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MEANS FOR STARTING SERIALLY OPERATED VAPOR CONVERTERS.

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946,053. Patented Jan. 11, 1910.

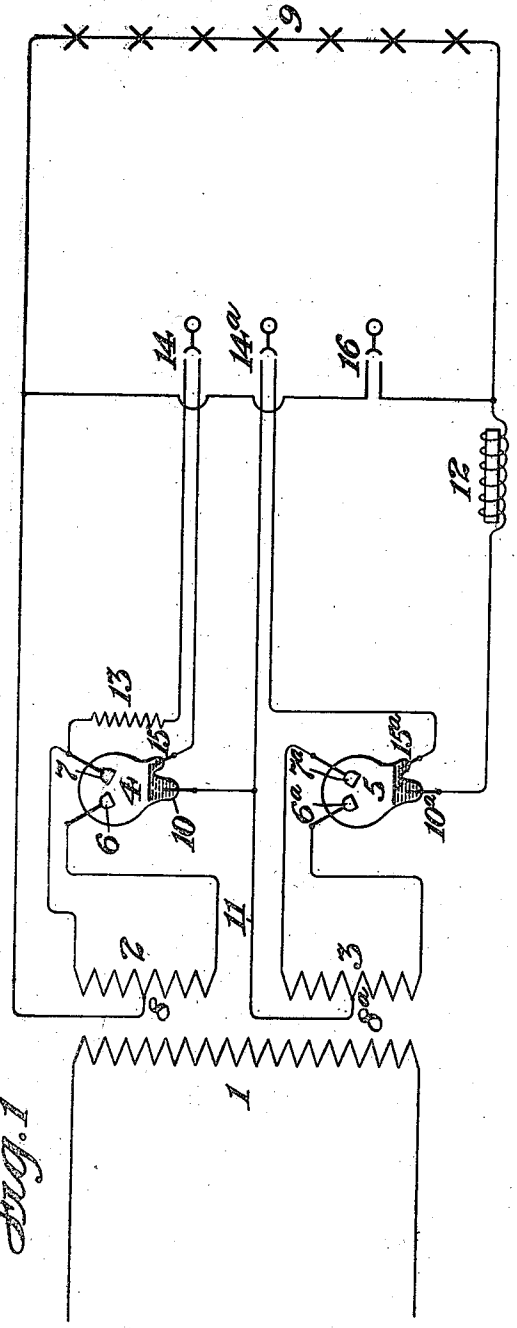


Fig. 1

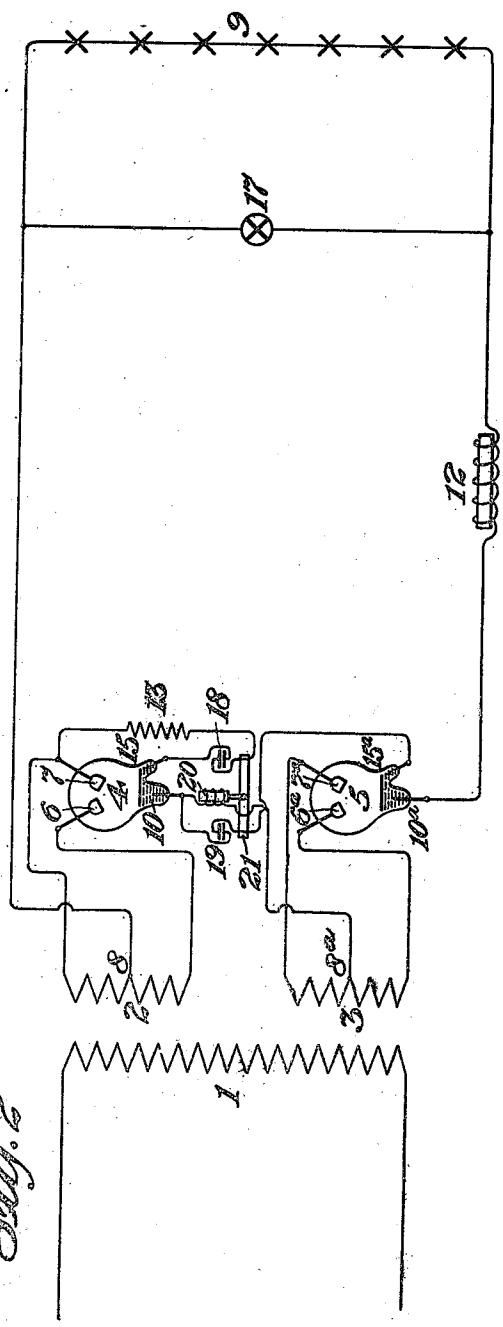


Fig. 2

WITNESSES

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## MEANS FOR STARTING SERIALLY-OPERATED VAPOR-CONVERTERS.

946,053. Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed March 8, 1907. Serial No. 361,267.

*To all whom it may concern:*

Be it known that I, FREDERICK H. VON KELLER, a citizen of the United States, and resident of New York, county of New York, State of New York, have invented certain new and useful Improvements in Means for Starting Serially-Operated Vapor-Converters, of which the following is a specification.

The present invention relates to means of starting a number of vapor converters operated in series. These converters are preferably of the type adapted to be started by the passage of current directly between electrodes within the container, the converters having a main negative electrode of vaporizable liquid material and a cooperating starting positive electrode, which is well adapted for this purpose. The starting operation may be performed by causing a connection between such electrodes and breaking this connection within the vacuum while it is carrying current. Current for this purpose may be obtained from the source of supply for the converter. This much of the starting operation is well known in the art but difficulty is met when two such converters are operated in series and each one is adapted by mechanical motion to produce a temporary connection between the negative and the starting electrodes; even when the two converters are agitated at the same time, only rarely, and as it were, accidentally, is the electrical connection opened in the two at the same instant. It will usually be necessary for the separation between the coöperating electrodes in both converters to occur during the same alternation. Starting by the usual method is thus seen to be difficult in the operation of a plurality of converters in series. The present invention overcomes this difficulty by providing means for causing the electrodes to lie normally in contact in the non-operating condition; and by providing electro-motive force for passing current through suitable temporary connections including all the bulbs in one circuit. By then starting a selected bulb by the necessary mechanical movement or by other suitable means, direct current is passed through the electrodes of the other bulbs. Subsequent motion of these bulbs, causing separation of their starting electrodes, will set them into operation, in view of the direct current flow already established in their respective negative electrodes. The temporary connections should then preferably be removed.

In the drawings I have illustrated a number of methods of using this invention but other arrangements may be used, as may be desired or found feasible without departing from the principle of this invention, providing that one of the converters is made to supply direct current through the other converters to cause them to start by the separation of electrodes.

Referring more particularly to the drawings, Figure 1, represents a direct current load circuit supplied by two vapor converters, connected in series, and started, one directly from this alternating current supply and the other from direct current produced by the first; in Fig. 2 I show a work circuit, operated by two vapor converters connected in series and started in the same general manner as Fig. 1, but having automatic means for disconnecting the temporary starting connections. This Fig. 2 illustrates the parts in the position which they occupy after the starting of the entire system into operation.

In the first figure, 1 is a source of electrical supply shown as the primary of a transformer having two secondaries, 2 and 3, supplying two vapor converters, 4 and 5. The positive electrodes 6 and 7 of the converter, 4, are connected to the terminals of the secondary, 2, whose middle point, 8, is connected with the direct current work circuit, 9, which may, for example, consist of a series of direct current arc lamps. The positive electrodes, $6^a$, and $7^a$, of the converter, 5, are connected to the terminals of the secondary 3, whose middle point $8^a$, is connected to the negative electrode 10 of the converter 4, through the conductor, 11. An inductance, 12, is connected to one terminal of the work circuit, 9, and to the negative electrode, $10^a$ of the converter, 5; the positive electrode, 7, is connected through a resistance, 13, and a plug cut-out, 14, to a starting electrode, 15, of the converter, 4. The conductor, 11, is connected through a plug switch, $14^a$, to the starting electrode, $15^a$, of the converter, 5. The plug switch, 16, closes or opens a short circuit connection across the load 9.

The operation is as follows: In the non-operating position, the electrodes, 10 and 15, are in contact and the plug switch, 14, is

closed; the electrodes, $10^a$ and $15^a$, are likewise in contact and the plug switch, $14^a$, is closed; the plug switch, 16, may also be closed or may be open in case a complete circuit exists through the load 9. Upon the application of voltage to the system, the voltage of that portion of the secondary, 2, lying between its middle point, 8, and the positive electrode, 7, causes a flow of current through the circuit which includes 13, 14, 15, 10, $14^a$, $15^a$, $10^a$, 12, 16 or 9 as the case may be, 8, and half of the secondary, 2, back to the resistance 13; this current is evidently alternating, since 1, is a source of alternating electrical supply. If now, by motion of the container of the converter, 4, or otherwise, a separation occurs between the electrodes 10 and 15, in a favorable point of time, the converter, 4, will start into operation, transforming the alternating current from the secondary, 2, into direct current, which passes from the electrode, 10, through $14^a$, $15^a$, $10^a$, 12, 16 or 9, as the case may be, back to 8. The plug switch, 14, may now be opened. By causing a separation between the electrodes $10^a$ and $15^a$, in the converter 5, a flow of direct current will be established between these electrodes through the vapor path in such a direction as to constitute $10^a$, a negative electrode when the converter, 5, will instantly start into operation; the plug switch, $14^a$, may now be opened for the converters, 4 and 5, are operating in series in the normal manner. If necessary, the plug switch, 16, may be opened to start the operation of the load, 9. As is well known, in systems of this character, the inductance, 12, serves to steady the current and to continue the flow of current over the zero point of the supply and this prevents the reëstablishment of the non-operating condition in the converters 4 and 5. During one alternation of the supply the upper half of the secondaries, 2 and 3, are supplying current in series through the inductance 12 and the load 9 and during the next alternation the lower halves of the secondaries, 2 and 3, supply current through the same circuit.

In Fig. 2, 1, is the primary of an alternating current transformer whose secondaries are 2, and 3, operating respectively the vapor rectifiers, 4, and 5. 6 and 7 and $6^a$ and $7^a$, respectively are the positive electrodes of the rectifiers and are connected to the terminals of the transformer secondaries 2 and 3. The middle point, 8, of the transformer secondary 2 is connected to one side of the direct current work circuit, 9, and the middle point $8^a$, of the transformer secondary 3 is connected through the cut-out operating coil, 20, with the negative electrode 10, of the rectifier 4. The negative electrode $10^a$, of the rectifier 5 is connected through the inductance 12 with the other side of the work circuit 9. The cut-out 17, is connected across the work circuit 9. A resistance, 13, connects the lead of the positive electrode 7 through a cut-out 18, in operative relation to the coil 20 with the starting electrode 15, of the bulb 4. The starting electrode, $15^a$ of the bulb 5 is connected through the cut-out, 19, which together with the cut-out 18 is operated from the coil 20 through the bar, 21, with the negative electrode 10. In their normal non-operating position the electrodes 10 and 15, and $10^a$ and $15^a$ are in contact, but are adapted to be separated by a suitable movement of the containers. The operation of the system illustrated in this figure is similar to that of Fig. 1, except for the method of opening the circuits to the starting electrodes 15 and $15^a$. Upon the initiation of current flow through the rectifier 4 which is the first to be started, the direct current will pass through the electrode 10, the cut-out 19, the electrodes $15^a$ and $10^a$ returning to its starting point as in Fig. 1. This current will produce no effect upon the coil 20. When, however, the separation of the electrodes $10^a$ and $15^a$ causes current to flow from the secondary 3 through the positive electrodes $6^a$ and $7^a$ to the negative electrode $10^a$ of the rectifier 5 in the normal manner, the coil 20 which carries this current will become energized and open the cut-outs 18 and 19 thus discontinuing the starting circuits. If the plug 17 which corresponds to the plug 16 of Fig. 1 has been closed during this starting, it may now be opened to put the work circuit 9 in operation.

It is, of course, not necessary that only two rectifiers should be utilized in the systems shown in Fig. 1 and Fig. 2, as the same method may be extended to any number of rectifiers operated in series, the first starting upon alternating current and supplying direct current for the subsequent individual starting of the others.

This system is particularly well adapted to those circuits in which direct current series arc lamps are operated from a constant current alternating supply. Such a supply may be obtained from constant potential alternating current mains by any of the well known methods as, for example, by a variable inductance or by a movable coil transformer as is well known in the art.

The resistance, 13, is shown merely as an illustration of one form of impedance, which may be used in the system herein disclosed, the function of such impedance being to control the initial or starting alternating current.

It is not necessary that this invention be utilized exactly as shown in these drawings, but modifications may be employed as may be found desirable without departing from the invention.

I claim as my invention:

1. The combination with an alternating current source, of a plurality of gas or vapor electric devices, each having main positive electrodes, a negative electrode, and a starting electrode coöperating with said negative electrode, such devices being adapted to be started by the separation of the starting electrode and the main negative electrode while current is flowing, temporary circuit connections permitting the passage of alternating current through the main negative electrode and the starting electrode of all the vapor devices in series, and means whereby the starting of current flow in one device causes direct current to flow between the starting electrode and the main positive electrode of the next succeeding device.

2. The combination with an alternating current source, of a plurality of gas or vapor electric devices, each having main positive electrodes, a negative electrode, and a starting electrode coöperating with said negative electrode, such devices being adapted to be started by the separation of the starting electrode and the main negative electrode while current is flowing, temporary circuit connections permitting the passage of alternating current through the main negative electrode and the starting electrode of all the vapor devices in series, and means whereby the starting of current flow in one device causes direct current to flow between the starting electrode and the main negative electrode of the next succeeding device, in such a direction that on the separation of the main electrode and the starting electrode of the said next succeeding device the said main electrode thereof shall be started as a negative electrode.

3. The combination with an alternating current source, of a plurality of gas or vapor electric devices, each having main positive electrodes, a negative electrode, and a starting electrode coöperative with said negative electrode, such devices being adapted to be started by the separation of the starting electrode and the main negative electrode while current is flowing, temporary circuit connections permitting the passage of alternating current through the main negative electrode and the starting electrode of all the vapor devices in series, and means whereby the starting of current flow in one device causes direct current to flow between the starting electrode and the main negative electrode of the next succeeding device, in such a direction that on the separation of the main electrode and the starting electrode of the said next succeeding device the said main electrode thereof shall be started as a negative electrode, and means for opening the temporary starting connections.

4. The combination with an alternating current source, of a plurality of gas or vapor electric devices, each having main positive electrodes, a negative electrode, and a starting electrode coöperating with said negative electrode, such devices being adapted to be started by the separation of the starting electrode and the main negative electrode while current is flowing, temporary circuit connections permitting the passage of alternating current through the main negative electrode and the starting electrode of all the vapor devices in series, and means whereby the starting of current flow in one device causes direct current to flow between the starting electrode and the main negative electrode of the next succeeding device, in such a direction that on the separation of the main electrode and the starting electrode of the said next succeeding device the said main electrode thereof shall be started as a negative electrode, and automatic means for opening the temporary starting connections.

5. The combination with an alternating current source, of a gas or vapor rectifier, a second gas or vapor rectifier, having a main negative electrode and a temporary coöperating starting electrode therein, connections for passing alternating current through the said main negative electrode and the coöperating starting electrode in the second rectifier, and means brought into operation by the starting of the first named rectifier for causing direct current to pass through the said main negative electrode and the temporary starting electrode of the second rectifier.

6. The combination with an alternating current source, of a plurality of gas or vapor electric devices, each having main positive electrodes, a negative electrode, and a starting electrode coöperating with said negative electrode, such devices being adapted to be started by the separation of the starting electrode and the main negative electrode while current is flowing, temporary circuit connections permitting the passage of alternating current through the main negative electrode and the starting electrode of all the vapor devices in series, and means whereby the starting of current flow in one device causes direct current to flow between the starting electrode and the main negative electrode of the next succeeding device, in such a direction that on the separation of the main electrode the starting electrode of the said next succeeding device the said main electrode thereof shall be started as a negative electrode, and automatic means for opening the temporary starting connections, and means for discontinuing the last named connections.

7. The combination with a source of alternating current of two gas or vapor electric devices, each having a plurality of positive electrodes and the negative electrode of vaporizable material and a temporary start-

ing electrode coöperating with the said negative electrode, the said negative electrodes and their corresponding starting electrodes being in contact with each other in the non-operating condition of the devices, means for passing current from an alternating current source through these pairs of coöperating electrodes and means whereby, upon successive separation of the coöperating pairs of electrodes, the two devices will be connected in series and operate to transmit direct current.

8. The combination with an alternating current source, of two gas or vapor electric devices, each having a plurality of positive electrodes, a negative electrode of vaporizable material and a temporary starting positive electrode coöperating with said negative electrode, the said negative electrodes and starting electrodes being connected in pairs in series during the non-operating condition of the devices, connections for passing alternating current through the said pairs of coöperating electrodes in series and an impedance introduced in such connections.

9. The combination with an alternating current source, of two gas or vapor electric devices, each having a plurality of positive electrodes, a negative electrode of vaporizable material and a temporary starting positive electrode coöperating with said negative electrode, the said negative electrodes and starting electrodes being connected in pairs in series during the non-operating condition of the devices, connections for passing alternating current through the said pairs of coöperating electrodes in series and an impedance introduced in such connections, such impedance being introduced in the connection between one of the positive electrodes of the first vapor electric device and the main negative electrode of the said device.

10. In a system of electrical distribution in which a plurality of vapor electric devices in series are utilized to supply direct current from an alternating current source to a load circuit, the method of starting which consists in utilizing the supplied electromotive force to start one of said devices into operation and utilizing the direct current thus produced for starting another of said devices.

Signed at New York, in the county of New York, and State of New York, this 6th day of March A. D. 1907.

FREDERICK H. VON KELLER.

Witnesses:

WM. H. CAPEL,

THOS. H. BROWN.