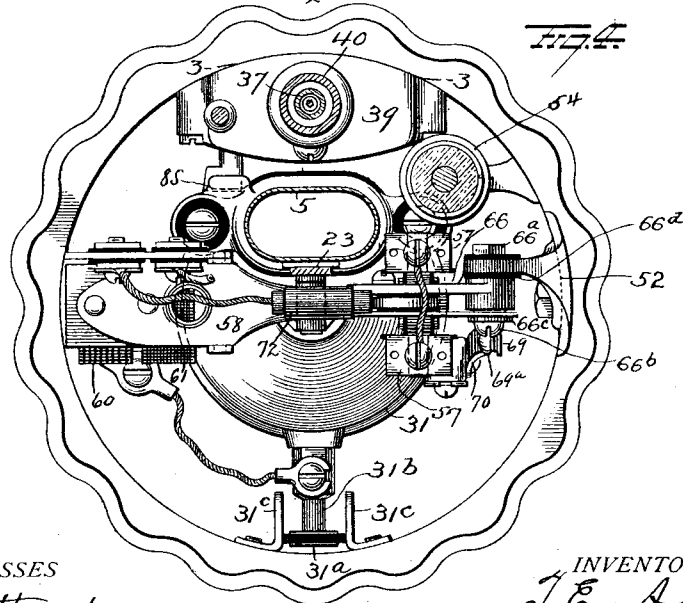
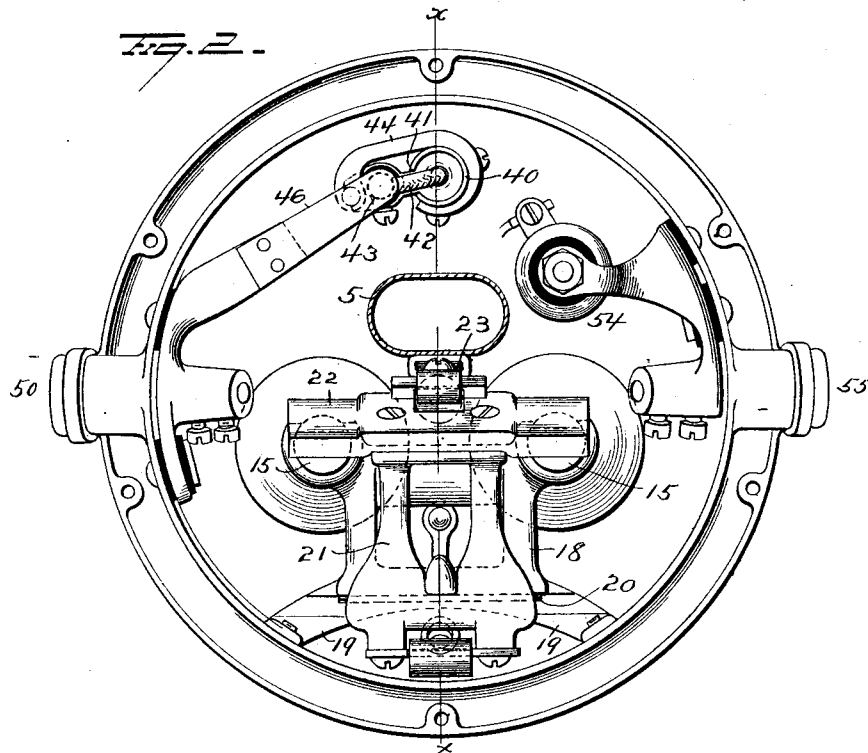
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7 SHEETS—SHEET 2.



WITNESSES
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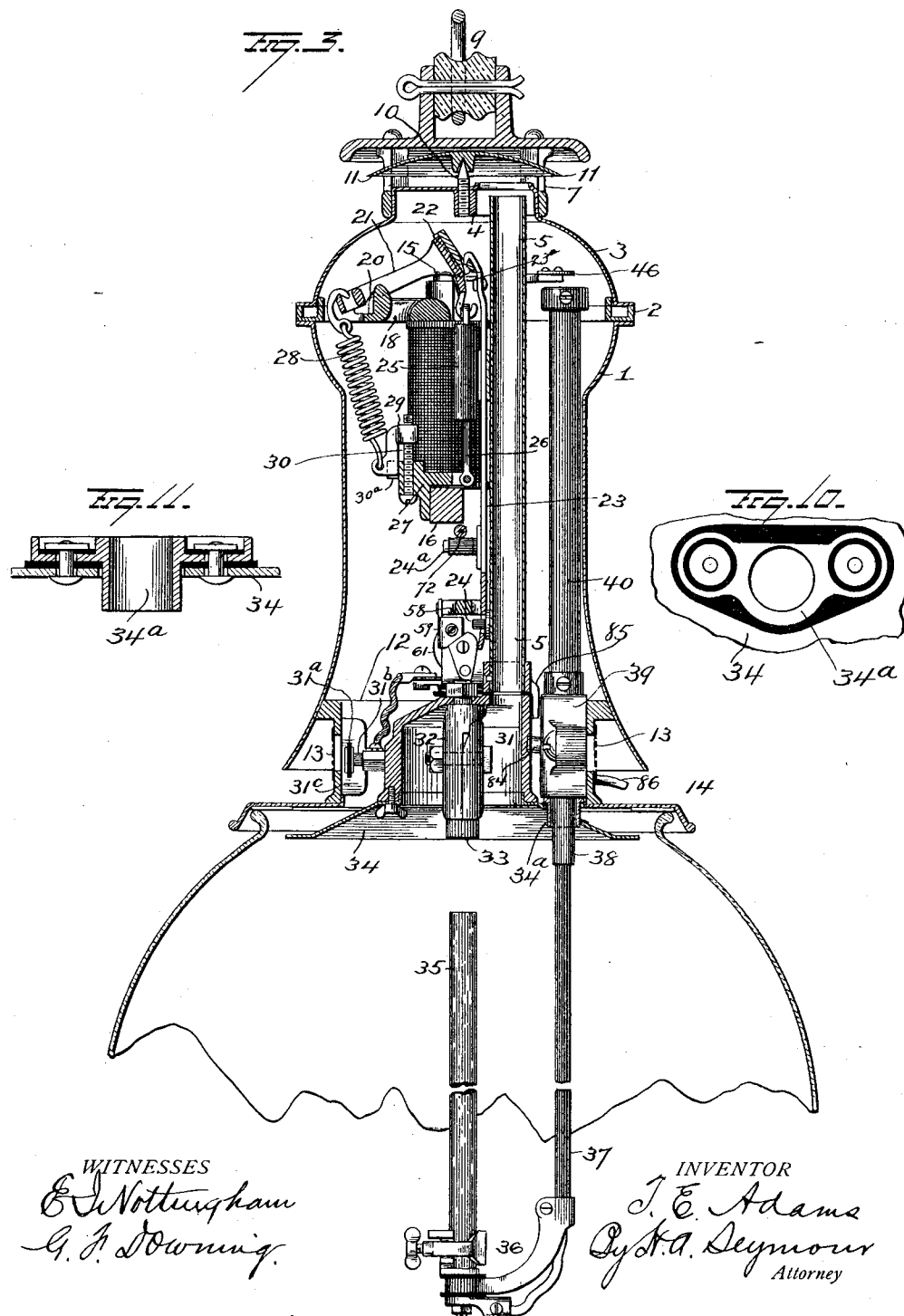
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7 SHEETS—SHEET 3.



WITNESSES

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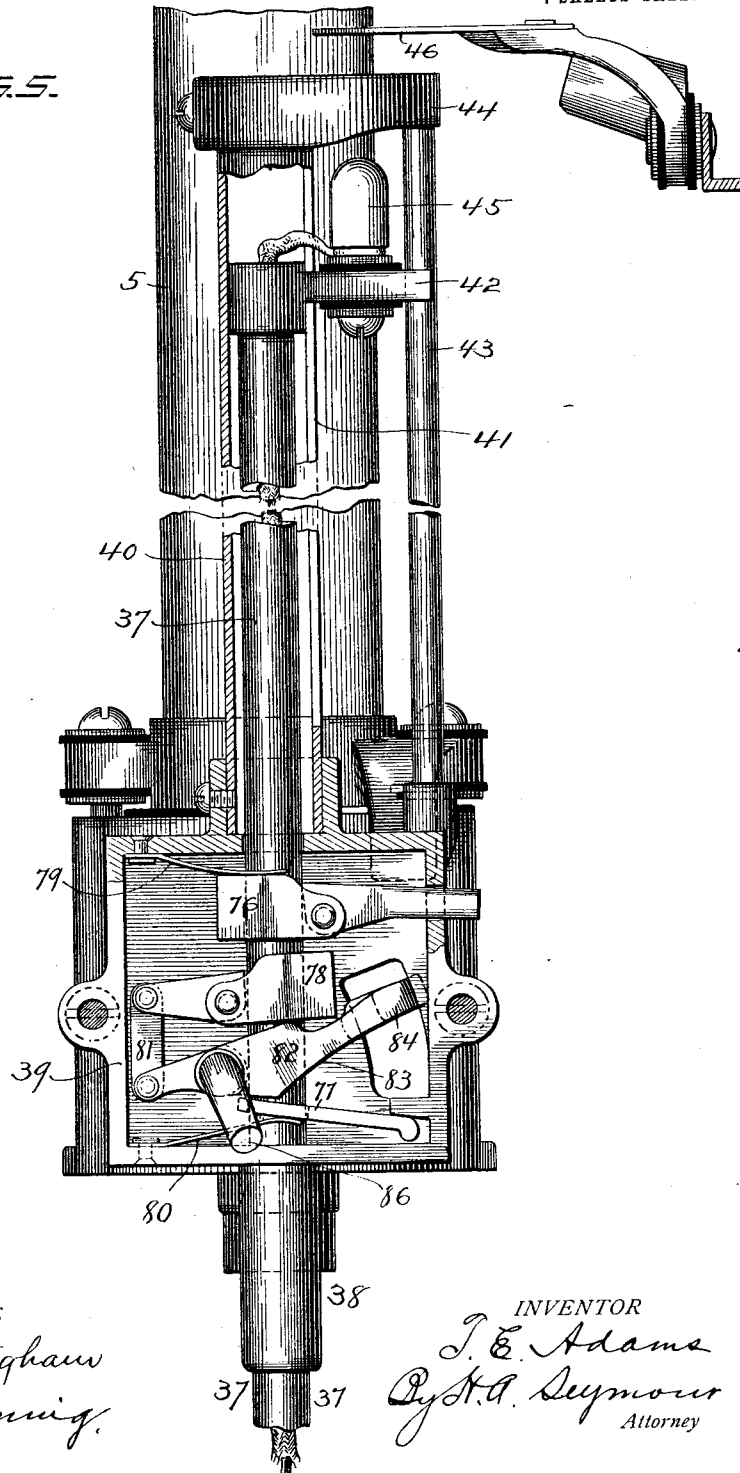
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7 SHEETS—SHEET 4.

Fig. 5.



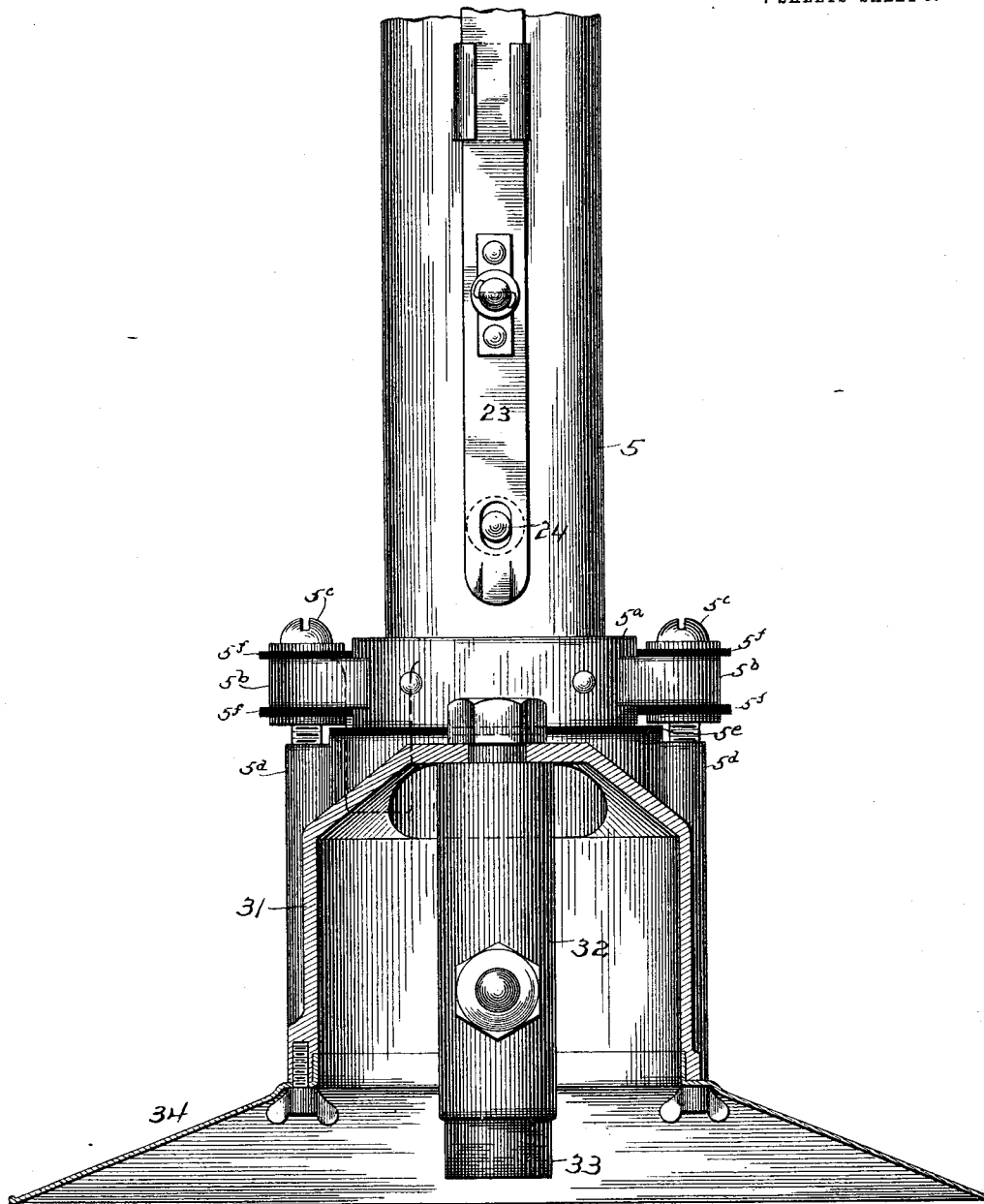
WITNESSES
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Patented Apr. 8, 1913.
7 SHEETS—SHEET 5.



T. E. ADAMS.

WITNESSES
G. Nottingham
G. F. Downing.

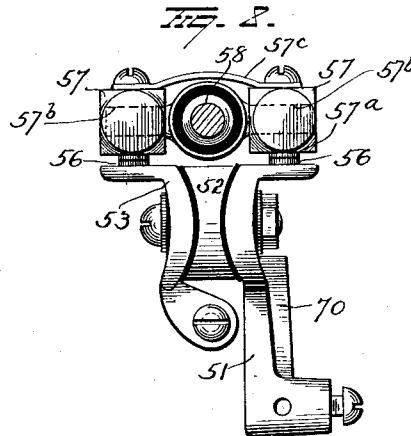
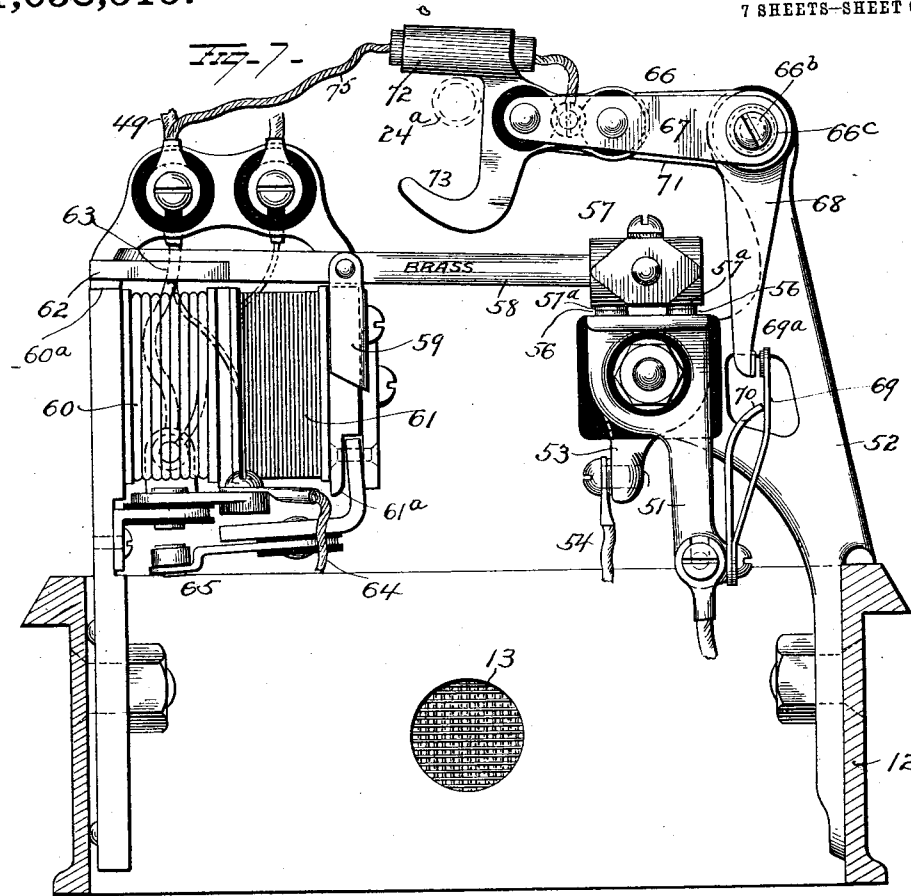
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Patented Apr. 8, 1913.

1,058,515.

7 SHEETS-SHEET 6.



WITNESSES
G. Nottingham
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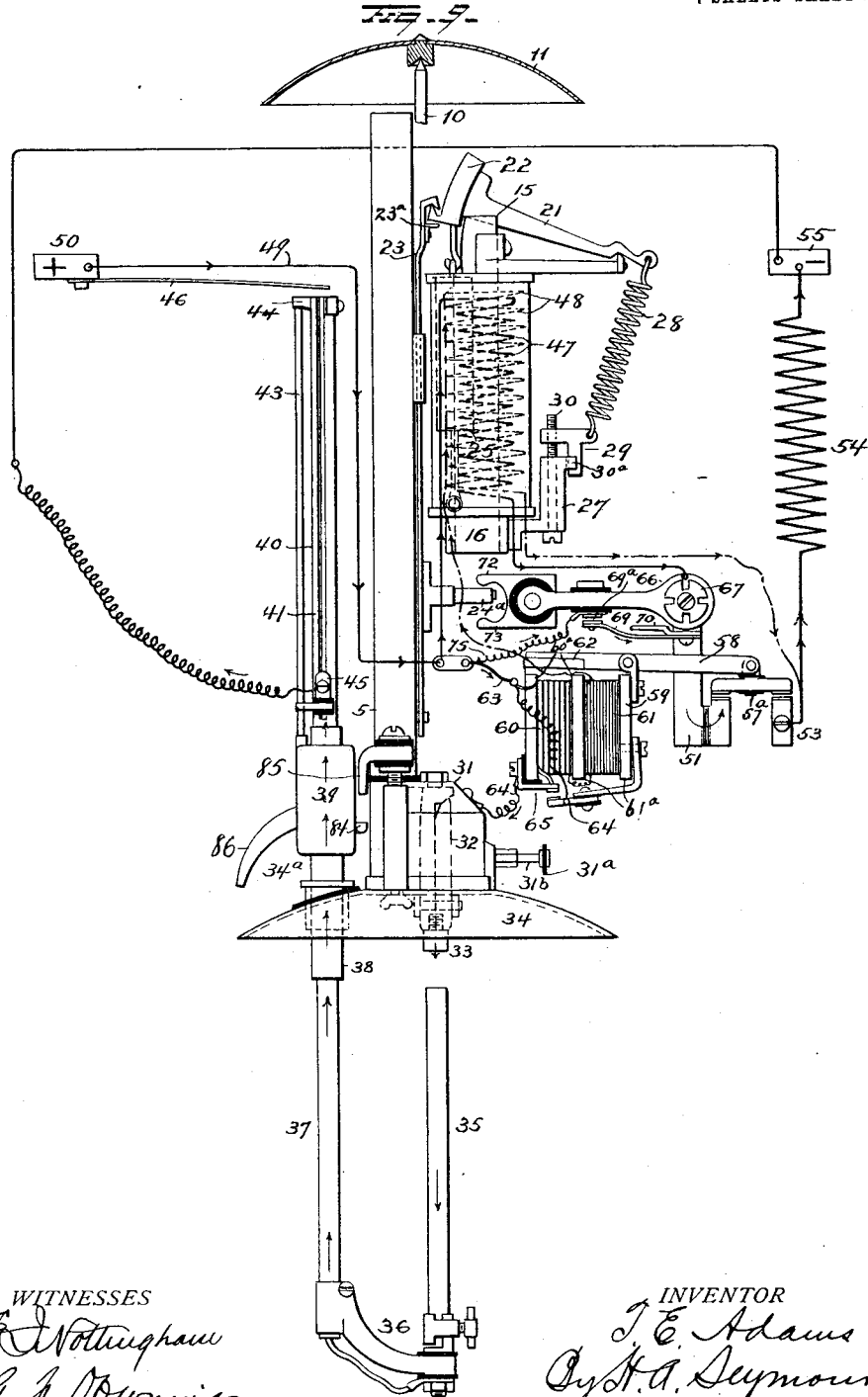
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APPLICATION FILED APR. 5, 1910.

1,058,515.

Patented Apr. 8, 1913.

7 SHEETS—SHEET 7.



WITNESSES
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UNITED STATES PATENT OFFICE.

THOMAS EDGAR ADAMS, OF CLEVELAND, OHIO, ASSIGNOR TO THE ADAMS-BAGNALL
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ELECTRIC-ARC LAMP.

1,058,515.

Specification of Letters Patent.

Patented Apr. 8, 1913.

Application filed April 5, 1910. Serial No. 553,604.

To all whom it may concern:

Be it known that I, THOMAS E. ADAMS, a resident of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in electric arc lamps, and more particularly to lamps of the flaming-arc type employing metallic or other electrodes which, when in operation, evolve certain gases or fumes giving off solid products, and on one of which slag will form and constitute, when congealed, an insulating mass at the end of the electrode.

One object of my present invention is to provide efficient means for insuring the proper starting of the lamp.

A further object is to so construct the mechanism of an electric arc lamp of the type specified, as to maintain as constant voltage of the arc as possible regardless of the length of the latter, or amperes of current.

A further object is to so construct an electric arc lamp of the flaming or metallic arc type, as to provide a mass of sufficient weight to aid the upper electrode in striking the lower electrode with sufficient force to remove congealed slag from the latter and to dislodge deposits of solid products from the vicinity of the upper electrode and the draft tube.

A further object is to so construct the mechanism of an arc lamp of the type specified and employing a feeding lower electrode, that the lower electrode will not only solidly withstand blows from the upper electrode, but which will also withstand the lifting action of the upper electrode when the two electrodes have been in contact and, upon separation, the surfaces are viscous.

A further object is to provide means which will respond to slight drafts of air and aid the escape up the draft tube of quickly cooling products of combustion from the arc.

With these objects in view, the invention consists in certain novel features of construction and combinations of parts as hereinafter set forth and pointed out in the claims.

In the accompanying drawings; Figure 1

is an elevation, with the casing shown in section, of an electric arc lamp embodying my invention; Fig. 2 is a plan view with the cap or head removed; Fig. 3 is a sectional view on the line $x-x$ of Fig. 2 with the cap or head in place; Fig. 4 is a horizontal sectional view on the line $y-y$ of Fig. 1; Fig. 5 is a section on the line $z-z$ of Fig. 4; Fig. 6 is an enlarged view of the draft tube and parts carried thereby; Figs. 7 and 8 are enlarged detail views showing the switch devices of the regulating and controlling mechanism, and Fig. 9 is a diagrammatical view. Fig. 10 is a fragmentary plan view and Fig. 11 is a sectional view showing attachment of the thimble 34^a to the reflector 34.

1 represents a casing, preferably of sheet metal and having a ring 2 secured to its upper end. To this ring, a cap or hood 3 is secured and provided with an opening embraced by casting 4 for the accommodation of the upper end of a draft tube 5. The cap or hood 3 has secured thereto, a ring 6 provided with posts 7 on which a top plate 8 is supported, said top plate being provided with attaching means 9 for suspending devices. A rod 10 is sustained by the casting 4 and projects upwardly through and beyond the top of the cap or hood to a point in proximity to the top plate 8. The upper end of the rod 7 is pointed and enters a socket in the center of a dished deflector 11 for supporting the latter in position to deflect products of combustion issuing from the upper end of the draft tube 5.

The lower end of the casing 1 sustains a cast ring 12 having perforations in its wall covered by wire netting 13, and to the lower edge of this ring, a globe cover 14 is secured. Any suitable means may be provided for supporting the globe with its upper edge under the cover 14.

A magnet frame comprising vertically disposed cores 15—15 and a cross bar 16, is disposed within the casing, with the cross bar secured to the wall of the latter, through the medium of blocks 17. A bracket 18 is secured to the upper ends of the cores 15 and arms 19 of this bracket are secured to the top ring 2 of the casing.

A knife bar 20 is secured to the bracket 18 and constitutes a bearing for a lever 21, to one end of which, an armature 22 is secured in position to cooperate with the magnet poles at the upper ends of the cores 15.

The armature 22 is connected by means of a flexible bar 23 with the draft tube 5, said bar extending downwardly from its connection with the armature and passing through suitable guides on the tube. The bar terminates near the lower end of the tube 5 and is provided near its lower end with a hole for the passage of a pin 24 projecting from said tube. The bar 23 is provided near its upper end with a stop 23^a to prevent its displacement from the armature 22. The armature lever has attached thereto in proximity to the armature 22, the upper end of an air pot 25, and the plunger in the latter is connected, by means of a rod 26, with a bracket 27 secured to the cross bar 16 of the magnet frame.

The upper end of a spring 28 is connected with the short arm of the armature lever 21, and the lower end of this spring is connected with an arm or slide 29 adjustably connected with the bracket 27 by means of a screw 30 and guided by lugs 30^a on bracket 27. By thus connecting the spring with the bracket 27, the tension of said spring can be readily adjusted.

An inverted bowl or hollow body or casting 31 is secured to the lower end of the tube 5 in such manner that the latter will communicate with the interior of said casting at one side of the longitudinal axis of the same. For securing the tube 5 to the casting 31, a collar 5^a provided with perforated bosses 5^b, is riveted to the lower end of tube 5 and screws 5^c are passed through said bosses and enter bosses 5^a on the casting 31. Insulating material 5^e is disposed between the tube 5 and casting 31 and the screws 5^c are externally separated from the bosses 5^b, as at 5^f, all as shown in Fig. 6. A holder 32 for an upper electrode 33 (preferably bronze or other metal) is located in the bowl or casting 31 in alinement with the axis of the lamp. By disposing the tube or flue 5 out of axial alinement with the electrodes and the arc, permits supporting centrally of an effective "weather vane" to respond to slight drafts of air and aid the escape of the quickly cooling products of combustion from the arc.

A reflector 34 is secured to the open lower end of the bowl or casting 31 and is provided with a central opening having a diameter about equal to the internal diameter of said bowl or casting.

It will be observed that the tube 5, casting 31 and reflector 34 are all vertically movable with the upper electrode. These parts are carried by a knife edge attached to the armature and are guided in their movements by a disk 31^a carried by an arm 31^b and movable between guides 31, said disk 31^a being guided between flanges 31^c secured to the ring 12.

The lower electrode 35 (which may con-

tain ferro-titanium or other material capable of sustaining a flaming or metallic arc) is supported by a suitable holder 36 carried at the lower end of a rod 37. This rod passes upwardly through a sleeve 38 depending from a clutch casing 39; through clutch devices in said casing, and enters a tube 40 secured at its lower end to the clutch casing and extending to the top of the lamp casing 1. The reflector 34 is made with an opening in which a thimble 34^a is secured (but insulated from the reflector), for the passage of the sleeve 38,—the latter thus serving to assist in guiding the reflector and the parts secured thereto, in their vertical movements. The tube 40 is made with a slot 41 for the accommodation of an arm 42 projecting from the rod 37 of the lower electrode carrier. The arm 42 is guided by a rod 43 secured at its lower end to the clutch casing and at its upper end to an arm 44 secured to the tube 40. The arm 42 at the upper end of rod 37 carries a binding post 45 which is electrically connected with the rod 37 and which, when said rod reaches the upper end of its throw, will engage a spring contact arm 46 connected with the positive terminal of the lamp, thus forming a cut-out as hereinafter explained.

I have thus far described the mechanical structure of the lamp, with the exception of the particular construction of the clutch devices, a detailed description of which will be hereinafter given. It will suffice at this point to state that the clutch devices are actuated by means movable with the upper electrode for causing a step-by-step upward feed of the lower electrode. I will now proceed to describe the electrical features employed for effecting the starting of the lamp and its subsequent regulation.

Coarse wire starting coils 47 and fine wire coils 48 (the latter being included in a constantly closed shunt circuit) are located on the magnet cores 15. One terminal of the coarse wire starting coils is connected, by means of a conductor 49 with the plus terminal 50 of the lamp, and the other terminal of the coils 47 is connected with an arm 51 supported by but insulated from a bracket 52 secured to the lower portion of the lamp framework. Another arm 53 is supported by and insulated from the bracket 52 and with this arm, one end of a resistance 54 is connected, the other end of said resistance being connected with the minus terminal 55 of the lamp. The arms 51 and 53 carry contact points 56, with which similar contact points on switch blocks 57 cooperate. These switch blocks are loosely mounted on a cross bar 57^b, which is loosely mounted on and insulated from a lever 58, said contact blocks being electrically connected together by means of a conductor 57^c, as

shown in Fig. 8. The switch blocks cooperate with the arms 51 and 53 to form a switch 57^a which normally closes the circuit of the starting coils 47. The lever 58 is of non-metallic metal (such as brass) pivotally supported between its ends on a frame 59 secured to the lamp framework. This frame 59 carries a coarse wire magnet 60 and a fine wire magnet 61, and the lever 58 is provided with an armature 62 which cooperates with the poles 60^a of the coarse wire magnet 60, so that under certain conditions, the lever will be operated to raise the switch blocks 57 and open the starting circuit. One terminal of the coil of magnet 60 is connected, by means of a conductor 63 with the conductor 49 and the other terminal of this coil is connected by means of a conductor 64 with the bowl or casting 31 and the upper electrode. One terminal of the coil of the fine wire magnet 61 is connected with the coil of coarse wire magnet 60 and the other terminal of the coil of magnet 61 is connected with one terminal of the fine wire coils 48 on the cores 15, the other terminal of the coils 48 being connected with the switch arm or terminal 53. It is apparent that as the coil of magnet 60 with which one terminal of the coil of magnet 61 is connected, is on the plus side of the lamp circuits and as the switch arm 53 is on the minus side of the lamp circuits, the fine wire coil of magnet 61 and the fine wire coil 48 will be in series in a constantly closed circuit shunting the electrodes. The poles 61^a of the fine wire magnet 61 actuates the movable member 64 of a switch 65, the respective members of which are connected with the terminals of the coil of coarse wire magnet 60, so that when the fine wire magnet 61 becomes sufficiently energized to actuate the movable switch member 64, the switch 65 will be closed and the coil of coarse wire magnet 60 short-circuited,—all of which will be hereinafter more fully explained.

A bell-crank-lever 66 is pivotally supported on a pin 66^a secured to the bracket 52, and a friction spring 67 is provided for this lever to cause the same to remain in the position to which it may be moved. The spring 67 is secured at one end to the lever 66 (but insulated therefrom) and through the free end of this spring, a screw 66^b freely passes and enters the end of pin 66^a,—a disk 66^c being disposed between the head of the screw and the spring. The spring thus presses the pivotal part of the lever against a disk 66^d disposed between the latter and the bracket 52. The depending arm 68 of the lever 66 carries a contact point to cooperate with a similar contact point on a spring arm 69 secured to and electrically connected with the switch arm 51, said arms 68 and 69 thus forming a switch 69^a. The

movement of the spring contact arm 69 is limited in one direction by a stop 70 so as to permit the depending arm 68 of the bell-crank-lever to move away from said spring contact arm. The horizontal arm 71 of the bell crank is bifurcated so as to form superimposed fingers 72—73,—between which a pin 24^a on the bar 23 carried by the flue or tube 5, projects. The upper finger 72 may be made tubular and thus afford means for supporting a flexible conductor 75 (suitably insulated from said finger if desired) and electrically connected at its respective ends, with the bell-crank 66 and the conductor 46. A branch circuit shunting the starting coil 47 is thus formed from the conductor 49 to the minus terminal of the lamp and including the switches 69^a and 57^a and the resistance 54,—this circuit being maintained normally open at the switch 69^a when the lamp is not in circuit, by the engagement of the pin 24^a with the upper finger 72 of the bell-crank.

When current enters the lamp it finds two paths,—one through the high resistance shunt circuit, and the other through the comparatively low resistance starting circuit including the coarse wire coils 47, switch 57^a and resistance 54. The now energized main magnets, will actuate the armature lever 21 against the resistance of the spring 25 and forcibly lower the upper electrode and attached parts, including the tube or flue 5, bar 23, bowl or casting 31 and reflector 34. During the descent of the bar 23 and tube or flue 5, the pin 24^a on said bar will engage the lower finger 73 on the horizontal arm of the bell-crank 66 and short-circuit the starting coil at the switch 69^a. The main magnets being thus deenergized, the spring 28 will raise the upper electrode and attached parts until the pin 24^a engages the finger 72 and moves the bell-crank 66 so as to open the short circuit at the switch 69^a, and the action above described will be repeated. By reason of the friction hinge of the bell-crank 66, the latter will remain stationary until positively moved by engagement of the pin 24^a with one or the other fingers 72 or 73 on the horizontal arm of said bell crank. The momentum of the forceful descent of the upper electrode and the parts which carry it, will actuate the lever of the clutch in such manner as to cause the lower electrode to rise a short distance, and the clutch will be thus operated with each descent of the upper electrode and attached parts, so that the lower electrode will be raised step-by-step until the electrodes come together. Should sufficient current pass when the electrodes are in contact, to energize series magnet 60, the armature lever 58 will be actuated and open the circuit of the starting coil 47, at the switch 57^a. The spring 28 will now operate to raise the

upper electrode and attached parts, and establish the arc. As the arc lengthens, more current will pass through the constantly closed shunt circuit including the fine wire coils 48 and the coil of magnet 61, and the cores 15 will become sufficiently energized to actuate the armature lever 21 and balance the pull of the spring 28 at the desired voltage of the arc, which may be varied by means of the screw 30. As the electrodes consume, the length and resistance of the arc increases, varying the pull of the shunt coils 48 against the spring 28 to maintain normal voltage. In a lamp burning continuously, the regulation proceeds until the upper electrode has descended until the increased opposition offered by the clutch causes the arc to lengthen and so increase the resistance as to force increased current to flow in the constantly closed shunt circuit, thereby energizing the fine wire magnet 61 sufficiently to actuate its armature and close the switch 65. The closing of the switch 65 will operate to short-circuit the coil of magnet 60 and hence the armature lever 58 will be released and permitted to close the switch 57^a, thus closing the circuit of the starting coils 47. The arc will be momentarily extinguished and will relight in the manner before explained. The continual feeding-up of the lower electrode will eventually bring the binding post carried by the rod 37 into contact with the spring arm 46 and thus a cut-out of practically no resistance will be formed, should the lamp remain untrimmed in the circuit. Should the lamp be so trimmed that the upper end of the lower electrode is a considerable distance below the lower end of the upper electrode, the mechanism will continue to operate as before explained until the electrodes come together and the lamp is lighted. If, when the electrodes come together, no electrical connection is established between them by reason of congealed slag forming insulation on the lower electrode, the mechanism will continue to "pound." The pounding of the upper electrode upon the slag covered end of the lower electrode will serve to dislodge the congealed slag from the latter. In order that this shall be accomplished effectually and in order that the contact of the metal electrodes with each other shall be sufficient to insure proper electrical connection between them, the weight of the tube or flue 5, casting 31 and reflector 34 is added to that of the upper electrode. As the upper electrode consumes, its reduced weight causes the arc-voltage to increase, (a few volts only is permissible) and therefore it is advisable to renew the upper electrode every time the lower electrode is renewed. To avoid waste, the upper electrode is made small, but its holder and attached parts including the tube or flue 5, casting 31 and re-

flector 34 moving with it, supply sufficient weight, not only to strike the lower electrode effectual blows, but to render the loss of weight of the upper electrode negligible.

In order that the lower electrode shall be properly fed upwardly step-by-step during the reciprocating action of the upper electrode, and in order that the lower electrode shall properly withstand the "pounding" as hereinbefore described without danger of being depressed, the clutch devices which sustain the lower electrode and by means of which its upward feeding is effected, are constructed as will now be explained in detail.

The rod 37 which carries the lower electrode holder 36, passes through the clutch box or casing 39 as before explained and located within this box or casing, are three clutches 76, 77 and 78, each disposed in position to engage the rod 37. The upper clutches 76 and 78 are of the ordinary form of pivoted dog clutch while the clutch 77 is of the ring type. The upper clutch 76 is maintained normally in engagement with the rod 37 by means of a spring 79. This clutch sustains the weight of the rod and the lower electrode and its holder, and normally prevents downward movement of the same during the "pounding" of the upper upon the lower electrode. The lower clutch 77 is maintained normally in engagement with the rod 37 by means of a spring 80. This clutch prevents upward movement of the rod 37 and operates to prevent the lower electrode from being drawn up by the upper electrode, in case the electrodes adhere upon making contact. The intermediate clutch 78 is connected, by means of a link 81 with a lever 82 which is pivotally supported at one side of the rod 37. The lever 82 is provided with an opening 83 for the free passage of the rod 37 and the free end of said lever terminates in an arm 84 which projects through an elongated slot in the box or casing 39, in position to be in the path of a foot piece 85 secured to the tube 5. One of the journals of the lever 82 is provided with an arm 86 within reach of an attendant, whereby the latter can operate the lever 82 to release either the upper or the lower clutch, when he desires to move the rod 37 up or down during the trimming of the lamp. It will be observed that when the tube 5 descends, the foot piece 85 will strike the projecting arm 84 of lever 82 and depress the latter, causing it to engage and depress the lower clutch 77 to release the rod 37 and also to cause the clutch 79 to grip said rod and raise the same a short distance through both the upper and lower clutches. When the tube 5 and upper electrode rise and the foot piece 85 moves away from the arm 84 of lever 82, the intermediate clutch 78 will become released from the rod 37; the upper clutch will prevent descent of said rod, and the clutch 76 will

assume its normal position to prevent ascent of said rod. These operations will be repeated during the reciprocating movements of the tube 5 and attached parts, causing a step-by-step upward feed of the lower electrode until the electrodes come together.

Various slight changes might be made in the details of construction of my invention without departing from the spirit thereof or limiting its scope and hence I do not wish to restrict myself to the exact details herein set forth.

Having fully described my invention what I claim as new and desire to secure by Letters-Patent, is:—

1. In an electric arc lamp, the combination with an armature lever and a magnet for actuating the same in one direction, of a tube freely movable up and down and connected with said armature lever, an upper electrode holder having fixed relation to and movable with said tube, overbalancing means for said tube connected with the armature lever, a lower electrode and means controlled by the movements of said tube for controlling the circuit of said magnet and thereby causing the tube and upper electrode holder to reciprocate and the upper electrode to forcibly strike the lower electrode a plurality of times successively, before an arc is drawn.

2. In an electric arc lamp, the combination with a freely movable tube, an inverted bowl secured thereto, and a reflector secured to said bowl, of an upper electrode holder rigidly secured in said bowl, an upper electrode, a lower electrode holder, and a lower electrode, a magnet, an armature lever connected with said tube, adjustable overbalancing means for the tube, reflector and upper electrode holder, connected with said armature lever, and devices controlled by the movements of said tube, reflector and upper electrode holder, for controlling the circuit of said magnet for causing said magnet and overbalancing means to drop the upper electrode a plurality of times successively upon the lower electrode before an arc is drawn between said electrodes.

3. In an electric arc lamp, the combination with upper and lower electrodes, a magnet having coarse and fine wire coils, an overbalanced armature lever connected with the upper electrode, a constantly closed high resistance shunt circuit including said fine wire coils, a low resistance branch circuit shunting the electrodes and including said coarse wire coils, a switch included in said branch circuit, a circuit shunting the coarse wire coils, a switch included in this

circuit, means movable with the upper electrode for opening and closing said last-mentioned switch, a magnet having a low resistance coil included in the main circuit, means actuated by this magnet for opening the first mentioned switch in the low resistance branch circuit, a switch magnet having a high resistance coil in series with the fine wire coils in the high resistance shunt circuit, a short circuit around the low resistance magnet coil in the main circuit, and a switch in said short circuit controlled by the high resistance switch magnet.

4. In an electric arc lamp, the combination with a vertically movable tube, an upper electrode holder sustained by said tube and movable with it, a magnet, and an overbalancing armature lever connected with said tube, of a lower electrode holder, a rod carrying said holders, clutch devices engaging said rod, means movable with the upper electrode holder for operating said clutch devices to move the lower electrode upwardly step-by-step and means for causing the upper electrode to reciprocate.

5. In an electric arc lamp, the combination with an upper electrode holder and means for reciprocating the same, of a lower electrode holder, a rod carrying said lower electrode holder, a clutch engaging said rod to prevent downward movement of the same, a clutch engaging said rod to prevent upward movement thereof, a third clutch, a lever connected with said third clutch, and means movable with the upper electrode for operating said lever to release the first-mentioned clutch and actuate the third clutch to grasp said rod and raise the same.

6. In an electric arc lamp, the combination with an upper electrode holder, and means for reciprocating the same, of a lower electrode holder, a rod carrying the latter, upper and lower clutches engaging said rod to prevent downward and upward movement respectively of the same, an intermediate clutch, a lever connected with the intermediate clutch, means movable with the upper electrode to operate said lever to release the lower clutch and actuate the intermediate clutch and cause the latter to grip and raise said rod, and an arm on said lever for operating the latter manually to release either the upper or the lower clutch.

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

THOMAS EDGAR ADAMS.

Witnesses:

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G. C. PAXTON.