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GRID-CONTROLLED DISCHARGE TUBE

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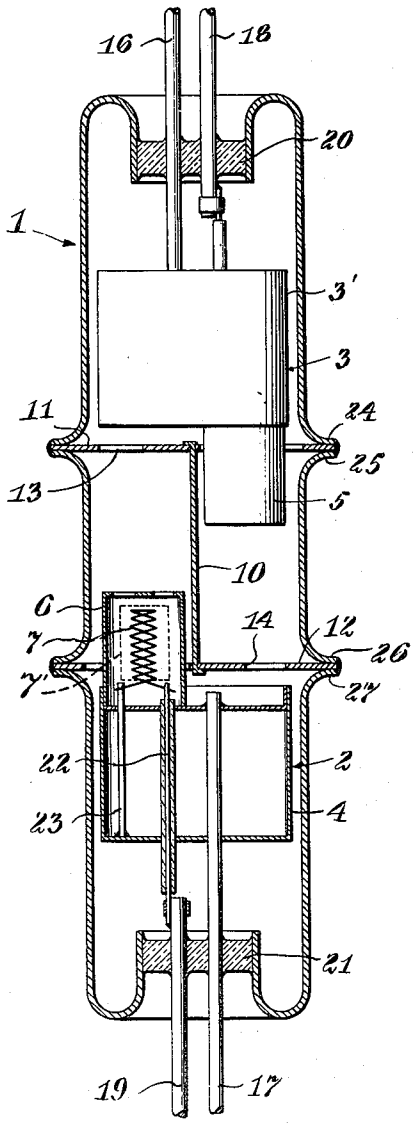

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GRID-CONTROLLED DISCHARGE TUBE

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The invention relates to electric discharge devices and particularly such devices utilized for full wave rectification.

An object of the invention is to provide a single tube with control of the current therethrough in either direction or alternating.

Another object of the invention is to provide a tube utilizing very little space and yet controlling various kinds of current.

A still further object of the invention is to provide a grid controlled discharge device which has effective grid heat dissipation.

Other objects and advantages of the invention will be apparent from the following description and drawing, in which:

The figure is a cross-sectional view illustrating a preferred embodiment of the invention.

The proposed invention concerns an electric discharge device having two similar electrodes, each of which can be effective either as a cathode or an anode or alternately one and the other, as the case requires. Such a tube can be used in alternating current operation where the current passes alternately in one direction and then in the other, through the discharge vessel. Two grids can be utilized and one of these can control the discharge in one direction, and the other can control the discharge in the other direction. The invention contemplates, however, utilizing one control grid in which the discharge is controlled in both directions by this one grid. The arrangement permits not only a very exact regulation of the ignition time point and, therefore, control of the effective current, but also from a design point, offers the advantage of greater simplicity. Such tubes are used for control purposes as, for example, for lights for theater lighting in which space may be a premium and accordingly, the invention is particularly adapted to be included in such systems in view of its economy of space.

The invention has a further advantage in cases where the circuit supplied from the tube comprises inductive or capacitive elements, which bring about a phase shifting of the current in respect to the voltage. Such inductive or capacitive loads can cause disturbances when other types of tubes are used, because the phase shifting might cause a discharge when not desired.

The invention, however, provides an accurate control of the discharge in spite of any phase shifting of current and voltage. The regulation or control is effected through a common grid which has an element dividing the discharge path into two parts and which is arranged in such a way in relation to the two electrodes that the discharge in one direction occupies a different space from the discharge in the other direction and the two space discharge paths are separated from one another by this common grid element. The diffusion of ions from one discharge space to the other is at least difficult, if not impossible.

A preferred embodiment of the invention is disclosed in the drawing. The evacuated container 1 is preferably filled with a rare gas or metal vapor and has the two electrodes 2 and 3 at opposite ends of this container. Each of these electrodes preferably consists of a sheet cylinder 3 or 4 which acts as an anode, while on the front surface of the cylinder still another sheet cylinder 5 or 6 is connected which contains an electron source such for example, as the spiral hot cathode 7 in its interior, either of thoriated tungsten or oxide coated nickel or its alloys or it may form the well known indirectly heated cathode with a coated cylinder 7'. Both the cathode cylinders or screens 5 and 6 are closed off on their front ends facing the discharge space by sheets which have openings for the passage of the discharge therethrough. In addition, a control grid 10 is present which consists of three connected parts. The first part 11 lies near the electrode 3, and the second part 12 lies near the electrode 2. In both of these grid parts, openings 13 or 14 are provided for the passage of the discharge. Both of these grid parts are connected with one another by a transverse sheet which is fastened to the parts 11 and 12 preferably by spot welding and is so connected thereto that it sub-divides the path between the two electrodes into two parallel paths with the electron source part of one electrode facing the anode or electron receiving part of the other electrode. It will be noted that the part 5 acting as an electron source for the electrode 2 and the part 6 acting as an electron source for the electrode 3, projects somewhat farther into the discharge space so that electrons emerging from them only pass through the half of the discharge space set aside by the dividing transverse portion 10 of the grid for passage to the anode portion of the other electrode. The control of the discharge is, therefore, effected in both directions by one and the same grid.

The structure of this grid is such that mere phase shifting of the space discharge current and voltage applied to the tube can not start the discharge, but such discharge must wait the action of the common grid. It will be noted that the ionization of one side of the discharge space can

not encroach on the other side of the discharge space. Because the control grid serves as a separation wall, a diffusion of ions from one space to the other is prevented so that a premature ignition can not occur. In the arrangement illustrated, the functions of two tubes are combined within one tube in a very simple manner and space is utilized with extreme economy.

The effective value of the alternating current can be regulated in both directions by control of the discharge and in addition, a constant control of the mean value of the current is possible by utilizing more or less of the positive or negative half wave. The mean value can be controlled to a positive maximum value which is given by the use of the positive half wave alone or up to a negative maximum value given by the use of the negative half wave alone. The grid may be used to control the value of the current desired in the particular installation in which the tube is incorporated.

The tube is also suitable for controlling the direct current impulses. In this case, polarity need not be considered since the tube will pass current in both directions. However, the application of the discharge in both directions is dependent on the point of time of applying the control voltage on the control grid. The new tube, therefore, combines in compact form all that which would be obtained otherwise with different arrangements which operate separate from one another.

The individual parts of the tube are also arranged in a very effective manner for the effective cooling of the grid. On each side of the discharge vessel the two current leads **16** or **17** and **18** or **19** enter inside the tube and are sealed vacuum tight in the metal vessel walls by insulating seals **20** or **21**. In order to lend greater rigidity to the electrode system one can support it, if necessary, by insulation against the vessel walls. The lead to the heater coil **7** is led through to one terminal by a conductor **22** preferably coated with insulation. The second conductor **23** from the other end of the heater coil **7** is connected to the cylinder as disclosed and this cylinder is in turn connected to the other lead through the insulating seal to the exterior of the tube. The grid is preferably fastened in a simple manner by making the parts **11** and **12** of disk-shaped metal and connected air tight with the edges of corresponding flanges **24, 25, 26,** and **27** of the three metal portions of the tube. These metal portions comprise the cylindrical part attached to the central portion and having the other reentrant end sealed by the glass or other insulation **20** and **21** and containing the two current leads. The casing, instead of three portions, may be one metal portion in which the grid parts **11** and **12** are inserted in projections pinched about the peripheral edges of these disks. The material of this metal casing is preferably vacuum tight and the end portions at least, are preferably of metal that seals vacuum tight to glass.

The object of connecting the flanges **24, 25, 26,** and **27** to an extensive portion of the periphery of the grid disks **11** and **12**, is to provide a relatively large contact surface from these grid disks to the metal casing so that the heat of the grid may be conducted to the metal casing and radiated. If desired, artificial means such a fan or liquid cooling means such as water might be utilized in any desirable manner to carry away the heat of the grid.

It is apparent from the foregoing description that the invention utilizes a very compact tube for full wave rectification and furthermore, that the invention discloses a structure in which the grid of a tube is very effectively cooled. Although a preferred embodiment is illustrated in accordance with the patent statutes, yet various modifications may be made in the form, number and arrangement of the various elements therein without departing from the spirit of the invention and accordingly, only such limitations are intended upon the following claims as is necessitated by the prior art.

I claim:

1. A discharge device comprising a metal casing, a grid in said casing and having a contact with said metal casing, two main electrodes in said casing, each of said main electrodes including a portion adapted to be heated to an electron emitting temperature and a portion adapted to receive electrons, insulation sealed to said metal casing and at least two conductors for each of said two main electrodes sealed through said insulation, said grid partitioning the space before the electron emitting portion of the main electrodes from the space before the portion of said main electrodes receiving electrons.

2. A discharge device comprising a metal casing, two main electrodes within said casing, and two disks intermediate said main electrodes and having their periphery secured between portions of the metal casing, and a connecting portion between said disks partioning the discharge space.

3. A discharge device comprising a metal casing, two main electrodes within said casing, and two disks intermediate said main electrodes and having their periphery secured between portions of the metal casing, and a connecting portion between said disks partitioning the discharge space, said connecting portion being electrically conducting whereby said disks and connecting portion act as a single grid.

4. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of the electron-receiving portion of the first electrode and the electron-emitting portion of the second electrode from the electron-emitting portion of the first electrode and the electron-receiving portion of the second electrode.

5. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of the electron-receiving portion of the first electrode and the electron-emitting portion of the second electrode from the electron emitting portion of the first electrode and the electron receiving portion of the second electrode, the electron emitting portion of each main electrode comprising a filament and an electron emitting substance heated by said filament.

6. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of the electron-receiving portion of the first electrode and the electron-emitting portion of the second electrode from the electron-

emitting portion of the first electrode and the electron-receiving portion of the second electrode, the electron emitting portion of each main electrode comprising a filament and an electron emitting substance heated by said filament, said filament and substance being substantially enclosed by a casing projecting beyond the electron receiving portion of the main electrode.

7. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of the electron-receiving portion of the first electrode and the electron-emitting portion of the second electrode from the electron emitting portion of the first electrode and the electron receiving portion of the second electrode, the electron emitting portion of each main electrode comprising a filament and an electron emitting substance heated by said filament, one of the connections to said filament being connected to said electron receiving portion of said main electrode and the other connection being insulated from the electron receiving portion of said main electrode.

8. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of one group of portions from the other group of portions, said means comprising a common grid controlling both discharge spaces.

9. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of one group of portions from the other group of portions, said means comprising a common grid controlling both discharge spaces, the electron emitting portion of each main electrode comprising a filament and an electron emitting substance heated by said filament, said filament and substance being substantially enclosed by a casing projecting beyond the electron receiving portion of the main electrode.

10. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of the electron-receiving portion of the first electrode and the electron-emitting portion of the second electrode from the electron-emitting portion of the first electrode and the electron-receiving portion of the second electrode, said means including a disk extending across the surface of said electrodes and perforated for each discharge space and connected at said casing for the application of control voltage thereto.

11. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of the electron-receiving portion of the first electrode and the electron-emitting portion of the second electrode from the electron emitting portion of the first electrode and the electron receiving portion of the second electrode, said means including perforated disks adjacent the surface of the said electrodes, the electron emitting portion of each main electrode comprising a filament and an electron emitting substance heated by said filament, and said electron emitting portion projecting through an opening in each of said disks.

12. A discharge device comprising a casing, two main electrodes in said casing, each of said main electrodes comprising an electron receiving portion and an electron emitting portion, each of said portions facing the opposite portion of the other electrode and means partitioning the discharge space of one group of portions from the other group of portions, the electron emitting portion of each main electrode comprising a filament and an electron emitting substance heated by said filament, said means comprising perforated disks adjacent the surface of said electrodes and said electron emitting portion projecting through an opening in each of said disks, said disks being electrically interconnected.

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