

Sept. 20, 1932.

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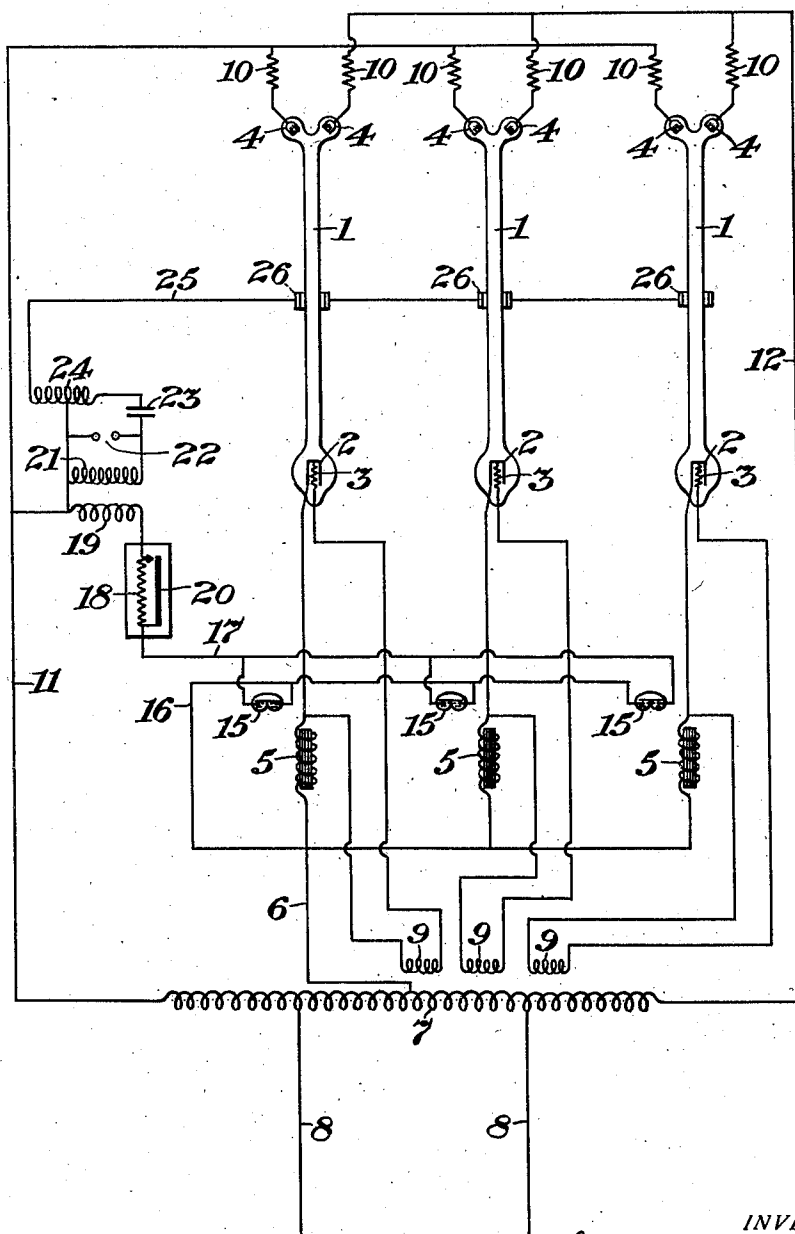
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SYSTEM FOR STARTING AND OPERATING GASEOUS ELECTRIC DISCHARGE DEVICES

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3 Sheets-Sheet 1

Fig. 1



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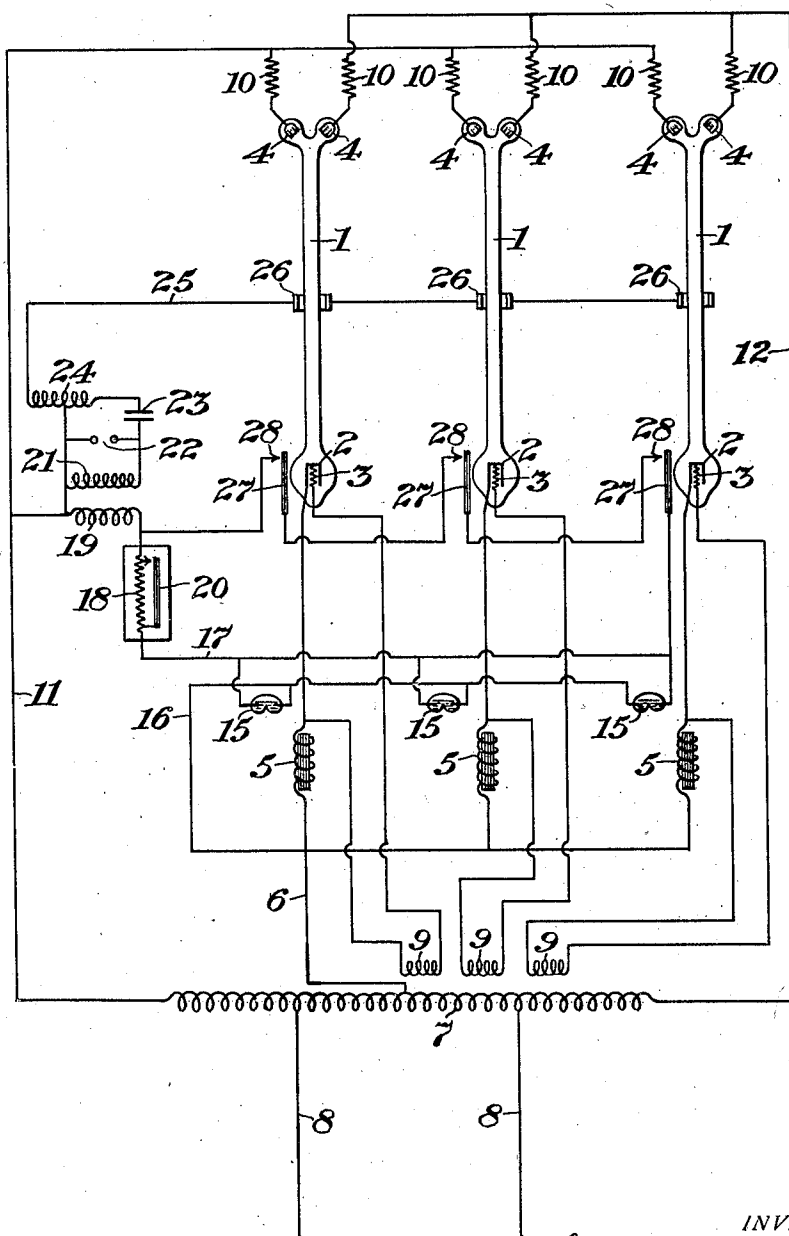
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SYSTEM FOR STARTING AND OPERATING GASEOUS ELECTRIC DISCHARGE DEVICES

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3 Sheets-Sheet 2

Fig. 2



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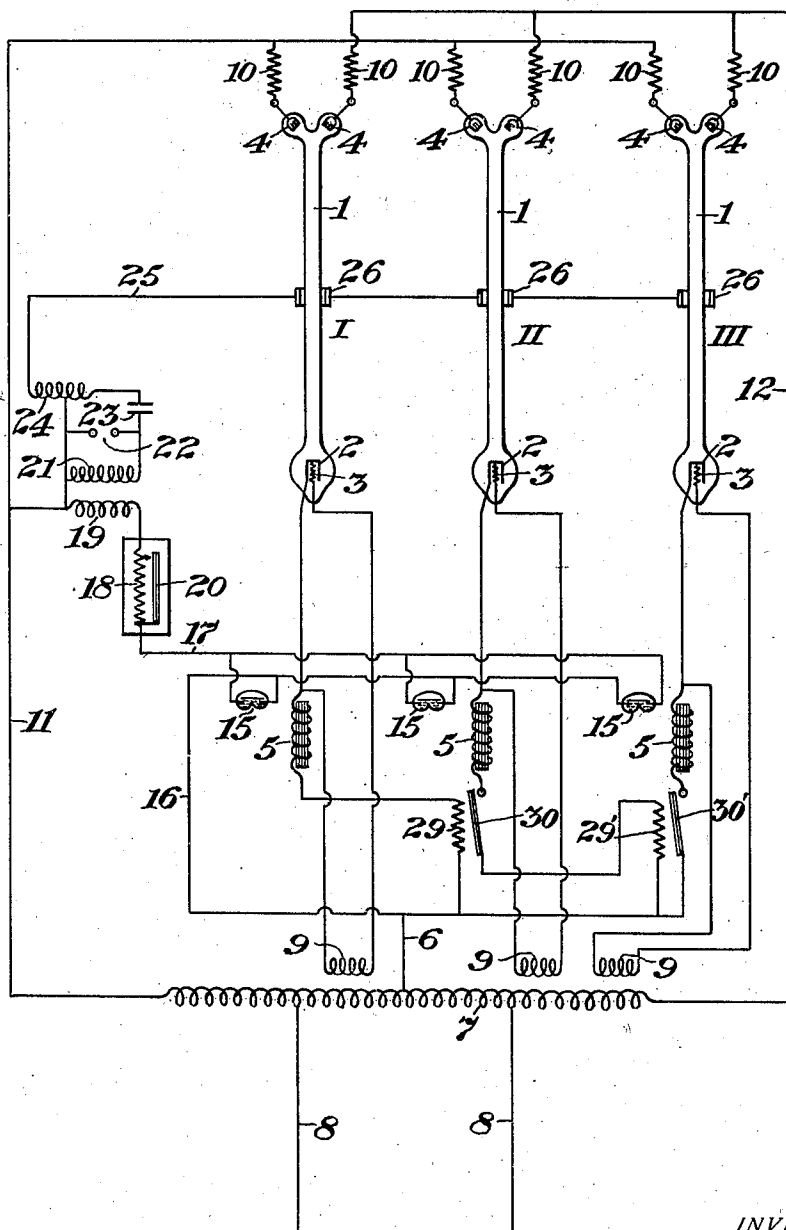
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SYSTEM FOR STARTING AND OPERATING GASEOUS ELECTRIC DISCHARGE DEVICES

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3 Sheets-Sheet 3

Fig. 3

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SYSTEM FOR STARTING AND OPERATING GASEOUS ELECTRIC DISCHARGE DEVICES

Application filed September 13, 1929. Serial No. 392,354.

The present invention relates to gaseous discharge devices, and particularly to a method and means for initiating and maintaining a discharge therein.

5 A particular object of the invention is to provide an improved method of starting a number of discharge devices, either simultaneously or in sequence. A further object of the invention is to provide a simple discharge
10 starting apparatus which will automatically start a discharge according to my new method and which will function only while the devices require it. Other objects and advantages of the invention will appear from the following detailed specification, or from an
15 inspection of the accompanying drawings.

The invention consists in a new and novel method, and in a new and novel combination of parts, as hereinafter set forth and claimed.
20 I have discovered that by a suitable combination of auxiliary apparatus, the starting of a lamp may be made automatic, this combination further providing means for starting simultaneously or in sequence a number
25 of discharge devices, each of which cooperates in a suitable manner with the starting apparatus to govern the operation thereof. The apparatus of my invention therefore makes possible the starting of commercial
30 installations with improved results.

For purposes of illustration I have shown several embodiments of my invention in the accompanying drawings, in which

35 Fig. 1 is a schematic diagram of a preferred form of my invention, designed for simultaneous starting of a plurality of gaseous discharge devices of the hot cathode type, three being shown by way of example,

40 Fig. 2 is a schematic diagram of a modification of the circuit of Fig. 1, and

Fig. 3 is a schematic diagram showing a modification of the circuit of Fig. 1, designed for sequential starting of a plurality of gaseous discharge devices.

45 In the drawings, with special reference to Fig. 1, each of the gaseous discharge devices 1, which may, for instance, contain neon or any other suitable gaseous atmosphere, has sealed therein a cathode 2 which is adapted
50 to be heated by a filamentary heater 3, and

a pair of separated anodes 4. Each of the cathodes 2 is connected through an inductance 5 and a common lead 6 to a midpoint of the auto-transformer 7, said transformer being energized from a suitable source of
55 alternating current through the leads 8. Each of the filamentary heaters 3 has one end thereof attached to its associated cathode 2, while the other end of each heater is connected to one terminal of the respective low
60 voltage secondaries 9. The other terminal of each secondary 9 is connected to the respective cathode 2, so as to complete each of the independent heating circuits. One anode 4 of each discharge device 1 is connected
65 through its respective ballast resistance 10 to a common lead 11 which connects with one end of the auto-transformer 7, while the other anode 4 of each discharge device 1 is connected through a similar resistance 10 to
70 a common lead 12 which connects with the other end of said auto-transformer 7. These circuits comprise the normal operating circuits of the discharge devices.

For control of the starting apparatus a
75 mercury switch 15 is associated with each of the inductances 5, each switch 15 being normally closed, but being moved to open circuit position magnetically when the core of the associated inductance 5 is magnetized by
80 the passage of a discharge current there-through. One terminal of each switch 15 is connected to a common lead 16 which in turn connects with the lead 6. The other
85 terminal of each switch 15 is connected through a common lead 17, resistance 18, and the primary 19 of a high frequency oscillator to the lead 11. A bimetallic element 20 which is in close proximity to the resistance 18 is adapted to short circuit said resistance,
90 after the elapse of a predetermined time, under the influence of heat generated in the resistance 18 by a current passing there-through. A secondary coil 21, in inductive relation to the primary 19, and having one
95 terminal connected to an end of said primary, has connected across the terminals thereof a spark gap 22 and in parallel with said spark gap a condenser 23 and a few turns of the coil 24. The free end of the coil 10

24 is connected through the lead 25 to metallic discharge electrodes 26 mounted adjacent to each of the discharge devices, preferably toward the middle of the arc path therein, and in such position as not to materially interfere with the useful light emission from said devices.

In the modification of this circuit shown in Fig. 2, a thermally responsive device, such as a bimetallic element 27 and a contact 28 is positioned adjacent to the cathode 2 of each discharge device, these bimetallic elements intercepting sufficient radiant heat therefrom when the cathode 2 is at operating temperature to be deformed into circuit making position with the associated contact 28. These contact making devices are connected in series between the lead 17 and a point between the resistance 18 and coil 19, so as to short circuit said resistance 18 when all of the cathodes 2 are at operating temperature.

With reference to Fig. 3, the circuit is identical with that of Fig. 1 except for the connections between the inductances 5 and the common lead 6. The inductance 5 of device I, which is designed to be the first to operate, is connected to the common lead 6 through a heating resistance 29. A bimetallic element 30 which is in thermal relation to said resistance 29 is adapted to close a similar circuit from the inductance of device II through a heating resistance 29' to the common lead 6 after current has passed there-through for a predetermined time. Similarly a bimetallic element 30', which is actuated by heat from the resistance 29', is adapted to close a circuit from the inductance of device III directly to the common lead 6, unless it is desired to operate more than three devices, after current has passed through said resistance 29' for a predetermined time interval.

In the operation of the apparatus of Fig. 1, upon application of an alternating potential to the leads 8 current immediately flows through each of the circuits formed by a secondary 9, filamentary heater 3, cathode 2, and the associated leads, the cathodes 2 being heated thereby. At the same time current flows from auto-transformer 7 through lead 6, lead 16, each of the switches 15 in parallel, lead 17, resistance 18 and primary coil 19 to lead 11, thence returning to the auto-transformer 7. The resistance 18 so reduces the potential drop across the oscillator primary 19 that the induced potential in the secondary 21 is insufficient to cause a discharge across the spark gap 22, so that as long as the resistance 18 is in circuit no high frequency current is generated. At the same time the heat generated in the resistance 18 starts to deform the bimetallic element 20. After a predetermined time interval, which is made to correspond with the time required

to heat the cathode 2 to a proper electron emitting condition, the bimetallic element 20 is deformed sufficiently by the heat transmitted from the resistance 18 to short circuit said resistance. As the full operating potential is thus impressed on the oscillator 19 a spark discharge is started across the gap 22, which allows the condenser 23 to discharge through the spark, thus developing a high frequency oscillating condition in the spark gap 22, condenser 23 and coil 24. These high frequency oscillations are conducted to the electrodes 26 by the lead 25. A high frequency discharge to the envelopes of the discharge devices 1 thereupon occurs which results in the initiation of a discharge in each of said devices. As the discharge starts in each device 1 its associated inductance 5 becomes energized and actuates the associated switch 15 to an open circuit position. As the last switch 15 thus opens the oscillator primary 19 is deenergized. In case of a delay in the starting of any of the devices 1 the element 20 may cool sufficiently to reinsert the resistance 18, but this automatically reheats the element 20, until it again short circuits the resistance 18, so that the high frequency will be recurrently applied to the devices 1 until a discharge has been started in all of them. In case the discharge is interrupted at any time in any of the devices 1 its associated switch 15 will immediately close, energizing the starting apparatus after the predetermined interval required to heat the element 20 in the same manner as described above in detail in connection with the starting of the discharge in all of the devices 1, until a discharge is again started in that device, whereupon the switch 15 is reopened and the oscillator deenergized.

In the modification of this circuit shown in Fig. 2 the addition of the bimetallic elements 27 and contacts 28 eliminates the delay in the initiation of a discharge under certain circumstances pointed out below. In this circuit the resistance 18 is short circuited by the making of contact of either the bimetallic element 20, or of all the bimetallic elements 27, both of which should occur at substantially the same time. The high frequency oscillator is thus energized, and continuously remains so until a discharge is initiated in all of the devices 1, since the short circuit of the resistance 18 is maintained by the circuit through the elements 27 and contacts 28, rendering ineffective the opening of the circuit by element 20 as it cools. After all the discharge devices are in operation the oscillator is deenergized, as before, by the opening of the last switch 15 as the discharge is initiated in the device 1 associated therewith. An important difference in operation occurs, however, when a discharge fails for any reason in any of the devices 1 while the cathode 2 thereof is at operating tempera-

ture. Since all of the elements 27 are then in contact making position, the resistance 18 will still be short circuited and the high frequency oscillator will be instantaneously energized by the closing of the switch 15 associated with the device 1 in which the discharge has failed, thus eliminating the delay which is unavoidable where only the bimetallic element 20 is used. After the interrupted discharge is again initiated the switch 15 will reopen as before to deenergize the high frequency oscillator. In case of failure of any of the cathode heaters 2 the circuit through the elements 27 and contacts will, of course, be rendered inoperative, but the remainder of the discharge devices will continue to operate in the manner previously described for the circuit of Fig. 1, in which this additional control circuit was not used.

With the modification shown in Fig. 3 the starting of device I is the same as that previously described in connection with the apparatus of Fig. 1. Device II and device III are initially rendered inoperative, however, by the open circuits existing at the thermal elements 30 and 30', respectively. When the discharge is started in device I, however, the thermal element 30 is heated by the passage of current through the resistance 29 until it closes the circuit from the cathode of device II, whereupon a discharge will be started in said device by the high frequency electrode 26, since this electrode is intermittently energized by the recurrently closing thermal element 20. The passage of the discharge current through device II then heats the thermal element 30' by means of the resistance 29', closing the energizing circuit of device III, a discharge thereupon being started in said device in the same manner as in device II.

While I have described the method and apparatus of my invention in connection with a specific gaseous discharge device, and in connection with single phase alternating currents, it will be understood that either is equally useful with other types of discharge devices which require auxiliary starting means, and that by obvious modifications either the method or the apparatus may also be employed on direct current and polyphase alternating current devices. It is furthermore to be understood that if desired the steps of the method may be performed manually and that various other substitutions and changes may be made either in the method or in the apparatus illustrated and described, without departing from the spirit of my invention.

I claim:

1. In combination, a gaseous discharge device, a discharge maintaining circuit therefor, means to produce a high frequency discharge in proximity to said device to initiate a discharge therein, and means to energize

said last named means at a predetermined time interval after said discharge maintaining circuit is connected to a source of energy.

2. In combination, a gaseous discharge device, a discharge maintaining circuit therefor, means to produce a high frequency discharge in proximity to said device to initiate a discharge therein, and means responsive to energy flow through said device to deenergize said discharge producing means.

3. In combination, a gaseous discharge device, a discharge maintaining circuit therefor, means to produce a high frequency discharge in proximity to said device to initiate a discharge therein, and means to energize said last named means at a predetermined time interval after said discharge maintaining circuit is connected to a source of energy and to deenergize the same when a discharge is initiated in said discharge device.

4. In combination, a gaseous discharge device having a cathode adapted to emit electrons when heated, a discharge maintaining circuit therefor, means to heat said cathode, means to produce a high frequency discharge in proximity to said device to initiate a discharge therein, and means to render said last named means operative after said cathode reaches operating temperature.

5. In combination, a gaseous discharge device having a cathode adapted to emit electrons when heated, a discharge maintaining circuit therefor, means to heat said cathode, means to produce a high frequency discharge in proximity to said device to initiate a discharge therein, means to deenergize said discharge producing means when said cathode is not at operating temperature, and means to deenergize said discharge producing means when a discharge is maintained in said gaseous discharge device.

6. In combination, a plurality of gaseous discharge devices, a discharge maintaining circuit therefor, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein and means to energize said last named means at a predetermined time interval after said discharge maintaining circuit is connected to a source of energy.

7. In combination, a plurality of gaseous discharge devices, discharge maintaining circuits therefor, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein, and means responsive to energy flow through said devices to deenergize said discharge producing means when a discharge is maintained in all said gaseous discharge devices.

8. In combination, a plurality of gaseous discharge devices, a discharge maintaining circuit therefor, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein, and means to energize said last named means

at a predetermined time interval after said discharge maintaining circuit is connected to a source of energy, and to deenergize the same when a discharge is maintained in all of said devices.

9. In combination, a plurality of gaseous discharge devices having cathodes adapted to emit electrons when heated, a discharge maintaining circuit therefor, means to heat said cathodes, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein, and means to render said last named means operative after said cathodes reach operating temperature.

10. In combination, a plurality of gaseous discharge devices having cathodes adapted to emit electrons when heated, a discharge maintaining circuit therefor, means to heat said cathodes, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein, means to energize said discharge producing means when a discharge is not maintained in any of said discharge devices, and means to render said discharge producing means inoperative for a predetermined time to allow said cathodes to attain operating temperature.

11. In combination, a plurality of gaseous discharge devices having cathodes adapted to emit electrons when heated, discharge maintaining circuits therefor, means to heat said cathodes, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein, means to energize said last named means whenever a discharge is not maintained in all said discharge devices, means to render said discharge producing means inoperative for the interval required to heat said cathodes to operating temperature after actuation of said energizing means, and means responsive to the thermal condition of said cathodes to render said last named means ineffective if said cathodes are at operating temperature.

12. In combination, a plurality of gaseous discharge devices having cathodes adapted to emit electrons when heated, discharge maintaining circuits therefor, means to heat said cathodes, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein and means to prevent the initiation of a discharge in said devices after said cathode heating means is energized during a time interval which is predetermined for each device.

13. In combination, a plurality of gaseous discharge devices, discharge maintaining circuits therefor, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein, and means to delay the initiation of the discharge in one of said devices until a prede-

termined time interval after the initiation of a discharge in another of said devices.

14. In combination, a plurality of gaseous discharge devices, discharge maintaining circuits therefor, means to produce a high frequency discharge in proximity to each of said devices to initiate a discharge therein, means to render said last named means inoperative until a predetermined time interval after said discharge maintaining circuits are connected to a source of energy, and means to delay the initiation of a discharge in one of said devices until a predetermined time interval after the initiation of a discharge in another of said devices.

15. In combination, a plurality of gaseous discharge devices, discharge maintaining circuits therefor, and means to initiate a discharge in said devices comprising a single generator of high frequency current, an electrical conductor therefrom terminating at a point adjacent to each discharge device, means to energize said generator when said devices are in a condition to support a normal discharge current, and means to deenergize said generator after a discharge has been initiated in each of said devices.

Signed at Hoboken in the county of Hudson and State of New Jersey this 12th day of September A. D. 1929.

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