Oct. 10, 1933. H. EWEST ET AL 1,930,123

ELECTRIC DISCHARGE APPARATUS

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Fig. 1

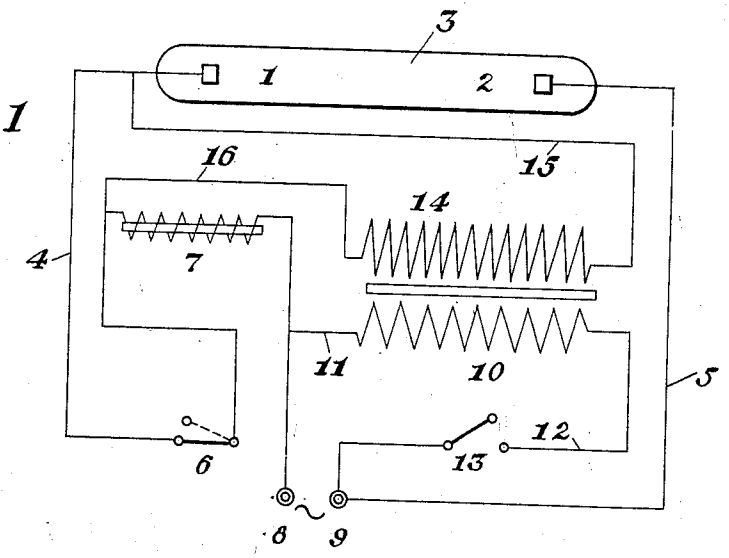


Fig. 2

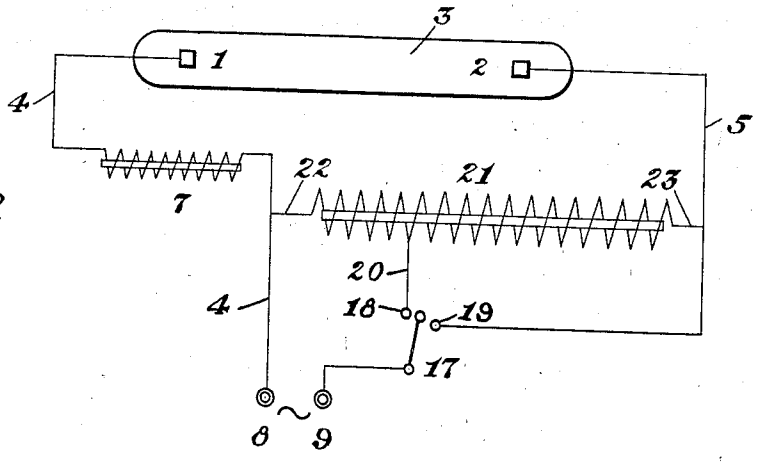
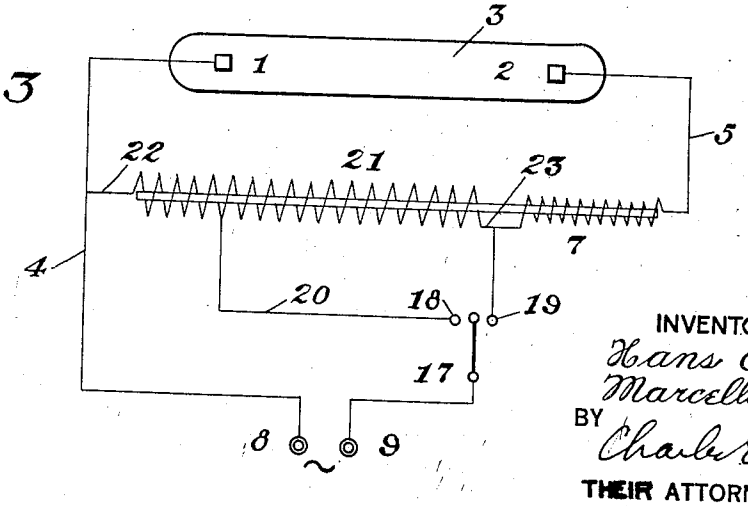


Fig. 3



INVENTORS
Hans Ewest
Marcello Pirani
BY
Charles V. Mullen
THEIR ATTORNEY

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Fig. 4

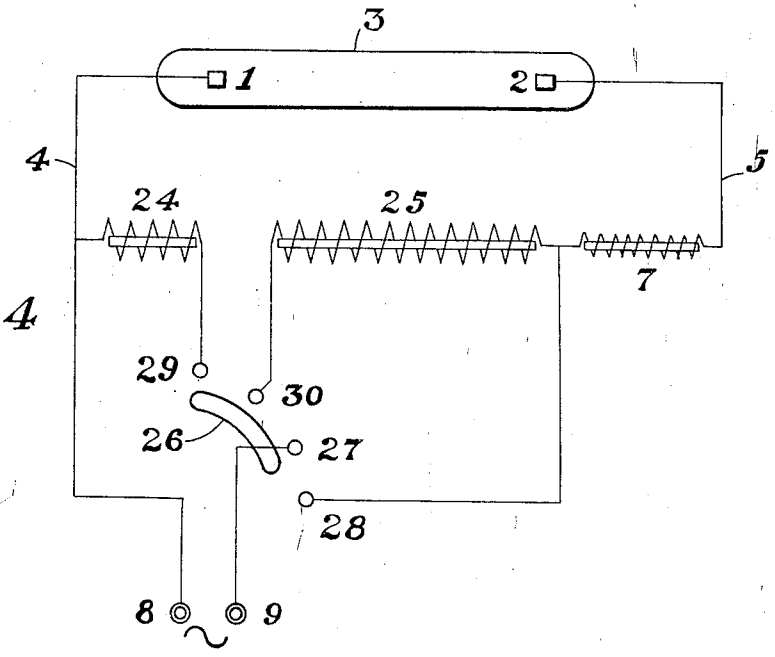
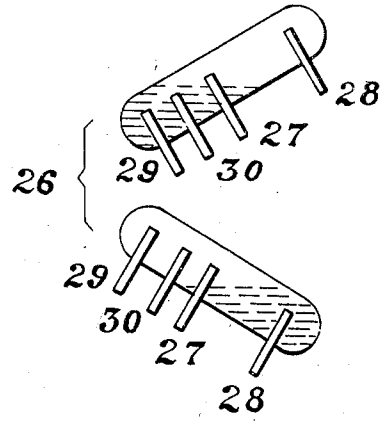


Fig. 5



INVENTORS
Hans Ewest
Marcello Pirani
BY
Charles V. Mullen
THEIR ATTORNEY

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ELECTRIC DISCHARGE APPARATUS

Hans Ewest, Berlin, and Marcello Pirani, Berlin-Wilmersdorf, Germany, assignors to General Electric Company, a corporation of New York

Application August 21, 1930, Serial No. 476,866, and in Germany September 4, 1929

4 Claims. (Cl. 176—124)

The present invention relates generally to gaseous electric discharge devices and particularly the invention relates to starting means for such devices operating on alternating current.

It is well known in the art that the voltage necessary to start such devices into operation is considerably higher than the voltage necessary to maintain the normal operation of the device. It is equally well known in the art that the initial or cold starting voltage is considerably higher than the voltage necessary to re-start the device during operation at each phase of the alternating current.

The object of the present invention is to provide a starting mechanism for gaseous electric discharge devices in which the initial or cold starting voltage is approximately three times the operating voltage and in which the re-starting voltage is located within the limits of the operating voltage. A further object of the invention is to provide a starting and operating mechanism for such devices of compact structure and of little cost.

In accordance with these objects the invention comprises a starting transformer, considerably under dimensioned with respect to the maximum current force, said transformer producing the required starting voltage and being open circuited after the electric discharge device has been started into operation. Because of the aforesaid open circuiting of the transformer during the operation of the device the capacity of said transformer may be as small as ⅕ of that capacity necessary for the continuous maintenance of the maximum operating current force and the starting voltage. Since the starting of the discharge requires only a short time, in the order of a few seconds, the under dimensioned transformer is not harmed by being overburdened during a short interval, as we have proven by experiment. For example, a gaseous electric discharge device equipped with oxide electrodes heated directly by the starting voltage, designed for a 2 ampere current intensity, 220 volt operating potential and a 750 volt starting potential may be started by a transformer having a capacity of 0.2 up to 0.3 instead of by a transformer having a capacity of 1.5 kva. As a transformer having a capacity of 0.2 to 0.3 has an over-all measurement of approximately 70, 70, 50 mm. as compared to the 250, 260, 160 mm. over-all measurement of a transformer of 1.5 kva capacity it is obvious that the first transformer requires less space and is much cheaper. If the operating potential of the gaseous electric discharge device is 600 volts the starting voltage will be approximately 2,000. Hitherto a large transformer having a capacity of 4 kva has been used generally for such devices having a current force of 2 amperes. Since the 600 volt operating potential requires a transformer only of 1.2 kva capacity a small auxiliary transformer to produce the additional 1400 volts may be used in accordance with this invention, said auxiliary transformer having a capacity of 0.4 to 0.6 kva. In this case also there is a saving of space and cost if a medium sized transformer to furnish the operating potential, as a transformer of 1.2 kva capacity, in conjunction with an under dimensioned auxiliary transformer to furnish the starting voltage, as a transformer of 0.4 to 0.6 kva capacity are used in place of a single large transformer of 4 kva capacity to furnish both the starting and operating voltages.

In the drawings accompanying and forming part of this specification four embodiments of the invention are shown for purposes of illustration in which,

Figs. 1 to 4 are schematic representations of circuits embodying the invention and,

Fig. 5 is a schematic representation of a switch suitable for use in connection with the circuit shown in Fig. 4.

Like numbers denote like parts in all the figures.

Referring to Fig. 1 the invention comprises a gaseous electric discharge device 3 having oxide electrodes 1, 2, said electrodes 1, 2 being connected to current source 8, 9 by leads 4, 5, said lead 4 having connected therein a switch 6 and a choke coil 7. Transformer 10, 14 produces the potential necessary to start the electric discharge device 3 into operation, said transformer 10, 14 being considerably under dimensioned with respect to the maximum current intensity. The primary winding 10 of transformer 10, 14 is connected to pole 8 of current source 8, 9 by lead 11 and to pole 9 by lead 12, said lead 12 having connected therein switch 13. The secondary winding 14 of the transformer 10, 14 is connected by lead 15 to lead 4 between switch 6 and electrode 1 and by lead 16 to the one end of choke coil 7. In starting the gaseous electric discharge device 3 switch 6 is first opened and then switch 13 is closed cutting into the circuit the transformer 10, 14. The high potential current induced in secondary winding 14 then flows to electrode 1 over lead 15 and to electrode 2 over lead 16, through choke coil 7, the usual main circuit knife switch 8, 9 and over the lead

5. The starting circuit is then not connected in parallel to the discharge path, hence the high potential induced in the secondary 14 during the starting operation cannot enter the operating circuit without causing the starting of a discharge in the electric discharge device 3. As soon as the high potential induced in the secondary 14 ionizes the gas in the discharge path and heats up the electrodes 1, 2, which operation requires only a very short time, said electrodes are connected to the main circuit knife switch 8, 9 by closing switch 6, then switch 13 is broken to open circuit transformer 10, 14. Switches 6, 13 may be combined into a single switch having such operating characteristics that transformer 10, 14 is open circuited immediately on the starting of the discharge so that said starting transformer 10, 14, which is considerably under dimensioned with respect to the maximum current intensity, is not injured since it is connected into the circuit only during the starting operation which takes place almost instantaneously.

In the embodiment of the invention shown in Fig. 2, a single-coil tap-transformer 21 is used which may be divided in the proportion of 220: 750 by tap lead 20 connected to the contact 18 of the switch 17, 18, 19, said switch 17, 18, 19 being connected into lead 5. The smaller part of transformer 21 is connected to lead 4 by lead 22 and the other part of said transformer 21 is connected to lead 5 by lead 23. When switch member 17 is in contact with contact 18 the smaller part of transformer 21 acts as a primary and the larger part of transformer 21 acts as a secondary, as is well known in the art. A high potential is thus produced to start the electric discharge device 3 into operation. This circuit has an advantage over that shown in Fig. 1 in that the secondary potential does not pass by the circuit.

The circuit shown in Fig. 3 is similar to that of Fig. 2 with the exception that in this embodiment of the invention the choke coil 7 is connected into lead 5 and is wound on the iron core of the auto-transformer.

In the circuits shown in Figs. 1–3 it is possible for leakage currents to pass through the transformer. In the circuit shown in Fig. 4 this is avoided. The transformer consists of two windings 24, 25. A mercury switch 26 (shown in its two positions in Fig. 5) is provided to bridge the contacts 29, 30, 37, or the contacts 27, 28. Winding 24 is connected to lead 4 and the contact 29; winding 25 is connected to lead 5 and contact 30. When mercury switch 26 is in such position that contacts 29, 30 and 27 are bridged the windings 24, 25 are connected to each other and to the current source 8, 9 to act as an auto-transformer furnishing the high voltage necessary to start the electric discharge device 3 into operation. When operation is established mercury switch 26 is tipped to such position in which only contacts 27, 28 are bridged. Only the potential of the current source 8, 9 is then on the electric discharge device as windings 24, 25 are open circuited. As there is a gap between contacts 29 and 30 no leakage currents can flow through the windings 24, 25.

It will be understood of course, that while we have shown and described particular switch mechanisms we contemplate the use of various and different switching means serving the same purpose, and further, an electric-magnet actuated by changes in potential in the electric discharge device may be inserted in the circuit to automatically manipulate the switch mechanisms. Various other substitutions, modifications and changes in the forms and details of the device and in its use and operation may be made by those skilled in the art without departure from the broad spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, an electric discharge device comprising a container, electrodes sealed therein, a main source of current connected to said electrodes, and a starting circuit for said device comprising a high voltage starting transformer momentarily connected across the terminals of said main source, said transformer having a kva capacity less than that of a transformer required to maintain normal operation of the device.

2. In combination, an electric discharge device comprising a container, electrodes sealed therein, a main source of current connected to said electrodes, and a starting circuit for said device comprising a high voltage starting transformer momentarily connected across the terminals of said main source, said transformer having a kva capacity less than that of a transformer required to maintain normal operation of the device, and means for connecting and disconnecting said transformer from said main source.

3. In combination, an electric discharge device comprising a container, electrodes sealed therein, a main source of current connected to said electrodes, and a starting circuit for said device comprising a high voltage starting transformer momentarily connected across the terminals of said main source and in operative relation to the terminals of said device, said transformer having a kva capacity less than that of a transformer required to maintain normal operation of the device and means for connecting and disconnecting said transformer from said main source.

4. In combination, a gaseous electric discharge device, a high voltage transformer and means to open circuit said transformer immediately on the start of said gaseous electric discharge device, said transformer being under dimensioned with respect to the maximum current intensity of said gaseous electric discharge device and adapted to start said gaseous electric discharge device.

HANS EWEST.
MARCELLO PIRANI.