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ELECTRIC DISCHARGE DEVICE

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WITNESSES:
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My invention relates to electric discharge apparatus and has particular relation to rectifying apparatus.

It is an object of my invention to provide apparatus for supplying direct current of one polarity or the opposite polarity and of variable magnitude to a load from an alternating current source.

Another object of my invention is to provide apparatus for energizing a direct current motor to rotate at a variable speed in either one direction or the other.

An ancillary object of my invention is to provide an electric discharge device of simple construction that shall be capable of rectifying alternating current and transmitting it in either one direction or the opposite direction.

An incidental object of my invention is to provide an electric discharge device of the mercury vapor type, the control characteristic of which shall be substantially constant as a function of temperature over the operational temperature range.

According to my invention, I provide a system incorporating an electric discharge device comprising a single evacuated container in which a plurality of cathodes are supported. A control electrode is associated with each cathode and the cathodes are connected to the terminals of an alternating current power supply through the load to be energized. Apparatus is provided in the system for applying potential to the control electrodes and for varying the control potential thus supplied.

When one of the control electrodes is maintained at a sufficient negative potential, the space in the region of its corresponding cathode is ionized and it may operate as an anode. If another control electrode is simultaneously maintained at a positive potential the space in the region of its corresponding cathode is ionized and a conducting path is established between the first-mentioned cathode as an anode and the last-mentioned cathode as a cathode. Current of one polarity will thus be transmitted between the cathode with which the positive control electrode is associated and the cathode with which the negative control electrode is associated. By varying the potential applied to either of the control electrodes, the magnitude and polarity of the potential supplied to the load may be varied.

The novel features of which 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 a specific embodiment, when read in connection with the accompanying drawing, in which the single figure is a diagrammatic view showing a system constructed in accordance with my invention.

The apparatus shown in the drawing includes an electric discharge device comprising a container of glass or other insulating material which is highly evacuated and in which a globule of mercury is inserted. The container is in the form of an elongated cylinder and restrained by blocks and is provided at the ends thereof.

On each of the presses 7 and 9 a V-shaped filament 11 and 13 is supported from a plurality of wires 15 in the usual manner. Enclosures 17 and 19 comprising cylinders 21 of metal mesh closed at the top and bottom by blocks 23 of insulating material surround the cathodes 11 and 13. The enclosures 17 and 19 are supported from the respective presses 7 and 9 by wires 25 projecting therethrough and the insulating blocks 23 are provided with the usual openings for securing the supporting wires 25 and for permitting the supporting leads 15 for the cathodes 11 and 13 to engage the cathodes.

The system is energized from an alternating current power source through a transformer 21 provided with a plurality of secondaries whereby the cathodes 11 and 13 are heated. One of the cathodes 13 is directly connected to one terminal of a further secondary section 33 while the other terminal is connected to one terminal of the direct current load 35 that is to be energized. The remaining terminal of the load 35 is directly connected to the remaining cathode 11.

I have found that my system has particular utility in apparatus in which the load 35 is a direct current motor that is to rotate at a variable speed in one direction or the other.

The control electrodes 17 and 19 are connected to intermediate taps 37 of batteries 39 and 41 and are maintained at positive or negative potential relative to the corresponding cathodes 11 and 13 by movable taps 43 with which the batteries are provided and which are connected to the cathodes.

As a movable tap 43 is displaced the corresponding control electrode 17 or 19 may be maintained at any desired potential relative to the corresponding cathode 11 or 13. It is seen that if one of the control electrodes, say the electrode 17 is maintained sufficiently negative relative to its corresponding cathode 11 the electrons emitted from the cathode will produce ionization and a unidirectional current will be transmitted between the last-mentioned cathode 13 and the first-mentioned cathode 11.
(which operates as an anode) and through the load 35.

As the potential impressed on the last-mentioned control electrode 19 is varied, the point in the cycle of positive principal potential at which the electric discharge device 1 becomes energized is varied, the current transmitted through the load 35 is varied. If it becomes desirable to transmit current through the load 35 in the opposite direction, the first-mentioned control electrode 17 may be raised to a positive potential relative to the cathode 13 and the last-mentioned control electrode 19 may be raised to a negative potential of sufficient magnitude to prevent ionization in the region of the cathode 11.

One of the advantages which I have observed in utilizing electric discharge devices of the type described herein in which it will be noted the control electrode completely surrounds the cathode is explained in detail in a copending application, Serial No. 638,626 filed September 30, 1932, and assigned to the assignee of the present application. In this connection, particular attention is called to Fig. 5 of the drawing of the last-mentioned application. A consideration of this view will show that for the usual range of temperatures, in an electric discharge device of the type shown in Fig. 4 of the drawing of the present application, the control characteristic is substantially constant as a function of temperature.

It will be noted, moreover, that my system is of particular advantage by reason of its simplicity for an electric discharge device is here provided which incorporates only four elements and which operates as a rectifier to transmit current in either one direction or the opposite direction.

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 an evacuated container having a gaseous medium therein, a plurality of electrically independent electron emitting electrodes disposed in spaced relationship in said container and a metal mesh substantially completely surrounding each of said emitting electrodes.

2. An electric-discharge device comprising an evacuated container having a gaseous medium therein, a plurality of electrically independent electron emitting electrodes disposed in spaced relationship in said container and means including a metal mesh substantially completely enclosing each of said emitting electrodes.

3. An electric-discharge device comprising an evacuated container having a gaseous medium therein, an electron emitting electrode disposed in said container, means cooperative with said emitting electrode to collect the charge emitted thereby and an enclosure, including a surface substantially surrounding said electrode on every side and having at least a portion permeable to electrical charges.

4. Apparatus according to claim 3 characterized by that enclosure is a cylindrical body, the wall surfaces of which are composed of metal mesh and the bases of which are composed of insulating plates.

5. In combination, an electric-discharge device comprising an evacuated container, a plurality of electron emitting electrodes disposed in spaced relationship in said container, and a metal mesh surrounding each said emitting electrode, an alternating source of power, means for connecting the terminals of said source to said emitting electrodes and means for charging the metal mesh surrounding each of said emitting electrodes to such a potential that flow of current from the last said emitting electrode is prevented.

6. An electric-discharge device comprising an evacuated container having a gaseous medium therein, a plurality of electrically independent electron emitting electrodes disposed in spaced relationship in said container and a perforated metallic body substantially completely surrounding each of said emitting electrodes.

7. In combination, an electric-discharge device comprising an evacuated container, a plurality of electron emitting electrodes disposed in spaced relationship in said container and a perforated metallic body surrounding each said emitting electrode, an alternating source of power, means for connecting the terminals of said source to said emitting electrode and means for charging the perforated metallic body surrounding each of said emitting electrodes to such a potential that the flow of current from the last said emitting electrode is prevented.

8. An electric-discharge device comprising a discharge path, a plurality of electrically independent electron emitting electrodes disposed in spaced relationship in said container and a metal mesh substantially completely surrounding each of said emitting electrodes.

9. Apparatus according to claim 8 characterized by that a separate control electrode is associated with each main electrode.

10. In apparatus for supplying power to a load in combination, an evacuated container, a metal mesh surrounding each said terminal of said source, a second electron-emitting electrode connected to one terminal of said source, a second electron-emitting electrode connected to another terminal of said source, a control electrode associated with each said electron-emitting electrode, means for impressing a potential between said first electron-emitting electrode and the control electrode associated therewith to permit current flow from said second electron-emitting electrode.

11. Apparatus according to claim 10 characterized by means for varying the flow of current from the second electron-emitting electrode.

12. An electric-discharge device comprising an evacuated container, a plurality of electrically independent electron emitting electrodes disposed in spaced relationship in said container and a control electrode substantially completely surrounding each of said emitting electrodes, the above-mentioned electrodes constituting the entire electrode-system for said device.

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