No. 631,975. Patented Aug. 29, 1899.

H. A. WAGNER & D. W. ROPER.

MEANS FOR OPERATING ELECTRIC ARC LAMPS.

(Application filed May 25, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

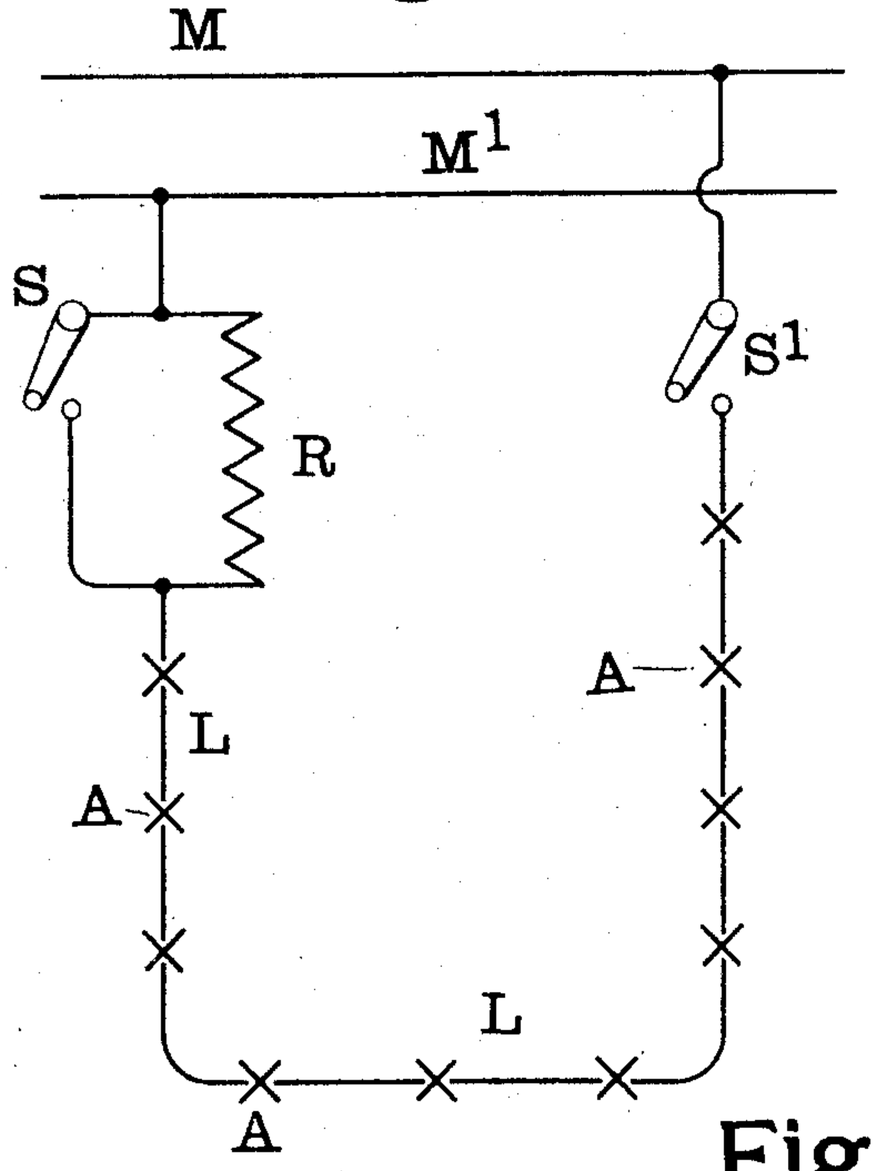

Fig. 2.

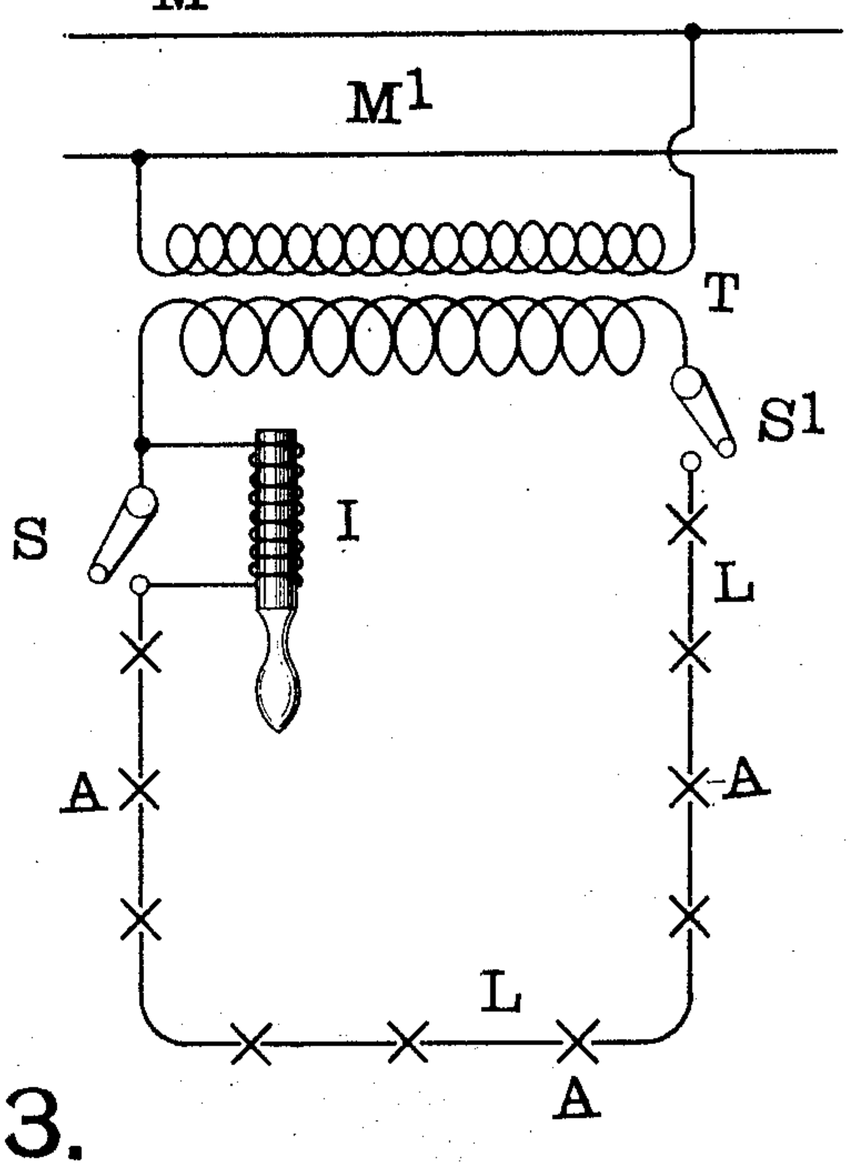

Fig. 3.

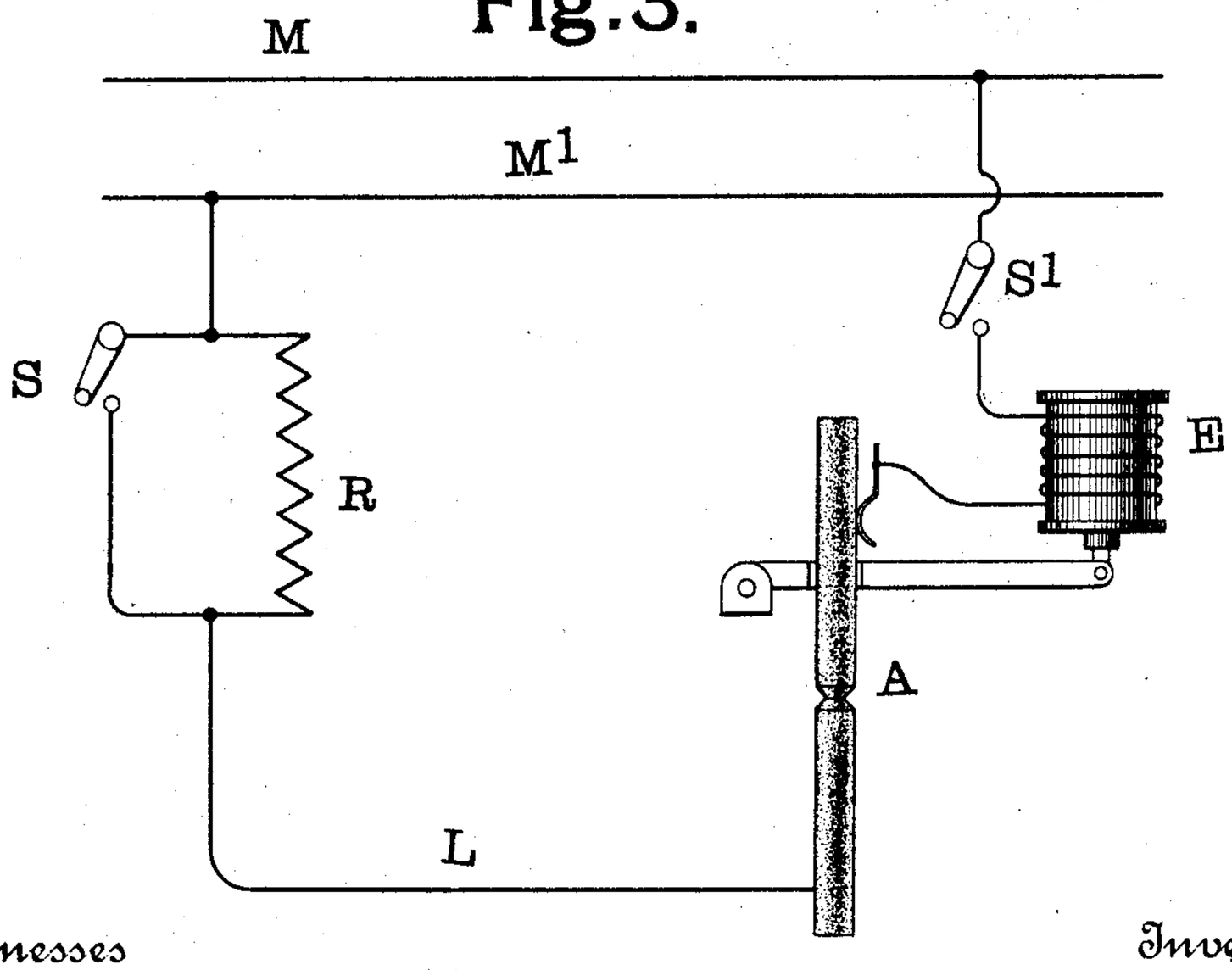

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Fig.4.

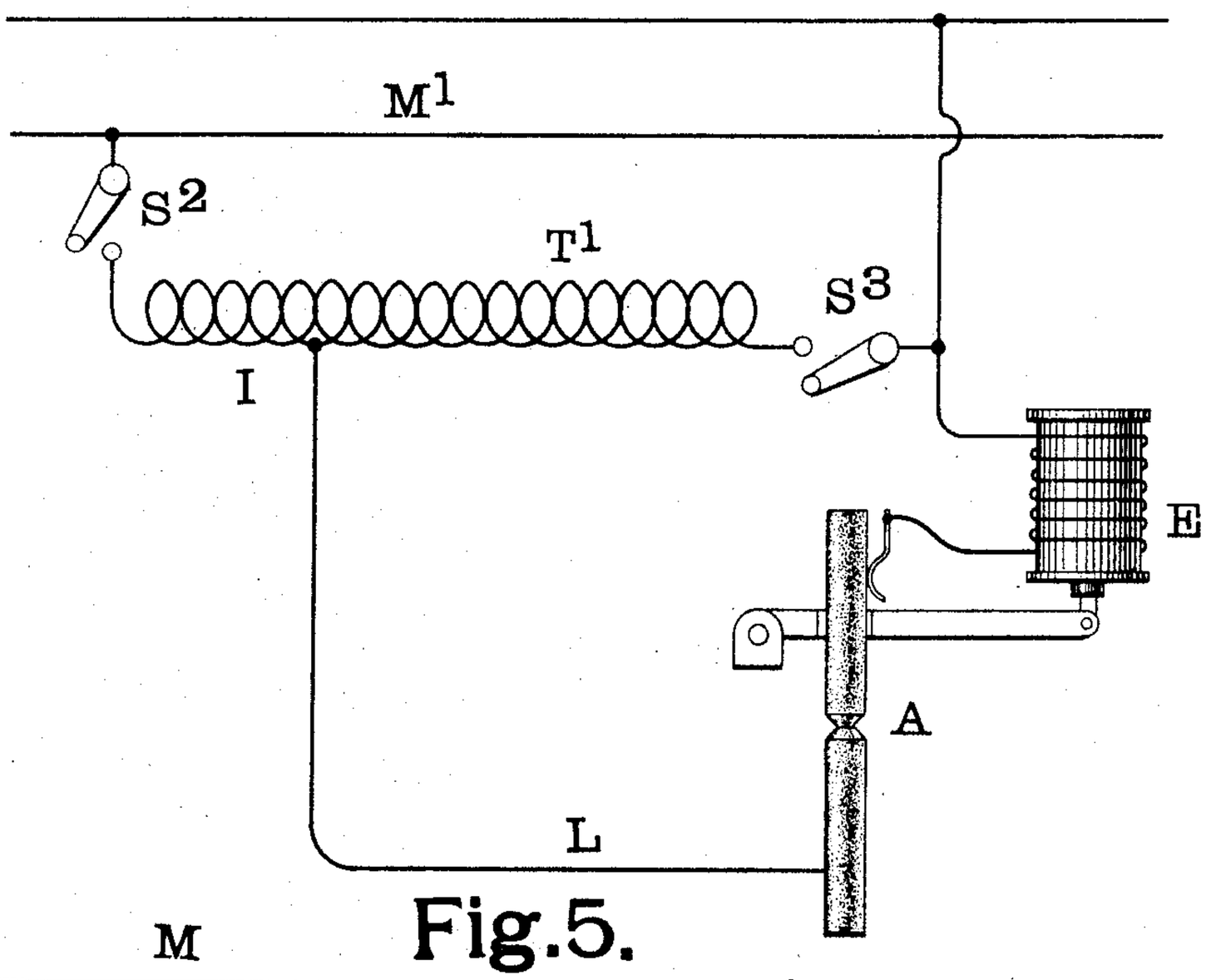
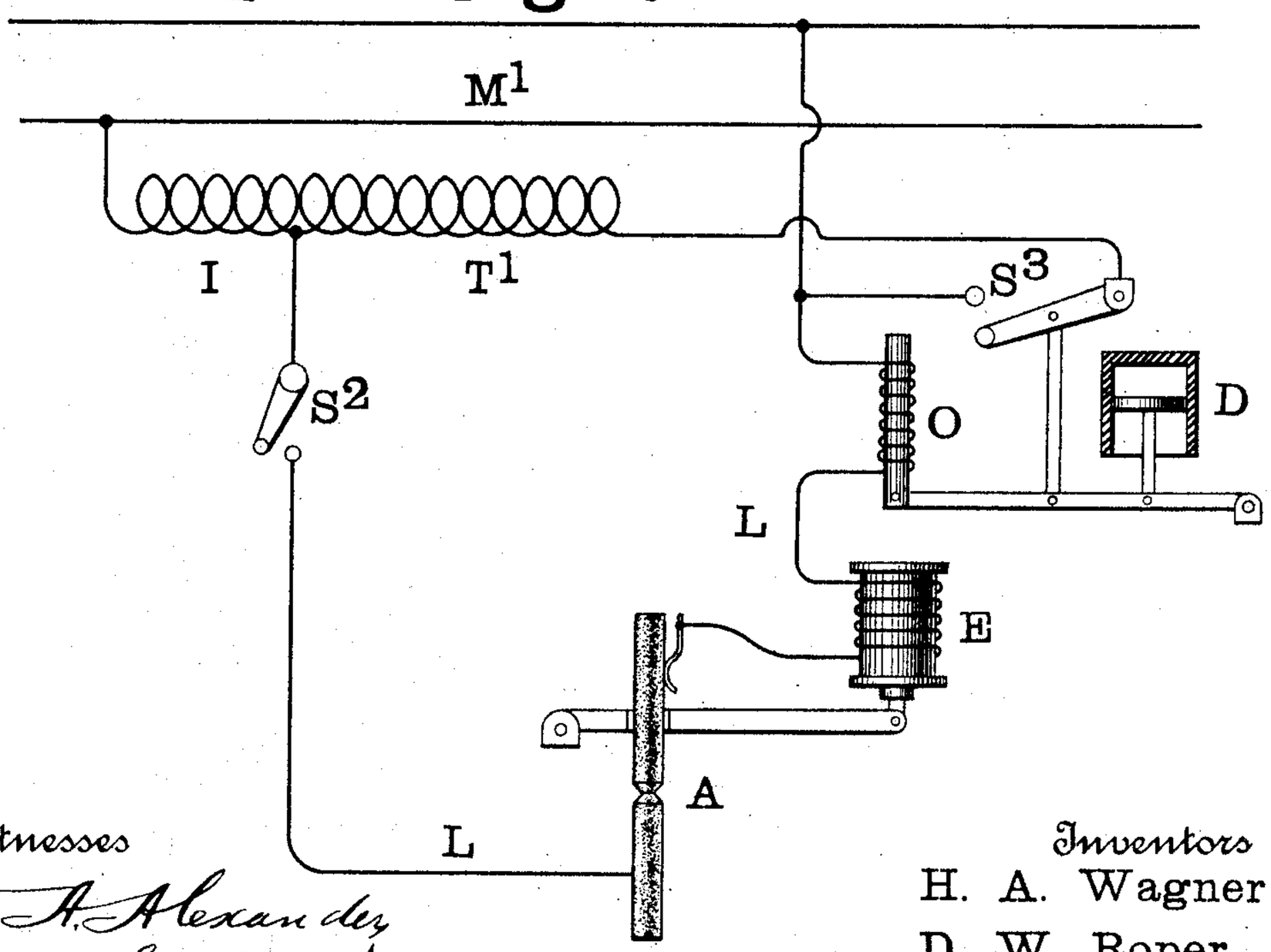


Fig.5.



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UNITED STATES PATENT OFFICE.

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MEANS FOR OPERATING ELECTRIC-ARC LAMPS.

SPECIFICATION forming part of Letters Patent No. 631,975, dated August 29, 1899.

Application filed May 25, 1899. Serial No. 718,162. (No model.)

To all whom it may concern:

Be it known that we, HERBERT A. WAGNER and DENNEY W. ROPER, citizens of the United States of America, residing at St. Louis, in the State of Missouri, have invented a certain new and useful Method of and Means for Operating Electric-Arc Lamps, of which the following is such a full, clear, and exact description as will enable any one skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

This invention relates to a method of and means for operating electric-arc lamps on constant-potential circuits or circuits derived from a constant-potential source, whereby the efficiency of distribution is increased and the cost of operation reduced.

When an arc-lamp circuit is open and no current is passing the carbons are in contact and the resistance of the circuit including the lamp is only a small fraction of that of the same circuit when the lamp is in normal operation. At the instant of closing the lamp-circuit the full voltage of a constant-potential source applied to the low-resistance lamp-circuit causes a sudden rush of current through the lamp-circuit far above the normal, and this passing through the controlling solenoid draws the carbons violently and suddenly apart. This action is so rapid that the carbon vapors, upon whose existence the arc is dependent, do not have time to form and the arc is broken. This interrupts the circuit and prevents the flow of current which energizes the controlling-magnet, and the carbons coming together again the action is repeated many times, causing chattering. This chattering continues until the carbons finally become heated by the action of the current and an arc is struck. The chattering is especially violent with differential lamps, as at the instant of rupturing the arc the full strength of the shunt-coils assists the weight of the moving parts in bringing the carbons together. This chattering is very annoying to the user of the lamp and destructive to the lamp mechanism. This chattering may be reduced in several ways. A quiet start may, if other conditions are favorable, be obtained by using soft-cored carbons. These carbons are, however, expensive and short-lived. Another method of overcoming this chattering is to use dash-pots to restrain the upward movements of the controlling-magnet; but if these dash-pots are sufficiently strong to stop the chattering they necessitate the maintenance of an excessive current in the lamp-circuit. Still another method of preventing such chattering consists in using a fixed resistance kept continually in the lamp-circuit. This latter prevents excessive current therein and is a very effective method of reducing the chattering at the start, but the operating efficiency is very low, as the resistance required for smooth operation is considerably less than that necessary for a quiet start. Our method of overcoming this difficulty secures a quiet start without allowing the current at starting to exceed the normal without sacrificing the efficiency of the lamp during operation, and permits the use of harder, less expensive, and longer-lived carbons.

We have found that if the carbon-tips are first heated to redness in any suitable way, as by a current too weak to lift the carbons, sufficient carbon-vapor will be formed to maintain the arc when the normal current is applied to the lamp, and our invention relates to this method of preparing the carbons for starting the arc and means for accomplishing the same, whereby a distinct separation of the starting and operating conditions is secured. By the first step of our method the carbon-tips are heated by a reduced current insufficient to cause chattering. The next step of our method consists in altering the connections or arrangement of the lamp-circuit so as to remove the resistance employed at starting and strike the normal arc. By making this total separation of the starting and running conditions we are enabled to make each set of conditions the most favorable for the purpose instead of compromising on one set of conditions which is not the best for either starting or for permanent operation.

In the accompanying drawings, illustrating diagrammatically several forms of our invention, Figure 1 shows our invention applied to a number of arc-lamps operated in series; Fig. 2, the same, but illustrating diagrammatically a transformer for modifying the vol-

tage; Fig. 3, our invention as applied to a single arc-lamp operated by direct current; Fig. 4, our invention as applied to single arc-lamps operated by alternating current; Fig. 5, the same as Fig. 4, but showing a solenoid and dash-pot for automatically cutting out the resistance employed at starting.

The same marks of reference refer to the same parts throughout the different figures of the drawings.

Having now more particular reference to Fig. 1, M M' are the constant-potential mains. A A A are the arc-lamps. R is a starting-resistance, S a switch for short-circuiting the starting-resistance, and S' a switch for opening the lamp-circuit L. This arrangement is equally applicable to direct or alternating current lamps.

Fig. 2 shows our invention as applied to a circuit containing a series of alternating-current arc-lamps in which the desired voltage for the series of lamps is different from that of the constant-potential mains. T is a transformer for making a change in the voltage and may be wound and connected in any desired manner. The starting-resistance I in this instance is preferably made inductive.

The ways of applying our invention shown in Figs. 1 and 2 are also applicable to a single arc-lamp in cases where the voltage of the constant-potential source is suitable for a single arc-lamp.

Fig. 3 shows the application of our invention to a single direct-current arc-lamp operated from mains M M' whose voltage is suitable for one arc-lamp, E being the ordinary electromagnetic device for controlling the arc.

Fig. 4 illustrates the method especially applicable to single alternating arc-lamps. In this case the inductive starting-resistance I forms part of an economy transformer or auto-converter T'. One end of the lamp-circuit L is connected to the economy-transformer intermediate its ends, and the other end of the lamp-circuit is connected to the lamp. When the switch S^2 is closed and switch S^3 is open, I acts as an inductive starting-resistance in series with the lamps, as above described. With the switch S^2 and the switch S^3 closed, the economy-coil acts in the ordinary manner to reduce or transform the voltage of the circuit to that desired for operating the arc-lamp. When both switches S^2 and S^3 are open the apparatus is out of circuit.

Fig. 5 is the same as Fig. 4, with the addition of a solenoid O for automatically closing the switch S^3 and a dash-pot D for slowing the action of the solenoid. The solenoid acts to close the switch S^3 as soon as the circuit-closing switch S admits current to the lamp; but the dash-pot retards this action until the carbon-points are sufficiently heated to permit the arc being started. Any other device with a time element in its action may be used instead of the dash-pot and solenoid for operating the switch S'.

The switch S of Figs. 1, 2, and 3 and the switch S^3 of Fig. 4 may be operated in any desired way.

Having fully set forth our invention, what we desire to claim and secure by Letters Patent is—

1. In an electric-arc-lighting system, the method of heating the carbon-tips by a reduced current, and then altering the connections of the circuit to permit the flow of normal current and the normal operation of the lamp.

2. In a system of electric-arc lighting, the method of first heating the lamp carbon-tips by an electric current insufficient to permit the carbons to separate, and then suitably varying the current or connections to allow the carbon-controlling mechanism to draw the arc and permit the lamp to operate normally.

3. In an electric-arc-lighting system, the method of heating the carbon-tips by a reduced current and then, without opening the circuit, altering the connections or arrangement of the circuit so as to allow the normal current to pass.

4. The method of operating an electric-arc-lighting system, which consists in interposing a resistance in the lamp-circuit at starting to reduce the current and thereby heat the carbon-tips without separating them, and then, when the tips have been so heated, cutting out the said resistance to allow the normal current to flow and the arc to be drawn.

5. In a system of electric-arc lighting, means for first heating the lamp carbon-tips with a current insufficient to lift the carbons apart, in combination with means for subsequently increasing the current to the normal amount required for drawing the arc and operating the lamp or lamps.

6. In an electric-arc-lighting system, the combination of an electric circuit, an arc lamp or lamps therein, a resistance in said circuit at starting for reducing the current passing through said lamps to an amount sufficient to heat the carbon-tips to redness but insufficient to draw the arc, and a switch for cutting out said resistance after starting to bring the current up to the normal operating amount.

7. In an electric-arc-lighting system, the combination of an electric circuit, an arc lamp or lamps therein, carbon-controlling mechanism, a resistance in said circuit for reducing the current passing through said lamps, and an electrically-controlled switch and retarding device, whereby said resistance may be automatically shunted at a predetermined interval after current is applied.

8. In an electric-arc-lighting system, the combination of an arc-lamp with carbon-controlling mechanism, a divided transformer-coil, a lamp-circuit connected therewith, one end of said lamp-circuit being connected to said transformer at its point of division, and an electrically-controlled slow-acting switch between the other end of said lamp-circuit

and one end of said divided transformer and open at the start, whereby the transformer-coil may first impose impedance in series with the lamp, and at a given interval thereafter transform the voltage for the normal operation of the lamp.

In testimony whereof we have hereunto set our hands and affixed our seals in the presence of the two subscribing witnesses.

HERBERT A. WAGNER. [L. S.]
DENNEY W. ROPER. [L. S.]

Witnesses:
A. C. FOWLER,
W. A. PARKER.