Feb. 18, 1958 W. C. WHITE 2,824,254

POOL-TYPE ELECTRIC DISCHARGE APPARATUS

Filed Dec. 10, 1954

Fig. 1.

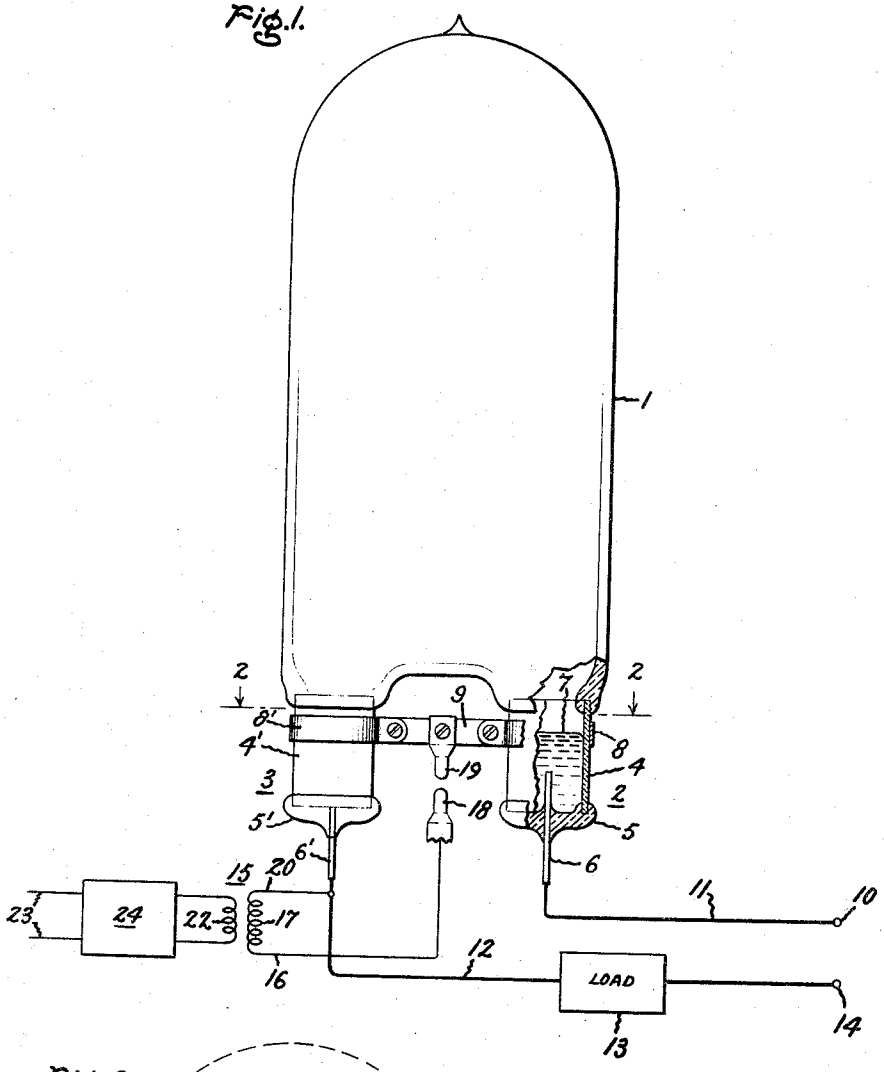
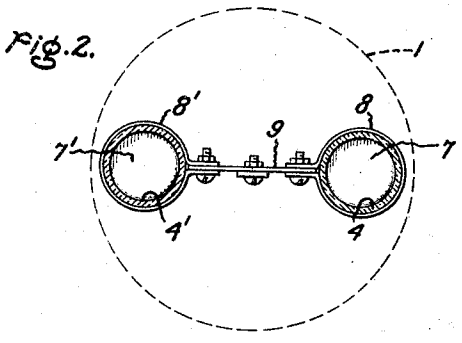


Fig. 2.



Inventor:
William C. White,
by Paul A. Frank
His Attorney.

United States Patent Office 2,824,254
Patented Feb. 18, 1958

2,824,254

POOL-TYPE ELECTRIC DISCHARGE APPARATUS

William C. White, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application December 10, 1954, Serial No. 474,342

3 Claims. (Cl. 313—165)

My invention relates to improved controlled electric discharge apparatus of the pool type, and, more particularly, to apparatus of this type employing a plurality of pool electrodes operable either as anodes or cathodes and enclosed in a single envelope.

In the transmission of moderate amounts of electric power between alternating current circuits or between an alternating current circuit and a direct current circuit of either polarity, it has been common practice to employ electric discharge devices having a pool-type cathode, a solid anode and an immersion ignitor type of starting electrode. These devices are used in pairs with each device adapted to operate as a unilaterally conducting path between the anode and cathode, conduction taking place when the solid anode is positive with respect to the pool-type cathode and when it is initiated by suitable energization of the starting electrode. The present invention relates to an improved device of this general character but employing in a single envelope two pool-type electrodes which are adapted to serve either as anodes or cathodes depending upon the polarity of the voltage applied thereto and the voltage of the associated starting electrode. A single device of the present invention may, therefore, be energized from an alternating current circuit to operate as a unilaterally conducting device with a direct current output of either polarity or as an alternating current switch depending upon the energization of the associated starting electrodes.

It is an object of my invention to provide a new and improved electric discharge device utilizing pool-type electrodes.

It is a further object of my invention to provide new and improved starting and main electrode assemblies in a pool-type tube.

Further objects and advantages of my invention become apparent as the following description proceeds, reference being had to the accompanying drawing in which:

Fig. 1 is an elevational view partly in section of a two-pool discharge device embodying my invention, and

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1 showing further details of the pool-type electrodes and associated starting electrodes.

Referring now to the drawing, I have shown my invention embodied in an electric discharge device including a generally cylindrical envelope 1, which may be of glass, and from the lower end of which extends a pair of spaced electrode assemblies 2 and 3 which provide both the power electrodes and the starting electrodes of the device. Since each of the electrode assemblies is the same, only one will be described in detail and corresponding parts will be designated by the same reference numerals.

Referring now to the drawing, the assembly 2, which has been shown partially broken away, includes a hollow cylinder 4 of ceramic material sealed at its upper end to the enevelope 1 and closed at its lower end by a glass

disc 5 through which a terminal conductor 6 is sealed. The conductor 6 extends through the disc 5 and into the pool electrode 7 which may be a body of mercury or similar conducting liquid. The mercury pool does not rise to the top of the cylinder 4 but is of sufficient depth to cover the upper end of the terminal 6 by a substantial amount to prevent burning away of this electrode by the discharge during operation of the device.

In addition to forming a receptacle for the mercury electrode 7, the cylinder 4 also provides the dielectric portion of the improved starting electrode of the device and separates the mercury pool from a conducting band 8 clamped around the cylinder. The band is preferably positioned at least partially above the level of the mercury within the sleeve 4, facilitating the formation of a cathode spot when a suitable voltage is applied to the starting band as will become more apparent as the description proceeds.

As previously indicated, the construction of the electrode assembly 3 is the same as that just described in detail in connection with the assembly 2 and, in applying the reference numerals thereto, corresponding numerals have been primed in order to facilitate further reference to the corresponding parts. As illustrated in Figs. 1 and 2, the cylinders 4 and 4' are substantially less than half the diameter of the envelope 1 and since they are joined to the envelope near the outer edge thereof, the pool electrodes and the cylinders are spaced apart a substantial distance. In the application of the discharge device, it is contemplated that both of the starting bands 8 and 8' may be energized by the same voltage and, in order to facilitate this, they are connected together by a conducting strap 9 which extends therebetween.

In a specific embodiment of my invention, the ceramic cylinders were of what is known as high-fired alumina which is essentially sintered Al_2O_3. The cylinders were approximately one inch in diameter and had wall thickness of about .05 inch. With this particular construction, the voltage pulses applied to the starting electrodes 8 and 8' had a peak amplitude of several thousand volts.

In addition to the electrical properties of the alumina ceramic which render it very effective in this type of starting electrode, it also resists the tendency of the mercury to coat or erode the insulating material of the starting electrode with a resultant improvement in the life and operation of the device. These starting electrode assemblies are also not adversely affected by the application of negative voltage pulses. It is, therefore, not necessary to suppress in the firing circuit the negative voltages as it has been with some of the high resistance starters of the immersion-igniter type. This removes some of the limitations that have existed in the application of firing circuits to the prior art devices.

Before describing the operation of the device in a particular application, the schematic power and firing circuits illustrated in Fig. 1 will be briefly described. The power circuit may be traced from one terminal 10 of an alternating current supply circuit through conductor 11, terminal 6, pool electrode 7, the discharge space of the device 1, pool electrode 7', terminal 6', conductor 12, a load illustrated schematically at 13 to the other terminal 14 of the supply circuit. It will be apparent to those skilled in the art that the device will conduct during either half cycle of the supply circuit voltage provided the starting band, associated with the pool electrode which is positive with respect to the other, is suitably energized to produce a cathode spot. In the drawing, I have shown a suitable circuit for energizing the starting bands 8 and 8' or including a pulse transformer 15 having one terminal 16 of the secondary winding 17 thereof connected to the conductor 9 through the terminals 18

and 19 of a spark gap. The other terminal 20 of the transformer is connected with the terminals 6 and 6' and in this way with the pool electrodes 7 and 7'. As illustrated, the connection is made directly with the terminal 6' and to the terminal 6 through the load 13 and the alternating current supply circuit (10, 14). It will be understood that the firing voltage pulses are of steep wave front compared to the alternating current supply and that the impedance of the load and the supply circuit is sufficiently low to render the application of the pulses to the starting electrode cathode circuit effective. The spark gap increases the rate of rise of the voltage pulses supplied by the transformer 15 by a factor in the order of ten to one.

The primary winding 22 of the pulse transformer is energized from an alternating current circuit 23 through a firing circuit illustrated schematically at 24. Circuit 23 is preferably energized by a voltage derived from the supply circuit 10, 14 so that the pulses have a definite phase relation with respect to the supply circuit and the voltage of the pool electrodes of the device. As will be readily understood by those skilled in the art, the circuit 24 may include means for shifting the phase of the voltage pulses impressed on the starting bands 8 and 8' and in this way control the voltage supplied to the load 13. Circuit 24 may include suitable apparatus for deriving pulses at twice the frequency of the supply circuit voltage and for applying only pulses of selected polarity to the starting bands 8 and 8'. In this way, it is possible to render the device conductive when a selected one of the pool electrodes is positive with respect to the other to produce a direct current output of selected polarity or to render the device conductive when both electrodes are positive to operate the device as an alternating current switch. The firing circuit may to advantage be of the type described in copending Lord application, Serial No. 450,976, filed August 19, 1954, entitled "Firing Circuit" and assigned to the same assignee as this application.

While I have shown and described a particular embodiment of my invention, it will be apparent to those skilled in the art that modifications may be made without departing from my invention and I, therefore, aim by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

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

1. An electric discharge device comprising a generally cylindrical envelope, a pair of thin-walled hollow cylindrical ceramic members extending in spaced relation from the lower end of said envelope, a pair of liquid electrodes comprising a body of mercury retained within each of said members and a conductor surrounding each of said ceramic members at the surface level of the mercury therein and cooperating with the said members to provide the starting electrodes of said device.

2. An electric discharge device comprising a generally cylindrical envelope, a pair of hollow cylindrical ceramic members extending in spaced relation from the lower end of said envelope, a pair of electrodes comprising a body of conducting liquid retained within each of said members and a conducting band surrounding each of said ceramic members at the surface level of the liquid therein and cooperating with the said members to provide the starting electrodes of said device.

3. An electric discharge device comprising a generally cylindrical envelope, a pair of thin-walled hollow ceramic members extending in spaced relation from the lower end of said envelope and providing wells for retaining two bodies of conducting liquid, and a starting electrode comprising a conducting band surrounding each of said members at the surface level of said bodies of conducting liquid.

References Cited in the file of this patent

UNITED STATES PATENTS

1,681,196	Rudenberg et al.	Aug. 21, 1928
2,438,139	Arnott	Mar. 23, 1948