P. H. THOMAS.

SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR LAMPS.

APPLICATION FILED AUG. 20, 1907.

968,897.

Patented Aug. 30, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

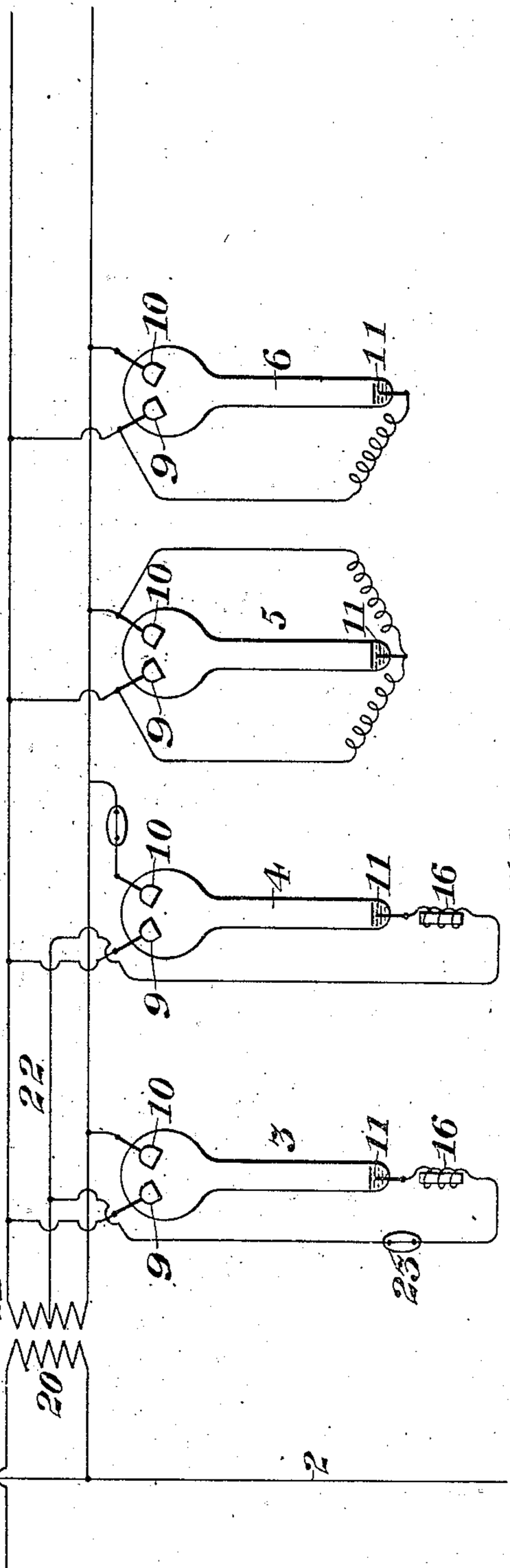
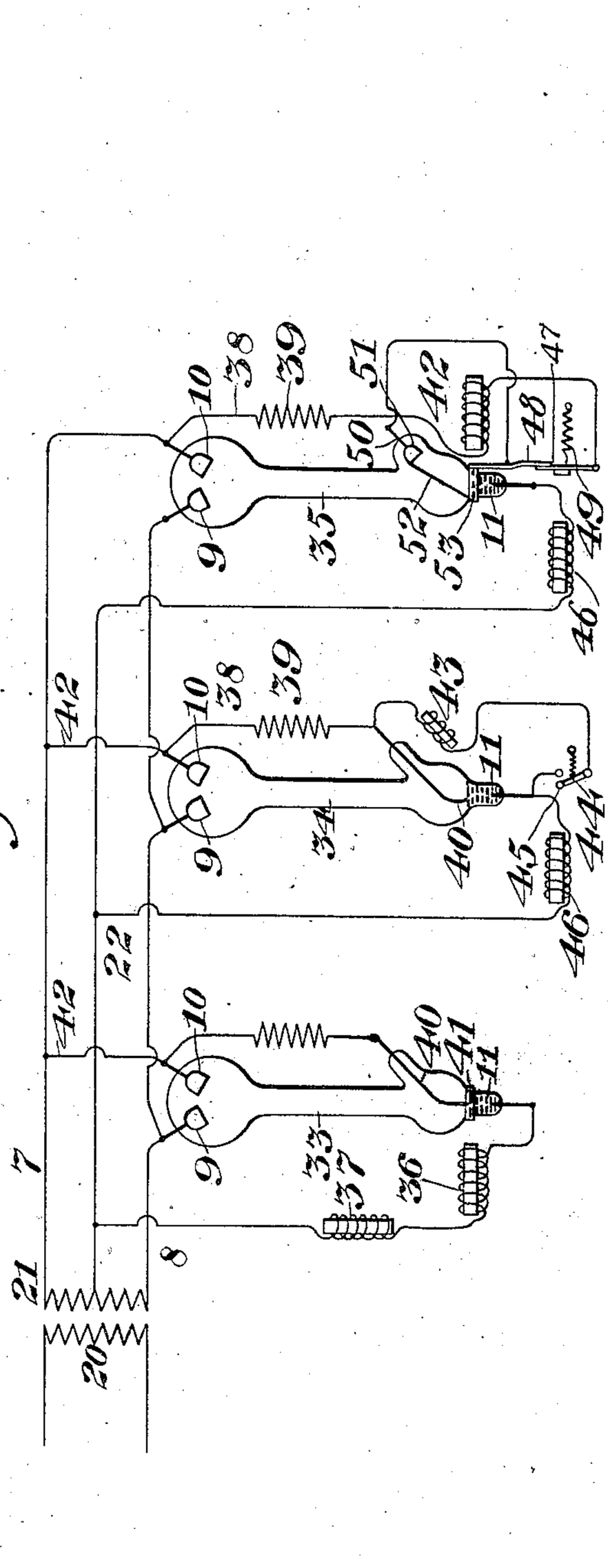


Fig. 2.



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2 SHEETS—SHEET 2.

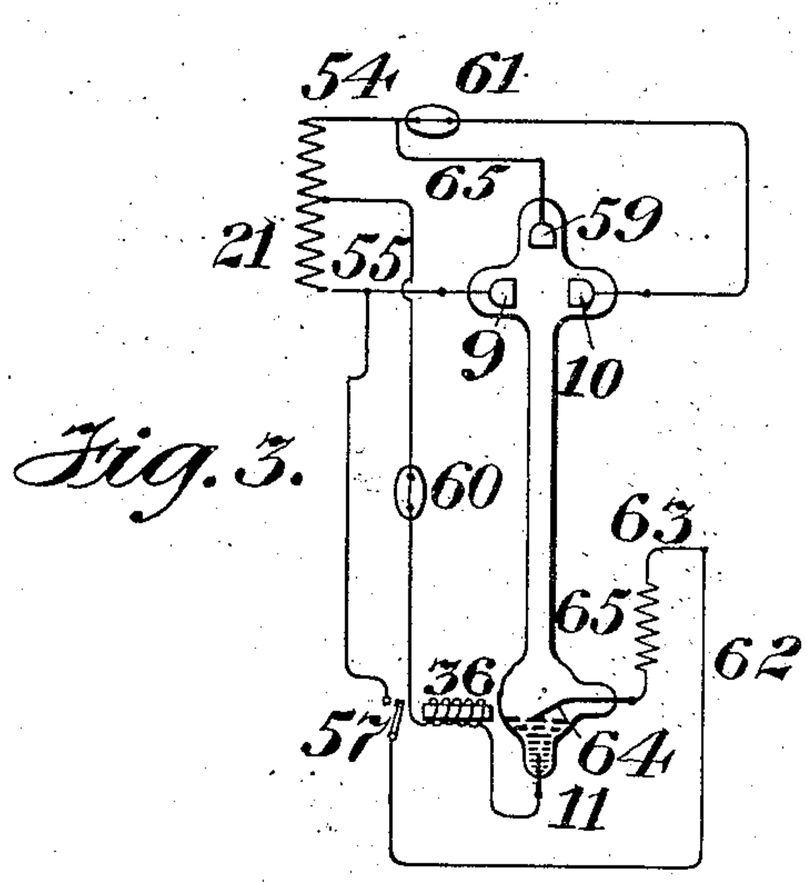

Fig. 3.

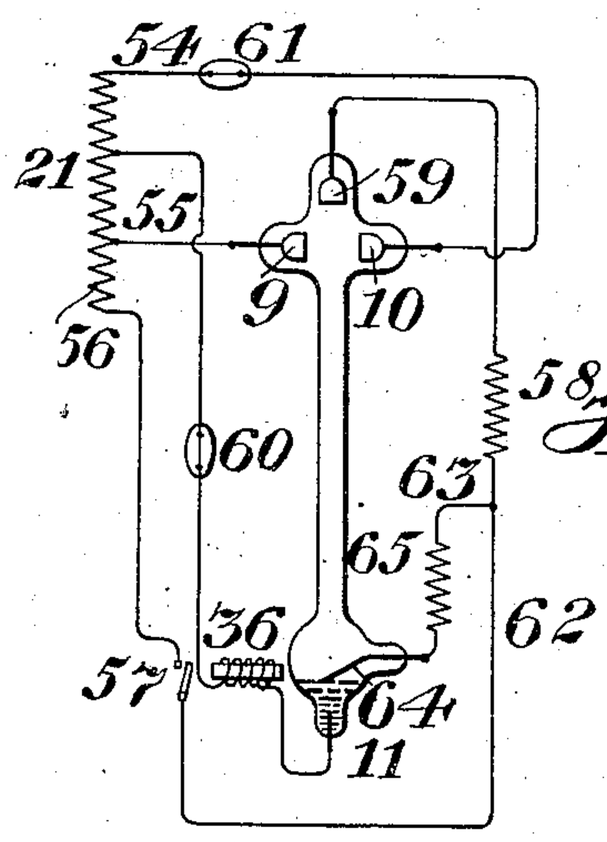

Fig. 4.

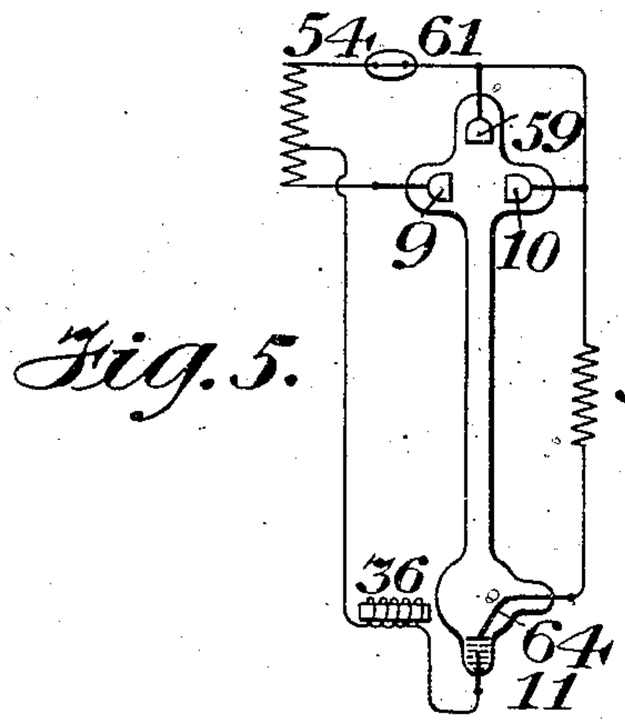

Fig. 5.

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SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR-LAMPS.

968,897. Specification of Letters Patent. **Patented Aug. 30, 1910.**

Original application filed May 5, 1906, Serial No. 315,276. Divided and this application filed August 20, 1907. Serial No. 389,364.

To all whom it may concern:

Be it known that I, PERCY HOLBROOK THOMAS, a citizen of the United States, and resident of Montclair, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Systems of Lighting and Distribution by Vapor-Lamps, of which the following is a specification.

Systems of electrical distribution whereby mercury vapor lamps or other vapor apparatus can be utilized in connection with the lighting of buildings or other work have already been disclosed, in which systems the lamps or other devices are situated in more or less close proximity to each other, so that the energy losses in distribution are comparatively small. It happens, however, that in other cases requiring the distribution of current by vapor electric devices, these devices may be widely separated, in such a manner that there would normally be very considerable energy losses in transmission, or inconveniences of control might be developed, if the transmission should be installed according to the usual methods of lighting streets or buildings. To avoid these difficulties I have invented a novel system of circuits adapted to be utilized with alternating or other kinds of current, as may be found suitable; and the system is applicable to vapor lamps and to other forms of vapor apparatus. In this system of circuits economy of distribution is obtained by the utilization of a comparatively high transmission voltage, and by dividing this voltage among a number of lamps or other vapor devices. I may, or may not, supply several such circuits from a common source.

The present invention contemplates the providing of starting means for the vapor apparatus and means for providing that disturbances in one of the said vapor devices shall not seriously influence the other devices. In connection with the starting apparatus, it is now well-known that automatic devices for this purpose may either actuate the container itself so as to cause a local rupture of the circuit or may operate magnetically an iron element of the apparatus for the same purpose. This is said without regard to any other means for starting, it being only understood that the types of starting apparatus are now sufficiently well known so that illustration of one such type is sufficient to constitute it an equivalent of other types now common in the art.

In the circuits illustrated, it is not intended that each individual lamp shall be operated only upon the circuit in connection with which it is shown; but it may be combined with other circuits shown or described, as may be found suitable or convenient.

In the accompanying drawings, forming part of this application, Figures 1 and 2 are diagrams of groups of lamps and circuits showing starting means adapted to be used in connection with these circuits. Figs. 3, 4 and 5 illustrate other starting circuits and devices.

In Fig. 1 I show, in connection with the mains 1 and 2, a primary, 20, of a transformer having a secondary, 21, connected to lamps or other vapor devices 3, 4, 5 and 6. In the case of the lamps 3 and 4 I show a tap, 22, leading from an intermediate point of the secondary 21 and connected through a ballast, 23, in the case of the lamp 3 and without such ballast in the case of the lamp 4 to the negative electrodes 11 of these lamps. In the circuit of the negative electrode in each instance is a choke coil or inductance 16. The lamps 3 and 4 are operated on a three-wire system of circuits, and the operation thereof is sufficiently clear, without further detailed comment. On the other hand, the lamps 5 and 6 may be operated from the same transformer by utilizing the full potential between the terminals of the secondary 21, without relying upon the tap or middle wire 22.

It will be understood that the systems represented by Figs. 1 and 2 may all be operated from the constant potential mains 1 and 2 or that any group of them may be so operated, or that all the systems operated from the said mains may be of the same character, the choice of systems being dependent upon convenience or upon the special conditions of any general system in which the special kinds of distribution herein set forth may be found most serviceable.

In Figs. 2, 3, 4 and 5 I illustrate starting circuits for the lamps or vapor devices shown in certain of the other figures of the drawings, said starting circuits being applicable to such lamps or devices whether in-

cluded in the circuits illustrated or subjected to other conditions of service. The lamps shown in Fig. 2 are marked 33, 34 and 35, and the system of circuits shown is not unlike that appearing in Fig. 1 of the drawings.

In connection with the lamp 33, which is illustrated in the position which it occupies before starting, I connect with the negative electrode 11 of the lamp a pair of coils, 36 and 37, which are included between the said negative electrode and the neutral wire, 22, leading to an intermediate point of the coil 21. These two coils 36 and 37 may be combined in one structure, if desired. In shunt to the lead of the electrode 10 I provide a conductor, 38, including a resistance, 39, leading to a supplemental positive electrode, 40, which may be of some solid magnetic material, as iron, dipping into the negative electrode, 11. When energy is applied to the system the inductance, 36, which acts as a starting coil, may lift the iron contact-piece 40 out of contact with the negative electrode 11 thereby breaking down the negative electrode resistance and causing a flow of current through the entire lamp, in a manner now common in the art. Of course, instead of moving a magnetic contact-piece away from the negative electrode, the starting coil may joggle the container itself in such manner as to interrupt the contact of an iron magnetic piece or other contact-piece with the negative electrode within the vacuum, this being a well-known equivalent for the separation of the contacts described above. In such a case the container might be itself surrounded near its lower end with a magnetic ring or collar, 41, which would be affected by the magnet for causing the separation described. In the first instance the current from the source passes through a circuit leading from the conductor 7 through a conductor, 42, to the conductor 38 and through the resistance 39 and the contact, 40, the electrode 11, the coils 36 and 37, back to the conductor, 22, and the neutral point or some intermediate point of the secondary 21. Thus there is at first a complete metallic circuit carrying sufficient potential for energizing the starting coil 36 and afterward the current passes through the vapor of the lamp 33 and maintains the vapor device in operation. The coil 36 may not only act as a starting coil but also as a sustaining coil. The starting circuit may be cut out as soon as the operation of starting shall have taken place, such a cut-out being illustrated in connection with the lamp 34 as will presently be described.

In connection with the lamp 34 I show a resistance, 39, in shunt between the positive electrode 10 and the negative electrode 11, while in the same shunt is shown a coil 43, acting as a starting coil for the apparatus. This coil 43 is shown in operative relation with a magnetic contact-piece 40 which is, in the non-operating position of the lamp, out of contact with the negative electrode 11. The resistance 39 and the coil 43 are included in the conductor 38 which leads to a cut-out, 44, whose terminals are in contact prior to the starting of the apparatus. One of the terminals, say 45, of the said cut-out is movable and is capable of being acted upon by an inductance, 46, in series with the vapor device 34. The action of starting is accomplished by transmitting energy through a circuit represented by the branch 7, the lead 42 extending to the positive electrode 10, the branch 38 including the resistance 39, the coil 43, the inductance 46, and the wire 22 leading to an intermediate point in the secondary 21. This constitutes a metallic path, which serves to complete a circuit of considerable potential between the branch 7 and the wire 22. When this circuit is traversed by current the coil 43 being energized brings the contact piece 40 into connection with the negative electrode 11 whereupon current passing through the inductance, 46, operates the movable element 45 of the cut-out 44 and opens the described shunt circuit. Thereupon the contact-piece 40 is released from connection with the electrode 11 and the negative electrode resistance at the said electrode is broken down and current passes through the lamp 34.

In connection with the lamp 35 in Fig. 2 I show a starting circuit in which a path for the current is first completed through the branch 7, the shunt 38, the resistance 39, an inductance 42 and a cut-out 47 having a movable element 48 and a second movable element 49, which second element, however, normally stands in a fixed position equivalent to that shown. The circuit beyond the coil 42 passes to the element 49 and from the element 48 it passes to the lead 50 running to a supplemental electrode 51 to which is connected a contact piece, 52, extending into proximity to or contact with the negative electrode 11. The said electrode 11 is joined through an inductance 46 to the conductor 22 leading to an intermediate point in the secondary 21. When energy is applied to the described circuit the starting coil 42 draws toward the right as shown in Fig. 2 the container 35, this being accomplished by means of a magnetic ring, band, or collar, 53, surrounding the lower end of the said container to which collar the element 48 may be joined. This separates the contacts 48 and 49 and interrupts the circuit of the magnet 43 after which the circuit is again closed between 48 and 49 by the release of the container. In this way an agitation of the container is brought about which alternately makes and breaks the circuit inside the vacuum chamber between the contact 52 and the negative electrode 11,

which process continues until current flows between the main electrodes 9 and 10 and the said negative electrode 11 whereupon the inductance 46 acts to withdraw the contact element 49 out of range of the element 48 and thereby permanently cut out the short-circuit originally described.

In Fig. 3 the starting anode 59 is connected to the point 54 of the supply 21 and the supplemental electrode 64 is connected through the resistance 65, the conductor 62 and the cut-out 57, to the point 55 of the supply 21. The cut-out 57 is operated by a sufficient flow of current through the coil 36. The cut out 57 is controlled by magnetism from the inductance coil 36 connected between the lead of the negative electrode 11 and the intermediate point of the transformer secondary 21. The main operating electrodes 9 and 10 are connected respectively to the points 55 and 54 in 21. The special ballast or resistance device 61 located in the lead of the electrode 10 serves to control the flow of current during normal operation.

The operation of the device is as follows: In the non-operating condition the supplementary anode 64 touches the surface of the cathode 11. The application of voltage to the transformer winding 21 then impresses voltage between the electrodes 9 and 10 and passes current through the point 55 the cut out 57 which remains closed until opened by the coil 36, the conductor 62, the resistance 65, the supplementary electrode 64; the cathode 11, the coil 36, the ballast device 60, which is similar to the device 61 and helps to control the flow of current to an intermediate point of the winding 21. The current thus passed through the coil 36 lifts the electrode 64 breaking down the negative electrode resistance of the cathode 11 and allows the favorably located electrode 59 to draw current through the light giving tube where it normally will run upon the electrodes 9 and 10. The resistances 65 and 58 serve to control the current in the electrodes 64 and 59. The coil 36 ultimately opens the cut out 57 and thus discontinues current in starting circuit.

Fig. 4 illustrates still another starting circuit in which the normal electromotive force is supplied from between the points 54 and 55 of a transformer secondary or other suitable source while an extra potential is supplied by a coil extending from the point 55 to a point 56. The terminal 56 is connected through a cut-out, 57, through a resistance, 58, to a supplemental or auxiliary positive electrode, 59. The negative electrode 11 is joined through an inductance 36 and a ballast, 60, to an intermediate point in the transformer secondary, while the terminal 54 is connected through a ballast, 61, to the electrode 10. The electrode 9 is connected to the point 55 in the secondary 21. From the circuit, 62, connecting the point 56 with the electrode 59, a branch, 63, is led off to a lead connected with a contact, 64, inside the container, said contact, 64, being normally in connection with the negative electrode 11 during the non-operating condition of the lamp. A resistance, 65, will usually be included in the branch 63. When the current is turned on, a complete metallic circuit is made from the point 56 over the circuits 62 and 63 through the resistance 65, the contact 64, the electrode 11, inductance 36, ballast 60, to an intermediate point in the secondary 21. By virtue of the arrangement shown an extra potential is conveyed by this circuit and the inductance 36 is energized sufficiently to operate both the contact 64 and also the cut-out 57 whereby the flow of current through the apparatus is initiated under the influence of the extra potential, which flows to the electrode 59 and through the vapor apparatus prior to the operation of the cut-out 57 long enough to accomplish the starting of the apparatus. Afterward, the lamp operates in a manner already set forth in detail in connection with other forms of circuits.

In Fig. 5 a modified form of starting circuit is shown wherein a supplemental electrode, 59, is used for starting up the lamp on unbalanced electromotive force. The sustaining coil 36 acts directly upon the magnetic starting contact 64 causing repeated makes and breaks between the said contact and the negative electrode 11 until the lamp starts into operation. A cut-out may be employed in connection with this circuit as already described in connection with other systems of starting. In connection with all these lamps or vapor devices ballasts may be used or dispensed with according to the needs or requirements. This is true of the ballasts shown at 60 and 61 in Figs. 3, 4 and 5 which either may, or may not, be present as desired. In Fig. 5, the accelerated current may be provided by connecting the circuit containing the sustaining coil 36 at a point other than the neutral point, as indicated in the said figure, whereby an unbalancing of the circuit is produced to compensate for the resistance of the ballast 61 and also for the purpose of securing the application of an accelerated electromotive force as already set forth.

This application is a division of my application Serial Number 315,276, filed May 5, 1906, in which parent application claims are made upon the apparatus described herein.

I claim as my invention:—

1. In a system of electrical distribution, a number of vapor devices, each having a common negative electrode and a plurality of positive electrodes, a temporary metallic

circuit through each of the said devices, a circuit in shunt to the said metallic circuit around each of the said devices, and means included in the shunt circuit for interrupting the metallic circuit through each device.

2. In a system of electrical distribution, a number of vapor electric devices, each having a common negative electrode and a plurality of positive electrodes, a supplemental positive electrode adapted to make contact with the common negative electrode, circuit connections to the said supplemental positive electrode, a shunt to the negative electrode around the said supplemental positive electrode, and means for operating the said supplemental electrode so as to break contact with the negative electrode and thereby initiate a local flow of current.

3. In a system of electrical distribution, a number of vapor electric devices, each having a common negative electrode and a plurality of positive electrodes, a supplemental positive electrode adapted to make contact with the common negative electrode, circuit connections to said supplemental positive electrode, a shunt to the negative electrode around the said supplemental positive electrode means for operating the said supplemental electrode so as to break contact with the negative electrode and thereby initiate a local flow of current, and means for interrupting the described shunt circuit.

4. In a system of electrical distribution, a number of vapor electric devices, each having a common negative electrode and a plurality of positive electrodes, a temporary metallic circuit through a portion of the device including the negative electrode, a shunt to the said metallic circuit, and means for interrupting the metallic circuit inside the device.

5. The combination with an alternating supply, a plurality of mercury vapor devices each comprising a hermetically sealed and completely exhausted container, a plurality of anodes and a common vaporizable cathode therein, and a starting electrode supplied with starting current from the source, of a common connection from one terminal of the supply to a part of the positive electrode and from another terminal of the supply to other positive electrodes and a common connection from the intermediate point of the supply to the several negative electrodes, together with electromagnetic means located between the negative electrode of any device and the line leading to the common intermediate point of the supply, whereby the initiation of normal current discontinues its starting circuit.

7. Starting means for mercury vapor apparatus including a hermetically sealed and completely exhausted container inclosing a plurality of anodes and a vaporizable reconstructing cathode, comprising a supplementary anode normally out of contact with the cathode, but adapted to contact therewith, a connection from the supplementary anode to a main anode, another connection from the supplementary anode to the cathode outside of the device, and means located in the last named connection for causing a contact between the negative electrode and the supplementary anode.

8. The combination with starting means for mercury vapor apparatus including a hermetically sealed and completely exhausted container inclosing a plurality of anodes and a vaporizable reconstructing cathode, comprising a supplementary anode normally out of contact with the cathode, but adapted to contact therewith, a connection from the supplementary anode to a main anode, another connection from the supplementary anode to the cathode outside of the device, and means located in the last named connection for causing a contact between the negative electrode and the supplementary anode, together with a cut-out and magnet coil for interrupting the last named circuit, said cut-out being responsive to the magnetic coil located in the lead of the cathode.

9. The combination with starting means for mercury vapor apparatus including a hermetically sealed and completely exhausted container inclosing a plurality of anodes and a vaporizable reconstructing cathode, comprising a supplementary anode normally out of contact with the cathode, movable relative to the container and adapted to contact with said cathode, a connection from the supplementary anode to a main anode, another connection from the supplementary anode to the cathode outside of the device, and means located in the last named connection for moving the supplementary anode to contact with the cathode, together with a cut-out and magnet coil for interrupting the last named circuit, said cut-out being responsive to the magnetic coil located in the lead of the cathode.

10. The combination with an alternating current source, a mercury vapor rectifying device including a hermetically sealed and

completely exhausted container and a plurality of anodes and a vaporizable reconstructing cathode therein, and connections from the anodes of the device to the terminals of the supply and a connection from the cathode to an intermediate point of the supply, of a supplemental electrode within the device adapted to make and break contact with the cathode together with electromagnetic means for controlling the starting electrode.

Signed at New York, in the county of New York, and State of New York, this 17th day of August A. D. 1907.

PERCY H. THOMAS.

Witnesses:

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THOS. H. BROWN.