H. N. POTTER.

SYSTEM OF LIGHTING BY GAS OR VAPOR ELECTRIC LAMPS.

APPLICATION FILED MAY 28, 1901.

956,168. **Patented Apr. 26, 1910.**

2 SHEETS—SHEET 1.

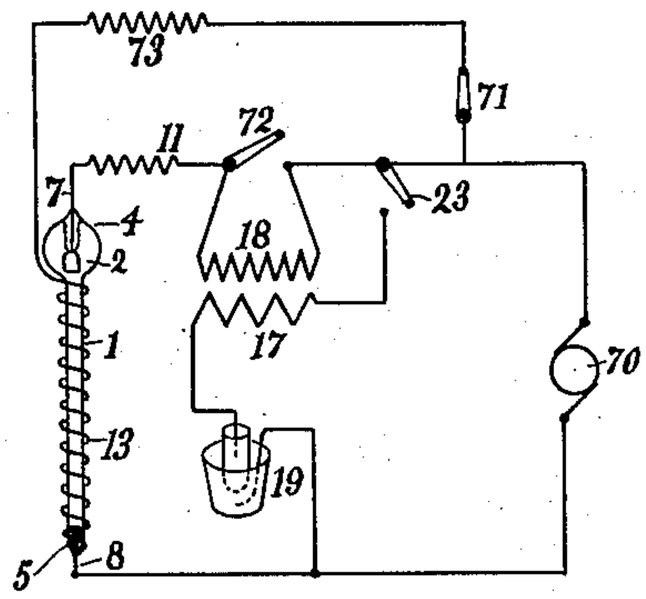


Fig. 1

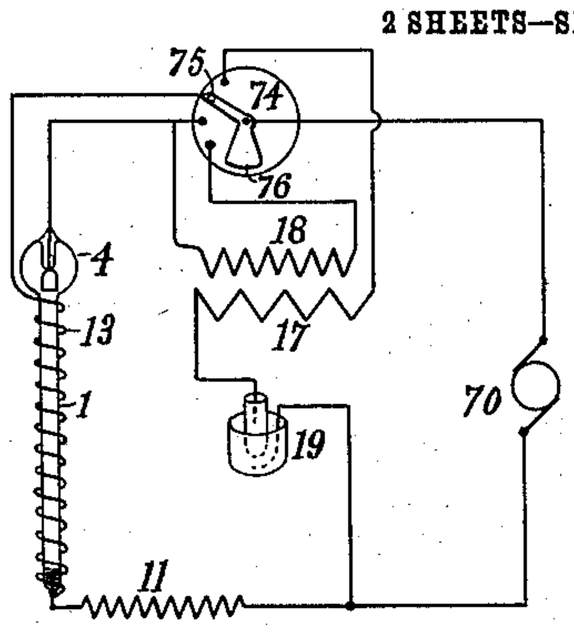


Fig. 2

Fig. 3

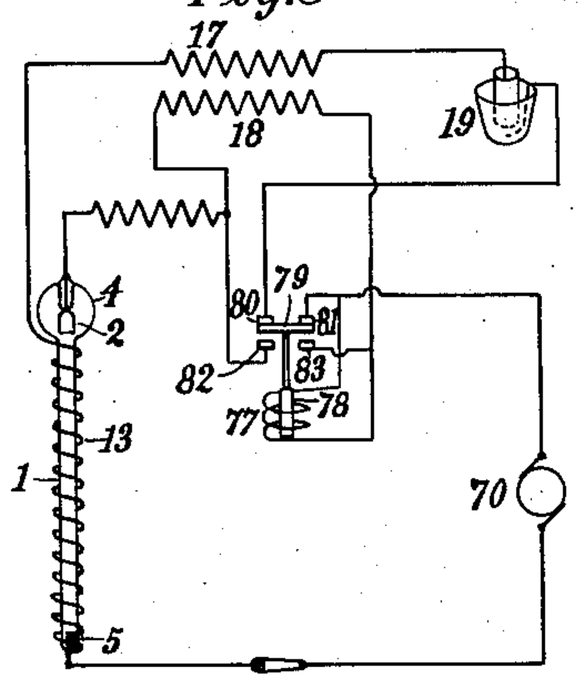


Fig. 4

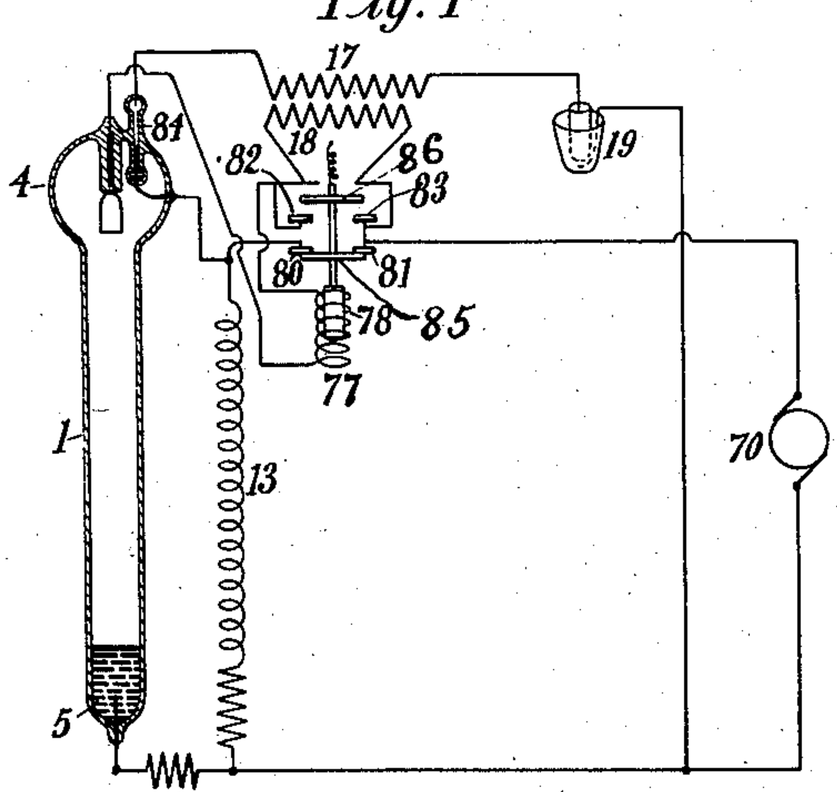


Fig. 5

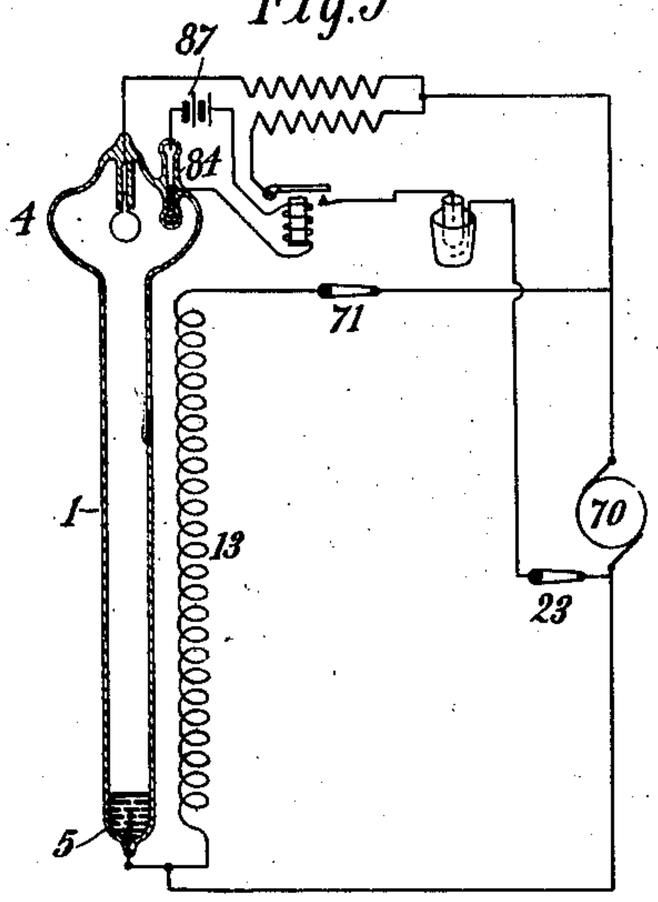
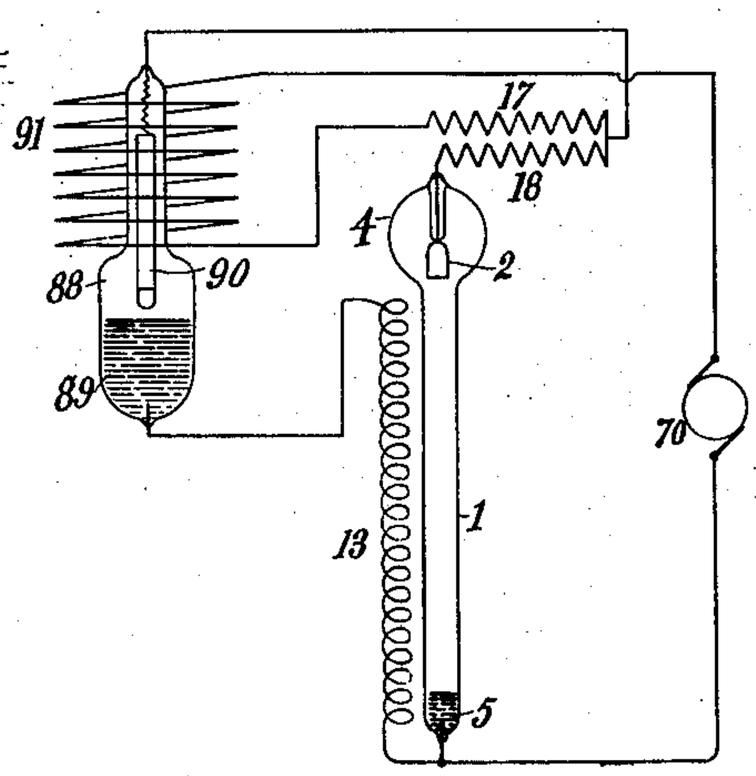


Fig. 6



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2 SHEETS—SHEET 2.

Fig. 7

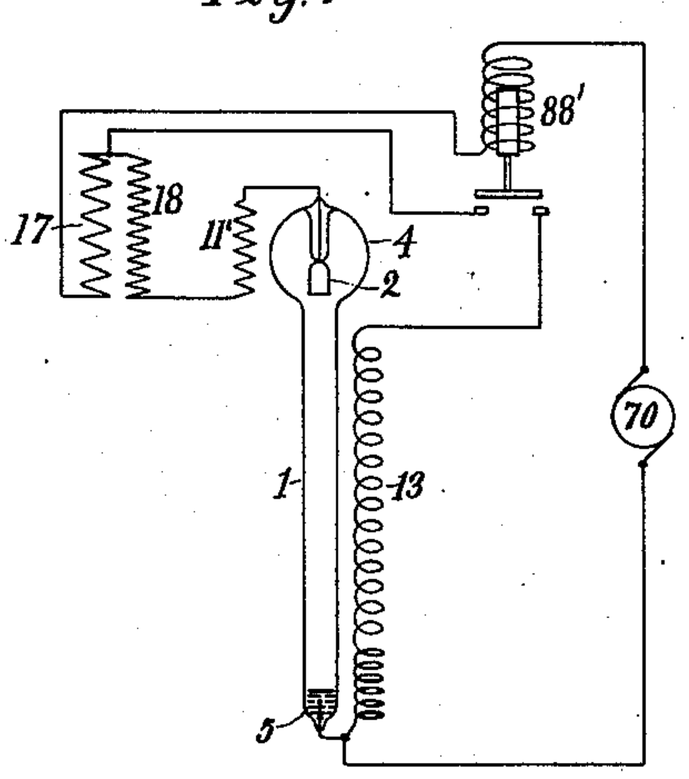


Fig. 8

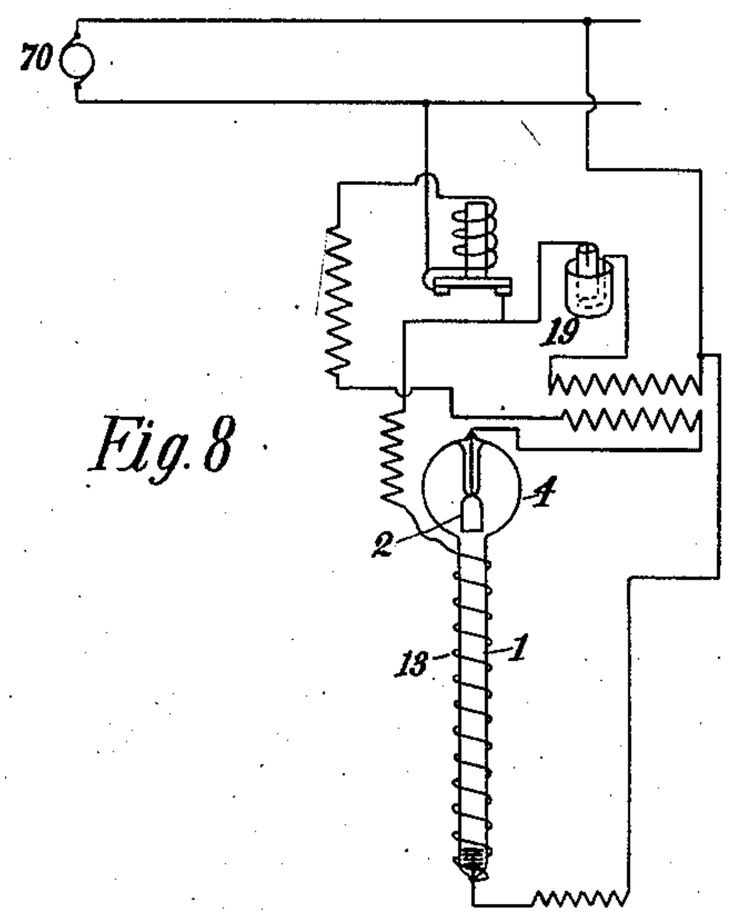
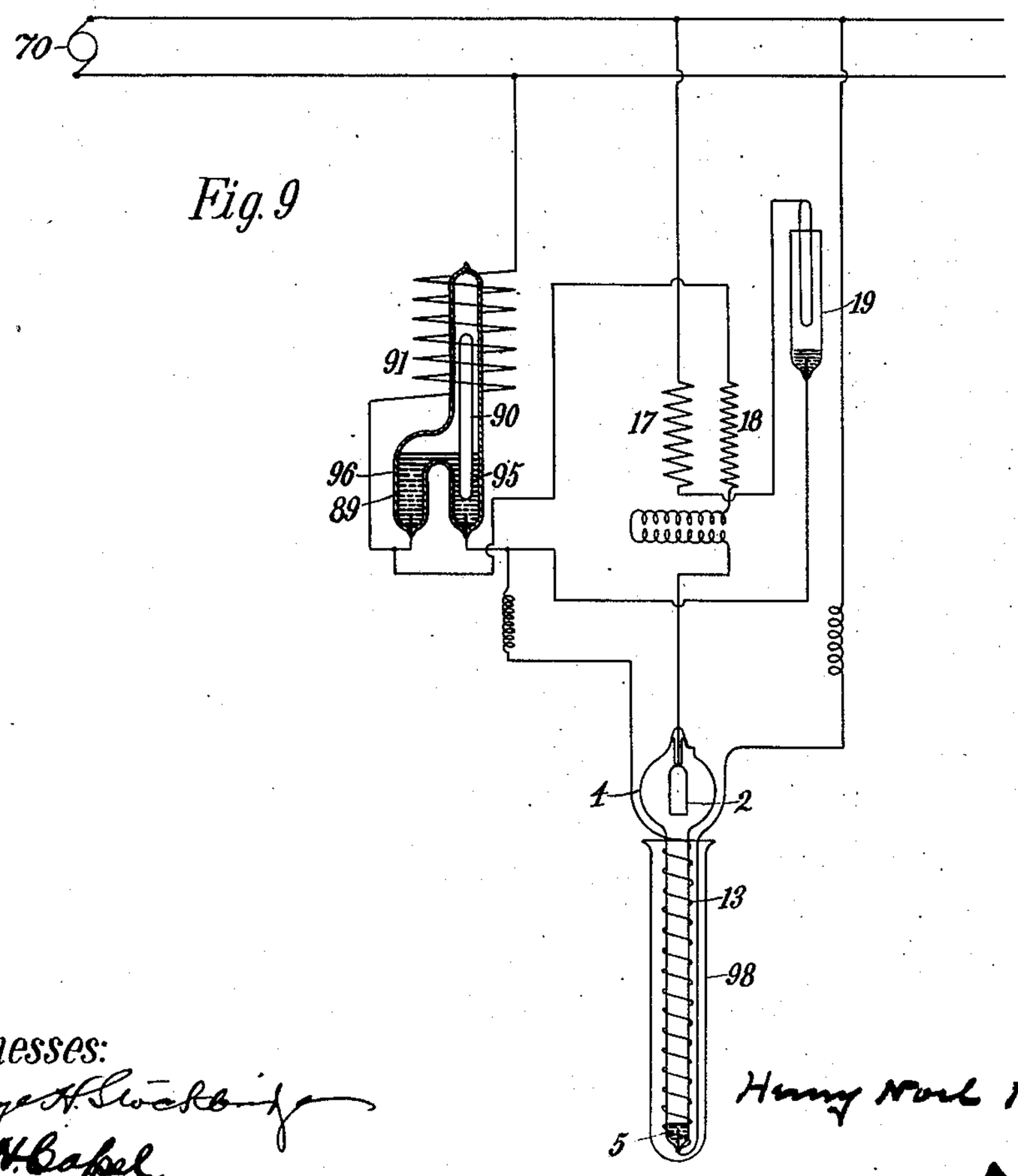


Fig. 9



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UNITED STATES PATENT OFFICE.

HENRY NOEL POTTER, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO COOPER HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SYSTEM OF LIGHTING BY GAS OR VAPOR ELECTRIC LAMPS.

956,168. Specification of Letters Patent. Patented Apr. 26, 1910.

Application filed May 28, 1901. Serial No. 62,182.

To all whom it may concern:

Be it known that I, HENRY NOEL POTTER, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Systems of Lighting by Gas or Vapor Electric Lamps, of which the following is a specification.

My invention relates to circuits and apparatus which may be used in operating gas or vapor electric lamps, and it also includes an improved heating arrangement for lamps of this class, as will fully appear from the specification which follows.

My invention is illustrated in the accompanying drawings in which—

Figure 1 is a diagram of a system of circuits to be used in operating gas or vapor electric lamps, together with a detail view of a single lamp and my heating arrangement combined therewith; Figs. 2, 3, 4, 5, 6, 7, 8 and 9, illustrate various modifications of the system shown in Fig. 1.

In the first figure of the drawing, 1 represents a transparent tube, say of glass, constituting the main portion of the container for a suitable conducting gas or vapor. In the present instance, I have illustrated a lamp in which the cathode (shown at 5) is a mass or puddle of mercury, while the anode, appearing at 2, is of iron. A bulb or enlargement, 4, is formed at the upper end of the tube 1, to serve as a cooling chamber. Leading in wires 7 and 8 are connected, respectively, to the anode 2 and the cathode 5.

I surround the body of the lamp, or a suitable portion thereof with a heater wire, 13, which will generally be a German silver wire wound upon the outside of the tube. I generally wind such a wire more closely where it is outside the mercury cathode as the latter, owing to its large specific heat, can absorb considerable heat and unless extra heat is provided, the duration of starting of the lamp will be unnecessarily prolonged.

In the system illustrated in Fig. 1, the lamp itself and the heater wire are arranged in separate parallel circuits supplied by a suitable generator, 70; while a third circuit, in parallel with the other two, includes a suitable electrolytic or other interrupter, 19, and the primary, 17, of a suitable starting transformer, the secondary 18 of which is in the lamp circuit. Switches 71 and 23, control, respectively, the heater circuit and the primary transformer circuit. The lamp circuit is also controlled by a switch, 72, which is adapted to cut in or out the transformer secondary. I may employ a resistance, 73, in the heater circuit and also a ballast-resistance 11 in the lamp circuit. In the condition shown in Fig. 1, the lamp is supposed to be starting, current passing from the dynamo 70 through the switch 71, resistance 73 (which is inserted merely for completeness, but may be equal to zero), heater wire 13 and back to the dynamo. When the heater has been operating for a sufficient length of time, the switch 23 is closed, thereby throwing in the primary 17 of the starting transformer and the interrupter 19. The secondary of the starting transformer now starts the lamp by its discharge, after which the switches 23 and 71 are opened and the switch 72 closed. The switch 71 can be opened at any time after the heater has performed its function, provided the switch 23 is closed before the lamp has sufficiently cooled off to prevent its starting.

In Fig. 2 I have shown a diagrammatic view of a switch, 74, combined with a system of circuits substantially the same as that appearing in Fig. 1, the switch 74 being adapted to perform the functions of the three switches shown in the former diagram. In this figure the ballast-resistance of the lamp is shown, for variation, in the common circuit of the heater and the lamp. As before, the lamp is shown starting. The switch 74 is provided with a narrow arm 75 and a broad segmental arm, 76. By moving the switch clockwise, the heater circuit will first be broken and the arm 75 will then close the primary circuit of the transformer at the same time that the arm 76 throws in the secondary of the transformer. The lamp starts instantly, so that the switch may continue in its forward movement, whereupon the circuit of the starter primary will be broken and the arm 76 will short-circuit the starter secondary by coming into contact with suitable terminals, as shown.

In Fig. 3, I have shown an automatic device for effecting the same sequence of operation. A variation is here introduced, however, in that the starter primary 17 and the interrupter 19 are put in series with the

heater 13, the latter being so proportioned that the primary of the starting transformer receives a sufficient voltage. The actuating coil, 77, of the automatic switch is provided with a core, 78, to which is attached a contact-piece, 79, which bridges two contact terminals, 80 and 81, in the position illustrated in the drawing. When the core is drawn in and the contact-piece 79 is carried downward the latter makes contact with terminals, 82 and 83, and breaks contact with the terminals 80 and 81. Inasmuch as the coil 77 is in the lamp circuit, the described operation will take place when the lamp starts into operation, whereby the circuit of the heater and the starter primary will be opened and the starter secondary will be short-circuited.

In Fig. 4 I have shown a device which is intended to relieve the interrupter of the necessity of uselessly operating during the preliminary period wherein the heater has not yet brought the tube to such a temperature as will permit it to be started. For the sake of clearness I have here represented the heater wire 13 as removed from the outside of the tube 1. I have also shown in the open portion of the lamp near the anode a small thermostat, 84, of the usual mercury thermostat type, whose function it is to close the primary circuit of the starting transformer when the lamp has been heated up to a point at which it will certainly start. Thus, the circuit containing the interrupter and the starter primary will be inactive until the necessity for its action intervenes. In this arrangement the core 78 carries two contact plates or contact-pieces, 85 and 86, one of which, according to the position of the core is adapted to make or break contact with the terminals 80 and 81, and the other of which is adapted to make or break contact with the terminals 82 and 83. The action is the same as that already described in connection with Fig. 3; that is to say when the lamp is started the circuit of the heater and the starting primary is opened and the starter secondary is short-circuited.

In Fig. 5, I have shown another arrangement embodying the same feature of thermostatic control, but I here operate the controlling switch of the starter primary by means of a local circuit, including a battery, 87. I again show in this drawing manually operated switches 23 and 71, although these switches might obviously be made automatic in their operation.

Fig. 6 illustrates a remarkably simple arrangement. With this system of circuits, I employ a combined cut-out and interrupter, 88, consisting of a chamber containing mercury, 89, an iron core, 90, which dips down into the mercury when no current is passing, and an atmosphere of hydrogen gas. As soon as current passes the core 90 is immediately lifted out of the mercury, being restored again by gravity as soon as the current ceases to flow. The circuit passes from the dynamo 70 through a coil, 91, surrounding the interrupter and cut-out 88, thence through the primary of the starter and thence through the interrupter contacts and the heater 13 back to the dynamo. When current passes through the described circuit, it is automatically cut off every time the core 90 is lifted out of the mercury 89, and a rapid automatic interruption and closure of the circuit takes place, the action being analogous to that of the "Neef" hammer of a Ruhmkorff coil. The heater receives current whenever the circuit is complete, and the starter secondary 18 receives an impulse every time the circuit is broken, so that the lamp tube is heated directly by whatever secondary discharge occurs, and also indirectly by the heater wire 13, the combined action being eventually sufficient to start the tube, whereupon the coil, 91, holds the interrupter contacts apart. The primary and secondary of the starter are so proportioned and disposed that they may operate as ballast for the lamp.

In Fig. 7, I have shown another modification, the main difference being that I have illustrated the interrupter diagrammatically at 88′ and have inserted a certain amount of extra ballast 11′ in series with the starter.

Fig. 8 illustrates another arrangement of circuits controlled by a single switch, this arrangement being generally the same as that illustrated in Fig. 7, except that a separate interrupter 19 is employed in connection with the switch. In this arrangement, however, the starter primary, as well as the interrupter and the heater, is cut out by the action of the switch when the lamp has begun to operate.

In Fig. 9, I have shown another arrangement of circuits and a modified form of interrupting device which I have found operative. The peculiar feature of this interrupter is that the break occurs between two surfaces of mercury, the core 90, in this instance, (controlled by the coil 88), merely causing the mercury 89 to overflow from one compartment, 95, to another, 96, thereby establishing a circuit to the heater 13 and the electrolytic interrupter 19. When the core 90 is lifted on the passing of current through the lamp, the mercury in the two compartments flows apart, thus breaking the circuits of the heater and the interrupter and starter primary and leaving the lamp in condition for continued operation. I have also shown in this figure of the drawing an outer tube, 98, preferably of ground glass, which is slipped over that part of the lamp upon which the heater wire is wound. This is a very satisfactory way of hiding the

heater wire, and as it hinders convection, it also causes the lamp to start more quickly.

The interrupter 19 may be of the well-known Wehnelt type, or it may be any other suitable device adapted to cause very rapid interruptions of the circuit.

The invention claimed is:—

1. In a system of lighting by gas or vapor electric lamps, a main circuit including a gas or vapor electric lamp and also including the secondary of a transformer, in combination with a heater for the lamp, an interrupter in circuit with the primary of said transformer, the heater, the interrupter and the transformer primary being in shunt to the main lamp circuit, and means for short-circuiting the secondary.

2. In a system of lighting by gas or vapor electric lamps, a lamp of the class described, a transformer whose secondary is in series with the lamp, a heater, an interrupter, and the transformer primary in shunt to the lamp, and an electro-magnetic device in the main lamp circuit, adapted to break the shunt circuit or circuits when the lamp begins to operate, and means for short circuiting the secondary.

3. The combination with a direct current source, a vapor electric lamp comprising a completely exhausted container and suitable electrodes therein, a transformer secondary in series therewith, of two circuits in shunt to said lamp and transformer secondary, the first including a heater for said lamp, the second including a primary of the said transformer and a circuit interrupter, and a coil in series with the lamp, together with means responsive to current through said coil for interrupting the circuits containing the heater and the transformer primary and for short circuiting the transformer secondary.

Signed at New York, in the county of New York, and State of New York, this fifth day of February, A. D. 1901.

HENRY NOEL POTTER.

Witnesses:
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