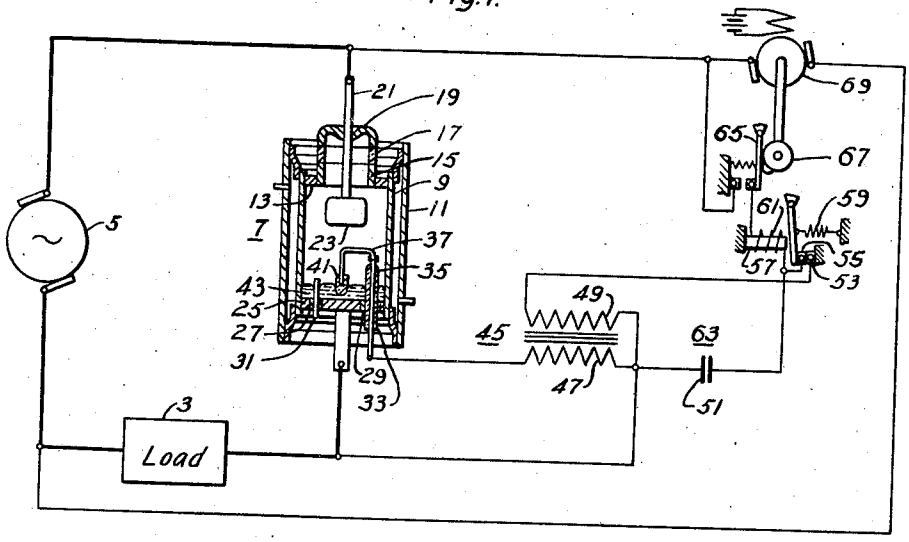
Dec. 19, 1944. A. H. TOEPFER 2,365,608

ELECTRIC DISCHARGE DEVICE

Original Filed June 23, 1939

Fig. 1.



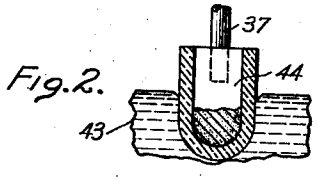


Fig. 2.

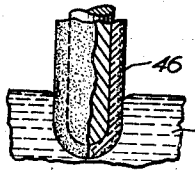


Fig. 3.

WITNESSES:

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UNITED STATES PATENT OFFICE

2,365,608

ELECTRIC DISCHARGE DEVICE

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Original application June 23, 1939, Serial No. 280,717. Divided and this application June 25, 1943, Serial No. 492,228

3 Claims. (Cl. 250—27.5)

My invention relates to electric discharge apparatus and has particular relation to electric discharge devices of the insulated-ignition-electrode type.

This is a division of my copending application, Serial No. 280,717, filed June 23, 1939, and assigned to the Westinghouse Electric & Manufacturing Company.

In discharge devices constructed in accordance with the teachings of the prior art, the ignition electrode is a conductor sealed in a glass jacket. The electrode is in contact with the pool which forms the cathode of the device, the glass serving as insulation between the conductor and the pool. A discharge is ignited by impressing an alternating potential between the conductor and the pool.

Discharge devices of the insulated-ignition-electrode type are designed to carry substantial current and develop substantial heat. In using the prior art devices it has been found that because of the excessive temperatures to which the ignition electrode is subjected, the insulation develops fissures when the apparatus operates for only a short time. The cathode and the ignition conductor are then interconnected and the useful life of the device is terminated. The use of mercury in a quartz tube for ignition purposes has been suggested. However, this arrangement has proved unsatisfactory because the mercury becomes turbulent when in operation and the properties of the electrode are irregular.

It is accordingly an object of my invention to provide an ignition electrode capable of withstanding the heat developed during operation for a discharge device of the insulated-ignition-electrode type.

According to my invention, the ignition electrode consists of a solid conductor such as a steel wire, a graphite rod or a dried and fired carbon mass enclosed in an insulating jacket of quartz. I have found, by carrying out a series of experiments, that the quartz withstands the heat developed in the discharge device and does not crack even if discharge current flows continuously for many hours. A less propitious arrangement which may be used in accordance with my invention when the loading of the discharge valve is intermittent is an insulating jacket of glass, reinforced by silicon carbide crystals embedded therein.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawing in which,

Figure 1 is a diagrammatic view showing a circuit utilizing a discharge device embodying my invention;

Figs. 2 and 3 are diagrammatic views showing modified igniters in accordance with my invention.

In the system shown in Figure 1, load 3 of any general type is supplied from a source 5 of alternating current, which may be of the usual commercial, 60 cycle type, through an electric discharge device 7. The device 7 comprises a pair of hollow, coaxial metallic cylinders 9 and 11 joined at the ends. During operation, a cooling fluid is conducted through the space between the cylinders 9 and 11 and prevents the structure from becoming overheated. The inner cylinder 9 is preferably composed of stainless steel and near its upper end, a metallic ring 13 is secured by welding or otherwise in such manner that the joint is vacuum tight. A flange 15 composed of a cobalt-nickel-iron alloy, known in the art as Kovar alloy, is secured to the inner surface of the ring 13. A glass ring 17 is sealed to the alloy flange 13 and a cobalt-nickel-iron alloy cap 19 is sealed to the glass. Through the cap 19 a metallic bar 21 is sealed, and the bar carries at its lower end, a block 23 of conductive material such as carbon or a metal which serves as the anode for a discharge device.

Near the lower end of the internal cylinder 9, a metallic disc 25 is sealed. The disc is provided with an opening 27 and a cobalt-nickel-iron alloy eyelet 29. Through the opening 27, a metal tube 31 is sealed and a glass sleeve 33 is sealed through the eyelet 29. A conducting lead 35 of the iron-nickel-cobalt alloy is sealed through the sleeve 33 and a wire 37 of steel or other conducting material is welded to the rod. The wire 37 is bent over to form a hook-like structure and at its free end a quartz jacket 41 is fastened. The quartz should have a thickness no greater than $\frac{1}{32}''$. A mercury pool 43 is disposed on the disc 25 and serves as cathode for the discharge device. The quartz jacket 41 on the wire 37 dips into the mercury pool 43 in such manner that the tip of the wire extends below the surface of the mercury. The metal tube 31 is used for exhausting the space between the inner cylinder 9, the disc 25, and the ring 13 and also for properly adjusting the heights of the mercury 43.

Because the quartz jacket 41 is thin the tem-

perature radiant developed in the quartz when an arc is fired between the pool 43 and the anode 23 is small. Therefore, no thermal stresses and resultant fissures develop in the jacket. I have found that if the jacket thickness is substantially greater than $\frac{1}{32}$ inch, substantial stresses are developed by reason of the temperature differences existing between the heated mercury and the wire 37.

In lieu of a wire a graphite rod or a mass 44 of dried and fired carbon may be disposed in the jacket 41 as shown in Fig. 2.

While the quartz jacket is used in the preferred practice of my invention, I have found that at times a jacket 44 composed of glass with silicon carbide crystals embedded therein as shown in Fig. 3 may be used. The glass-silicon-carbide jacket has substantial strength and is not ruptured by the stresses developed during operation.

In operating the discharge device 7 having an ignition electrode as described, ignition potential is supplied between the conducting wire 37 and the cathode 43 through an auxiliary transformer 45, the secondary 47 of which is connected between the conductor and the cathode. The primary 49 of the transformer is connected in series with a capacitor 51 across the fixed and movable terminals 53 and 55, respectively, of a spark gap. The terminals 53 and 55 are successively engaged and disengaged by the operation of a solenoid 57, which when energized, attracts the movable terminal 55 and when deenergized permits it to engage the fixed terminal under the action of a spring 59.

The solenoid coil 61, the terminals 55 and 53, and the capacitor network 63 are connected across the source during the half-periods during which the anode-cathode potential of the device 7 is positive by a switch 65. The switch 65 is closed during each of the half-periods by a cam 67 rotated by a synchronous motor 69. When the switch closes charging current flows to the capacitor 51 through the solenoid 57 and movable spark terminal 55 disengaged from the fixed terminal 53. A spark is, therefore, produced between the terminals and the cooperative action of the capacitive and inductive effect of the network 63 results in the flow of a high frequency current impulse through the network. The impulse is impressed between the ignition conductor 37 and the cathode 43 through the transformer 45.

When the spark terminals 53 and 55 are disengaged, the solenoid 57 is deenergized. The movable terminal 55 then reengages the fixed terminal 53 and a second high frequency impulse is impressed.

A discharge is initiated between the anode 23 and the cathode 43 of the discharge device 7 after the ignition potential has been impressed for approximately 100 micro-seconds. The discharge may be produced after the first high frequency impulse is impressed, or several impulses may be necessary.

In the practice of my invention, I have found that the ignition of discharge device 7 is certain and reliable when the current supplied to the solenoid 57 has a peak value of the order of ½ ampere. When the discharge is initiated between the anode 23 and the cathode 43, the ignition system is short circuited and the flow of ignition current is interrupted until the next period of the source.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. An electric discharge device comprising a cathode of the pool type and an ignition electrode consisting of a conductor enclosed in an insulating coating of glass having silicon carbide crystals embedded therein in engagement with said cathode.

2. An electric discharge device comprising a cathode of the pool type and an ignition electrode consisting of a conductor enclosed in an insulating coating at most, $\frac{1}{32}$'' in thickness and composed of glass having silicon carbide crystals embedded therein in engagement with said cathode.

3. An electric discharge device comprising a cathode of the pool type and an ignition electrode consisting of a carbon mass enclosed in an insulating coating at most $\frac{1}{32}$'' in thickness and composed of glass having silicon carbide crystals embedded therein in engagement with said cathode.

ADOLPH H. TOEPFER.