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G. H. ROCKWOOD, JR  
ELECTRIC DISCHARGE DEVICE

2,184,756

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FIG. 1

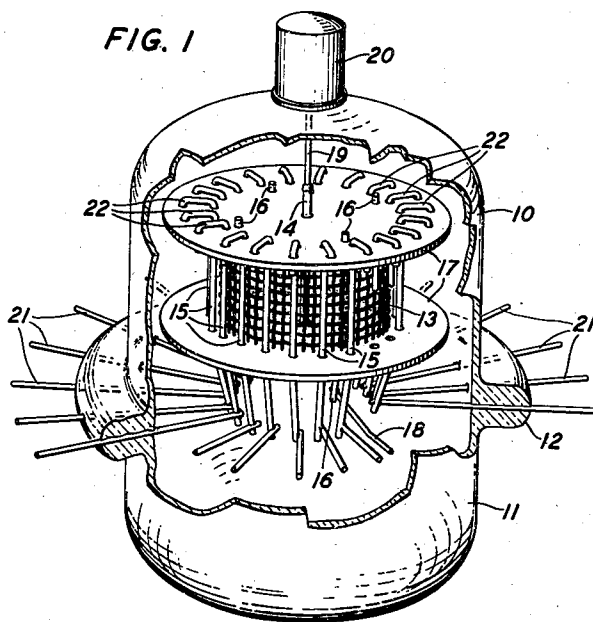


FIG. 2

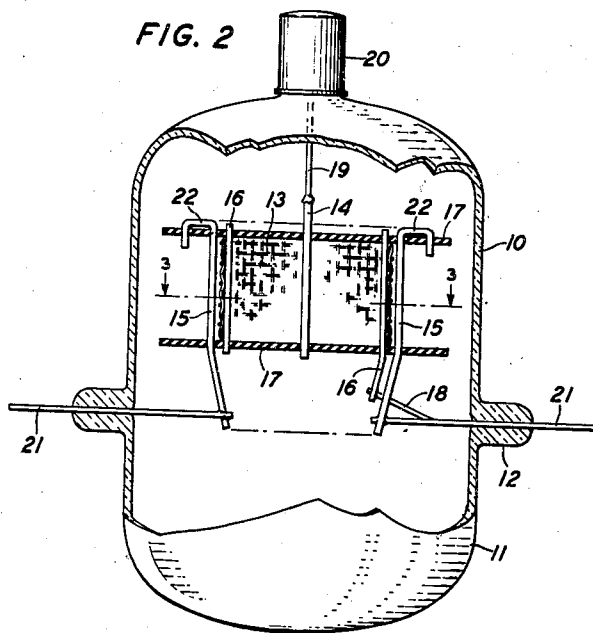
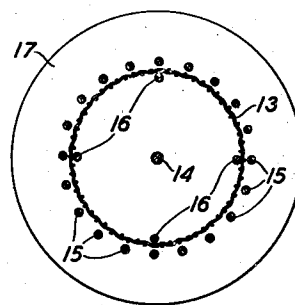


FIG. 3



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## UNITED STATES PATENT OFFICE

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## ELECTRIC DISCHARGE DEVICE

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14 Claims. (Cl. 250—27.5)

This invention relates to electric discharge devices and more particularly to gaseous discharge devices wherein the initiation of a discharge between two electrodes is controlled by a third or auxiliary electrode.

Electric discharge devices of the type comprehended by this invention comprise generally a cathode, a main or work anode and a control or ignition anode, the several electrodes being mounted within an enclosing vessel having an ionizable medium therein. When a suitable potential is impressed between the control or ignition anode and the cathode a discharge between these electrodes occurs. If the main or work anode is at a proper potential with respect to the cathode, the discharge between the control anode and the cathode results in the initiation of a discharge between the main anode and the cathode, which will continue until the circuit therebetween is interrupted or until the potential of the main anode is reduced below the value necessary to sustain ionization of the ionizable medium.

One object of this invention is to improve the efficiency of gaseous discharge devices.

Another object of this invention is to obtain low transfer current in electric discharge devices wherein a discharge between a cathode and anode is initiated as a result of an auxiliary discharge between the cathode and another electrode.

A further object of this invention is to facilitate the electrical connection individually of each of a multiplicity of circuits to another circuit.

Still another object of this invention is to obtain both a high main gap breakdown potential and a relatively low control breakdown potential in gaseous discharge devices.

In one illustrative embodiment of this invention, an electric discharge device comprises a cathode, a main or work anode to one side of the cathode and relatively widely spaced therefrom, and one or more control or ignition anodes on the other side of the cathode and in proximity thereto. The cathode may be of the cold type and the several anodes may be linear rods or wires mounted parallel to each other and to the cathode.

The invention and the various features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing, in which:

Fig. 1 is a perspective view of an electric discharge device constructed in accordance with this invention, a portion of the enclosing vessel being broken away to illustrate the electrode assembly more clearly;

Fig. 2 is a side view, partly in section, of the device shown in Fig. 1; and

Fig. 3 is a view in section along line 3—3 of

Fig. 2, illustrating the configuration and disposition of the various electrodes.

Referring now to the drawing, the electric discharge device illustrated therein comprises an enclosing vessel composed of two similar cup-shaped portions 10 and 11 hermetically joined at their edges in an annular flange or seal 12. The vessel has therein an ionizable medium, such as a gas or a mixture of gases, at a low pressure. For example, the vessel may have a filling of argon at a pressure of the order of 15 millimeters of mercury or it may have a filling of a mixture of approximately 1 per cent argon and approximately 99 per cent neon at a pressure of the order of 40 millimeters of mercury. Other gases or mixtures of gases at various pressures may be used. Argon, however, appears to be preferable inasmuch as it facilitates the attainment of a relatively high main gap breakdown potential and, furthermore, may be obtained at relatively low cost.

Disposed within the enclosing vessel are a cold cathode 13, a main or work anode 14, and a plurality of control or ignition anodes 15.

The cathode is a perforated cylinder coated on both its inner and outer surfaces with an electron emissive material, such, for example, as a mixture of barium and strontium oxides. It may be formed of metallic mesh, for example, a 16 by 16 nickel mesh, or may be of perforated sheet metal, for example, nickel. The cathode is supported by a plurality of equally spaced rigid uprights or rods 16 which extend through and are fitted in apertures in insulating spacers 17, such as mica discs, abutting the ends of the cathode. Preferably the discs or spacers 17 extend into proximity to the inner wall of the enclosing vessel. Electrical connection to the cathode may be established through a leading-in conductor 18 connected to one of the supports or uprights 16 and sealed in the flange or seal 12.

The main or work anode 14 may be a linear rod or wire mounted in the axis of the cathode 13 and fitted in central apertures in the spacers or discs 17. A suitable potential may be applied to the main or work anode 14 through a leading-in conductor 19 connected to a terminal cap 20 affixed to the portion 10 of the enclosing vessel. Preferably, the cathode is of relatively large diameter so that a high breakdown potential between the cathode and anode 14 may be obtained.

The control or ignition anodes 15, for example, twenty in number and equally spaced, may be linear wires or rods extending through the spacers or discs 17 and mounted parallel to the main or work anode 14. Preferably the control or ignition anodes are mounted in immediate proximity to the cathode 13 and are equally spaced therefrom. Each of the anodes 15 may be bent over at one end, that is, at the end toward the

terminal cap 20, as indicated at 22 to lock the insulating spacer or disc 17 at this end securely against the cathode. At the other end, each of the anodes 15 may be bent inwardly, that is toward the anode 14, to lock the other insulating

spacer or disc 17 firmly against the cathode 13. Suitable potentials may be applied to the control or ignition anodes 15 individually through radially extending leading-in conductors 21 hermetically sealed in, and projecting from, the annular flange or seal 12.

During operation of the device, the main or work anode 14 is maintained at positive potential, for example, of the order of 150 volts, with respect to the cathode. Each of the control or ignition anodes 15 is connected to one conductor from a corresponding station, such as a subscriber's telephone station. Another conductor from each of the stations is connected to the cathode 13 through a suitable source, such as a battery.

Whenever any one of the stations is in use, a circuit is completed between the corresponding control or ignition anode 15 and the cathode 13 so that a positive potential is impressed upon this control or ignition anode. The source in circuit with the ignition or control anodes is so chosen, depending upon the ionizable medium in the vessel 10, 11 and the spacing between the cathode 13 and anodes 15, that upon completion of the control circuit a discharge occurs between the cathode and the ignition anode energized. Almost simultaneously with the initiation of such discharge, a main discharge occurs between the cathode and the main or work anode 14.

It has been found that, in devices constructed in accordance with this invention, relatively small potentials may be utilized between the cathode and the control or ignition anodes to initiate a discharge therebetween, and hence between the cathode and the main anode. It has been found also that the transfer currents are very small, for example, of the order of one or two microamperes. Hence, facile and economic control of the relatively high power discharge between the cathode and the main or work anode is effected by small power expenditure in the discharge between the cathode and the control or ignition anodes. Each of the latter is substantially equally effective in initiating the main gap discharge so that uniform and individual control by each of the control or ignition anodes of the main gap discharge is achieved.

Although a specific embodiment of the invention has been shown and described, it will be understood, of course, that it is but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. A gaseous discharge device comprising an apertured cold cathode, a work anode on one side of said cathode and widely spaced therefrom, and an ignition electrode on the opposite side of said cathode, in immediate proximity and parallel thereto, said cathode screening said work anode from said ignition electrode.

2. A gaseous discharge device comprising an anode, a hollow reticulated cathode encompassing said anode, and a starting electrode outside of said cathode.

3. A gaseous discharge device comprising a

cylindrical apertured cold cathode, a work anode within said cathode and coaxial therewith, and an ignition anode outside of said cathode and parallel to the longitudinal axis thereof.

4. An electric discharge device comprising an enclosing vessel having an ionizable medium therein, a hollow mesh cold cathode, a linear rod work anode within said cathode, and a linear ignition anode outside of said cathode.

5. An electric discharge device comprising an enclosing vessel having a filling of gas at low pressure, a cylindrical foraminous cathode, a linear rod anode in the longitudinal axis of said cathode, and an ignition electrode outside of said cathode, the anode-cathode spacing being large in comparison to the spacing between said cathode and said control electrode.

6. An electric discharge device in accordance with claim 5 wherein said ignition electrode is a linear rod mounted in immediate proximity to said cathode and parallel to said anode.

7. A gaseous discharge device comprising a hollow reticulated cathode, a work anode within said cathode, and a plurality of ignition anodes outside of said cathode.

8. A gaseous discharge device in accordance with claim 7 wherein each of said ignition anodes is linear and is mounted parallel to said cathode.

9. An electric discharge device comprising an enclosing vessel having an ionizable atmosphere therein, a cylindrical foraminous cold cathode, a linear rod work anode mounted in the longitudinal axis of said cathode, and a plurality of linear rod ignition anodes outside of said cathode and parallel to said work anode.

10. An electric discharge device in accordance with claim 9 wherein said ignition anodes are mounted in immediate proximity to said cathode and are equally spaced therefrom.

11. An electric discharge device comprising a hollow apertured cathode, insulating members closing the ends of said cathode, a work anode within said cathode and supported by said insulating members, and an ignition anode outside of said cathode and extending between said insulating members.

12. An electric discharge device comprising an enclosing vessel having a filling of gas, a cylindrical foraminous cold cathode, insulating discs abutting the ends of said cathode, a linear rod work anode mounted in the longitudinal axis of said cathode and supported by said discs, and a plurality of linear ignition anodes outside of said cathode and extending through said discs.

13. An electric discharge device in accordance with claim 12 wherein said ignition anodes have integral portions maintaining said discs in engagement with said cathode.

14. An electric discharge device of the trigger type comprising an enclosing vessel having therein an ionizable atmosphere, a cylindrical metallic mesh cathode coated on its inner and outer surfaces with an electron emissive material, a linear work anode mounted substantially in the longitudinal axis of said cathode, and a linear ignition anode parallel to said work anode, mounted outside of said cathode and in immediate proximity thereto, the diameter of said cathode being great in comparison with the distance between said cathode and said ignition anode.

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