Aug. 20, 1957 W. J. SCOTT 2,803,783

ELECTRIC DISCHARGE DEVICES

Filed Jan. 7, 1955

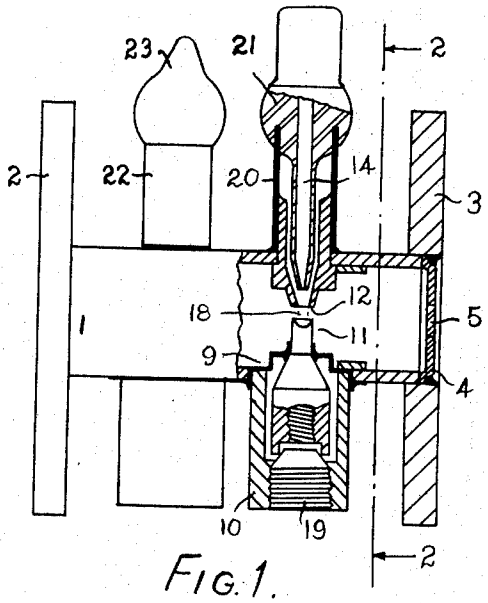


FIG. 1.

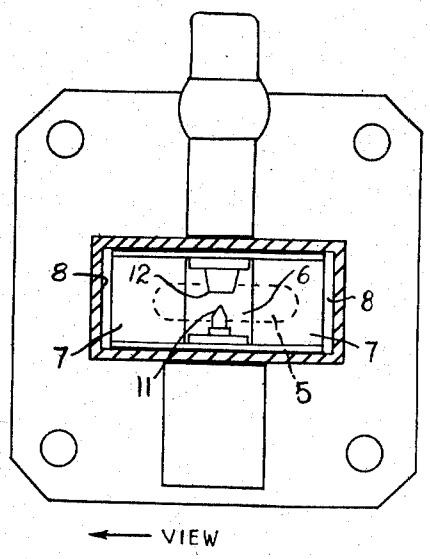


FIG. 2.

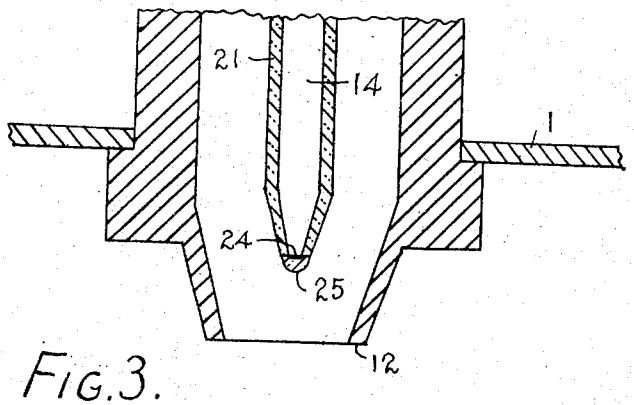


FIG. 3.

INVENTOR
WILLIAM JOSEPH SCOTT

BY Miles A. Gillam

ATTORNEY

United States Patent Office 2,803,783 Patented Aug. 20, 1957

2,803,783

ELECTRIC DISCHARGE DEVICES

William Joseph Scott, Rugby, England, assignor to The British Thomson-Houston Company Limited, a British company

Application January 7, 1955, Serial No. 480,520

Claims priority, application Great Britain January 8, 1954

8 Claims. (Cl. 315—41)

This invention relates to electric discharge devices of the kind in which a discharge, intended to occur between two main electrodes in an ionisable medium usually including water vapour under desired conditions, is stimulated by means of a priming discharge between one of the main electrodes and an auxiliary or primer electrode to which a potential with respect to that main electrode is applied during operation.

According to the invention at least the tip of the primer electrode is furnished with a coating of an oxide or oxides of vanadium either alone or on top of, or mixed with, or in chemical combination with other oxides, as in a glass or ceramic. Their combined resistances preferably should not exceed a few megohms.

One type of electric discharge device to which the invention is applicable is that known as a transmit-receive (T. R.) cell employed in radar systems for protecting the receiving apparatus from the energy of the transmitter, the transmitter and receiver being connected to a common aerial system. In a device of this character, a discharge is intended to occur (when the transmitter is producing energy pulses) between electrodes which form part of a tuned circuit resonant at, or near, the frequency of the transmitter energy, the electrodes being spaced apart in an evacuated chamber filled with an ionisable gas, such as argon containing a trace of water vapour. In one known arrangement, the primer electrode is in the form of a conductor substantially completely shielded by one of the main electrodes from the other main electrode. The sides of the primer electrode inside the cell are insulated by glass and/or ceramic except at the tip which is left bare. The exposed tip is usually of the sealing metal itself (usually in iron-nickel-cobalt alloy) or of oxidised copper or stainless steel.

Although in the past lives of from a few hundred to well beyond a thousand hours have been obtained with those tip materials, life is sometimes limited by the electrical discharge in the water vapour attacking the primer electrode and causing clean-up of the water, or erosion of or deposits on the electrodes.

It has been found that primer electrodes when tipped with a vanadium oxide or oxides alone or in association with other oxides, in accordance with the invention, can give relatively stable operation in the water vapour discharge. For example, a broadband T. R. cell of the type used in commercial marine radar is still in stable operation after 1,000 hours. This cell had an iron-nickel-cobalt alloy electrode wire whose tip was oxidised and then coated with a layer of conducting vanadium glass which is continuous with the sleeve of vitreous material which surrounds the remainder of the auxiliary electrode within the main electrode. The conducting vanadium glass may have a composition, by weight, comprising 74% V_2O_5, 18.5% P_2O_5 and 7.5% PbO. Other electrodes tipped with vanadium pentoxide show but little change after a few hundred hours operation.

In the accompanying drawings, Figs. 1 and 2 show respectively, in side elevation and end view, a T. R. cell of known kind to which the present invention is applicable, while Fig. 3 shows in partial cross section construction of auxiliary electrode embodying the invention.

Referring now to the known construction of T. R. cell shown in Figs. 1 and 2, this consists of a short length of metal wave guide **1** of rectangular cross-section having end flanges **2**, **3**, to enable it to be attached to similar flanges on wave guides extending in either direction from the T. R. cell. The cell is furnished with windows **4** at each end which are of the same construction and which serve to seal the cell hermetically so that it may be evacuated or filled with a suitable gas and/or vapour. Each window comprises a rectangular metal plate having a resonant slot **5** into which glass is sealed by fusion, the slot being of such dimensions as to be tuned to preferably the mid frequency of the frequency band over which the T. R. cell is to respond. Intermediate the windows **4** is a rectangular slot or iris **6** formed between the inner edges of two partitions **7** which extend between the opposite faces of the upper and lower longer walls of the guide. These are preferably formed by a single flange member the flanges of which are brazed to the inner faces of the walls of the guide. The partitions are separated from the side walls of the guide by spaces **8** for the purpose of facilitating the chemical cleaning and/or electro-plating of the envelope during manufacture.

Between the inner edges of the partitions **7** are coaxially mounted on the lower and upper walls of the guide the main electrodes **11**, **12**. These constitute, with the iris **6**, a resonant circuit tuned to substantially the same frequency as that to which the slots **5** are tuned. The lower electrode **11** is solid, is mounted on a flexible diaphragm **9**, and extends within a surrounding tube **10**, it being made adjustable towards and a limited distance away from the electrode **12** by means of an adjusting screw **19** threaded into the tube **10**. In place of screw **19** a second screw (not shown) can engage the female thread in electrode **11** for major retractions. The other main electrode **12** is fixedly mounted in the upper wall of the guide **1** and is made hollow to receive an auxiliary electrode **14**. This is sealed into the mounting tube **20** by means of a glass bead **21**. The interior of the T. R. cell is capable of being evacuated and filled with a suitable filling, if desired, through an exhaust tube **22** which is sealed off by a glass bead **23**.

As mentioned above, it is required that the main gap **18** present between the tips of the main electrodes **11**, **12**, become ionised under predetermined conditions, i. e. when a predetermined level of ultra-high frequency energy is present in the cell in order that the gap may act as an attenuator of that energy, whilst it is not so ionised by energy having a level of below the predetermined value. To this end, a carefully controlled continuous priming ionisation is applied between the hollow main electrode **12** and the auxiliary electrode **14** mounted within it.

In order to protect the tip of the auxiliary electrode against electrochemical action arising from the glow discharge in the presence of water vapour in the envelope, the tip of the electrode is coated with a material containing an oxide of vanadium.

Referring now to Fig. 3, the auxiliary or primer electrode **14** and the hollow main electrode **12** with which it is associated are shown on an enlarged scale to indicate the coating **24** of oxide formed on the tip of the electrode **14** after the insulating coating **24** has been removed, e. g. by grinding, and the protective coating **25** of vanadium oxide, such as the vanadium pentoxide glass above mentioned, subsequently applied to the electrode **14**.

Although the vanadium oxide containing coating **25** possesses a resistance, its function is primarily to constitute the tip of the primer electrode which is immune from

electro-chemical attack in a device containing water vapour. It may be used in addition to the resistor claimed in my co-pending application Serial No. 480,519 filed January 7, 1955, and assigned to the same assignee as the present application.

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

1. An electric discharge device comprising a sealed envelope filled with an ionisable medium, spaced electrodes in said envelope between which a discharge is adapted to take place when a voltage exceeding the breakdown voltage of said ionisable medium is applied between said electrodes, an auxiliary electrode spaced from one of said main electrodes and adapted to have a potential applied thereto with respect to said one main electrode whereby to cause a priming glow discharge to take place to said one main electrode, and a glass coating containing an oxide of vanadium over the end of said auxiliary electrode from which said priming glow discharge takes place.

2. An electric discharge device comprising a sealed envelope filled with an ionisable medium, spaced electrodes in said envelope between which a discharge is adapted to take place when a voltage exceeding the breakdown voltage of said ionisable medium is applied between said electrodes, an auxiliary electrode spaced from one of said main electrodes and adapted to have a potential applied thereto with respect to said one main electrode whereby to cause a priming glow discharge to take place to said one main electrode, and a glass coating containing vanadium pentoxide over the end of said auxiliary electrode from which said priming glow discharge takes place.

3. An electric discharge device as claimed in claim 2, in which a coating of an oxide of the metal of which said auxiliary electrode is composed is present between said end of said auxiliary electrode and said coating of vanadium pentoxide glass.

4. An electric discharge device as claimed in claim 2, in which said auxiliary electrode is enclosed in a sleeve of insulating material with which said glass is continuous.

5. An electric discharge device comprising a sealed envelope filled with an ionisable medium, spaced coaxial main electrodes in said envelope, an auxiliary electrode associated with one of said main electrodes, said auxiliary electrode being in the form of a conductor substantially completely shielded by said one main electrode from the other main electrode and from said one main electrode by a surrounding sleeve of vitreous material which exposes the tip of the auxiliary electrode, and a glass coating containing an oxide of vanadium covering said tip.

6. An electric discharge device as claimed in claim 5, in which said one main electrode is hollow, said auxiliary electrode being located within said one main electrode.

7. An electric discharge device as claimed in claim 5, in which said glass coating is composed of 74% V_2O_5, 18.5% P_2O_5 and 7.5% PbO, by weight.

8. An electric discharge device comprising a sealed metal envelope of rectangular cross-section, end walls to said envelope having windows in the form of resonant slots therein, said slots being filled with glass sealed to the rims thereof, coaxial main electrodes mounted on opposite walls of said envelope between said end walls, one of said main electrodes being hollow, an auxiliary electrode mounted within and insulated from said one main electrode, said auxiliary electrode being protected with an insulating sleeve which exposes the tip of said auxiliary electrode adjacent said one main electrode, a coating of an oxide of the metal of which said auxiliary electrode is constituted on the tip of said auxiliary electrode, and a coating of a glass containing vanadium pentoxide covering said oxide and adherent to said insulating sleeve.

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