Jan. 4, 1949. A. F. HENNINGER ET AL 2,457,891

ELECTRON DISCHARGE DEVICE

Filed Jan. 12, 1945

2 Sheets-Sheet 1

Fig. 1.

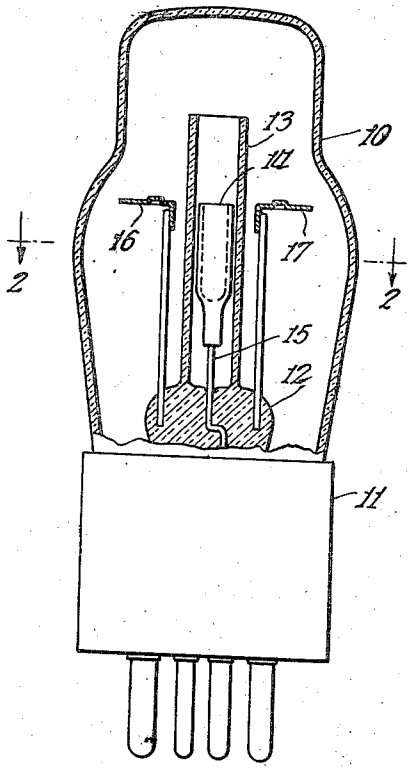


Fig. 3

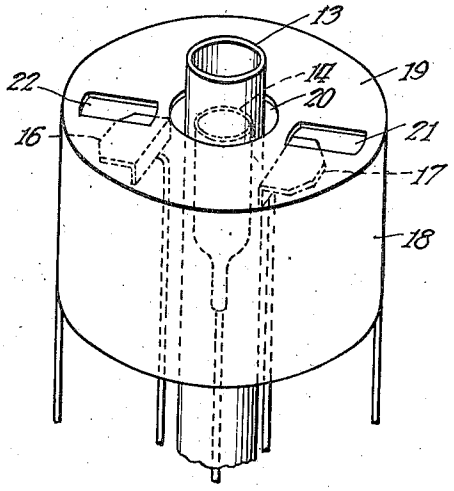
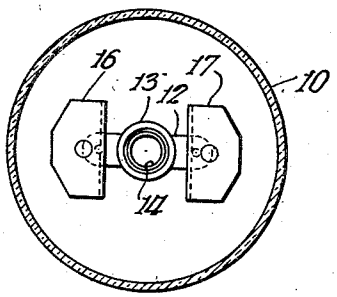


Fig. 2



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Fig. 4.

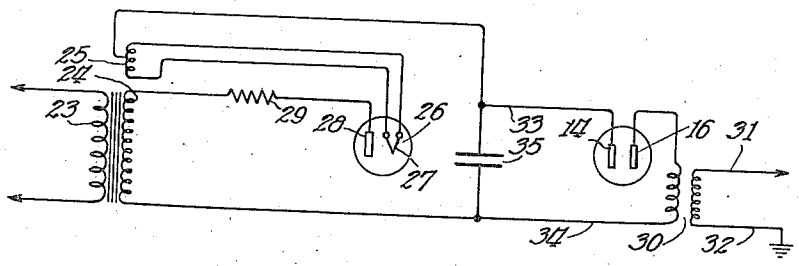


Fig. 5.

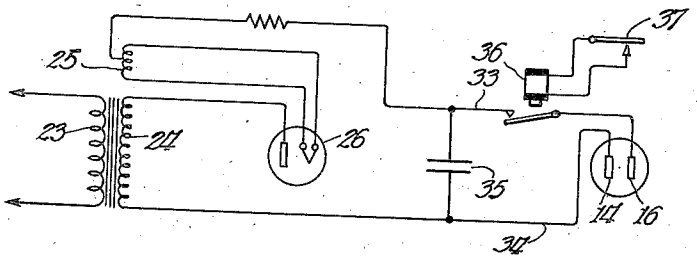
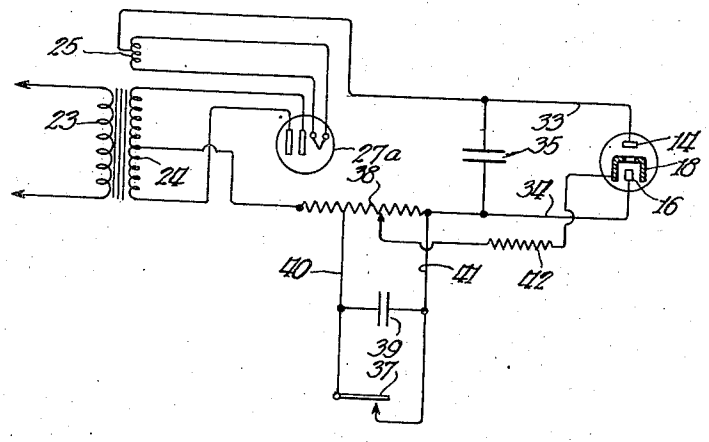


Fig. 6.



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UNITED STATES PATENT OFFICE

2,457,891

ELECTRON DISCHARGE DEVICE

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4 Claims. (Cl. 250—27.5)

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Our invention relates to electron discharge devices and has for its object the provision of a new and improved device of this character which has a wide spread between its starting voltage and its quenching voltage. A device such as this is of great value in connection with various types of circuits, such for instance as a circuit for electrically charging fences or circuits in connection with photo-flash purposes.

By the use of a device of this character we have been able to use a very simple and efficient circuit in which the size of the transformer and condenser are materially reduced below the values heretofore needed in connection with such and allied circuits. Such circuits in general are known as relaxation oscillator circuits.

In constructing our improved device we find that we obtain the results above set forth by the use of an electrode that is enclosed by a glass tube which protrudes a considerable distance beyond the upper edge of the electrode and associate such electrode with an exteriorly arranged electrode in such manner that the greatest potential stress may be directed transversely to the glass tube. We will explain our invention more in detail by referring to the accompanying drawings in which—

Fig. 1 is a side view of our improved device;

Fig. 2 is a top view thereof;

Fig. 3 is a modified form incorporating a control grid; and

Fig. 4 is a circuit showing the application of our device for purposes of charging a fence;

Fig. 5 is a circuit showing the application of our device to photo-flash purposes; and

Fig. 6 is a modification of the circuit shown in Fig. 5.

Referring more particularly to Figs. 1 and 2, we show a tube of the character described having the envelope 10 mounted in a suitable base 11, which base also carries the press 12. Extending upwardly from said press is a hollow glass tube 13 which is closed at the bottom at its connection to the press. Within said hollow glass tube we provide a hollow cup-shaped electrode 14 connected by a suitable wire 15 to one of the prongs extending from the base 11. Exteriorly of the glass tube but at about the same height as the upper edges of electrode 14 we provide the second electrode which here is shown as two separate and distinct metallic elements 16 and 17 which by means of suitable conductors are connected to another prong extending from the base 11.

Our improved device as herein shown is of such a character that the greatest stress between

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the electrodes is transversely of the glass tube. We find that a device of this nature has a wide spread between the initial break-down voltage and the quenching voltage and thus serves the purposes hereinbefore set forth to an exceptional degree. The tube itself may be filled with neon gas to the value of possible 60 mm., in which case we find the ionization or initial discharge voltage to be 600 volts and the quenching voltage 25 volts. As before stated, this is of great value when a condenser is used from which the discharge takes place to cause ionization in the tube. The condenser itself, which is more completely discharged by the use of our improved tube, may be of a low value, possible 2 microfarad, and it may be served from a 110 volt input transformer of moderate size.

Our improved tube also serves quite effectively as a trigger to govern the discharge when used in connection with a grid 18 shown more clearly in Fig. 3. The grid is an enclosing tube open at one end but provided with a cover plate 19 at the other, which cover plate however, has a central aperture 20 through which the glass tube extends and which also has openings 21 and 22 through which the discharge takes place. The shape of the holes and their distance from the electrode elements 16 and 17 govern the amount of grid blocking potential which is needed in order to bring about the result desired, these latter features being well understood in the art.

In Fig. 4 we have shown our improved device as embodied in a relaxation oscillator circuit which is adapted to cause an intermittent charge to a farm fence. This circuit consists of an input transformer having the 110 volt primary 23 and the secondary 24, which may have an output of anywhere between 400 volts to 1000 volts. The transformer is provided with a second secondary 25 which serves for filament heating purposes and also to establish a neutral connection as will be presently apparent. The circuit of the transformer includes a rectifier tube 26 having the filament 27 which is heated by the current from the coil 25. The other electrode 28 of the rectifier is connected with one terminal of the secondary 24 through a resistance 29 which may be of the order of 25,000 to 50,000 ohms. The central point of the secondary 25 is connected to one terminal 14 of our improved tube and the other electrode 16 is connected to the other terminal of the transformer secondary 24. This tube is in accordance with the circuit here shown and is adapted to cause a discharge about once per second.

Included in this connection is the primary winding of a transformer **30** whose secondary develops approximately 2,000 volts and which by means of the conductor **31** is to be associated with the fence to be charged, the other terminal **32** of the transformer being connected to ground. This transformer may be dispensed with and the fence connected directly to the tube. In this case the tube would be so designed as to have a higher striking voltage, up to 2,000 volts. The arrangement as per the values given herein is such that there will be about 40 impulses per second energizing the fence.

Connected across the conductors **33** and **34** is a 2 micro-farad condenser **35** which in the circuit shown requires roughly 60 half-wave periods of the alternating current for charging purposes. When said condenser is fully charged to the ionization voltage of our improved tube having the electrodes **14** and **16**, which in this case may be 600 volts, a discharge takes place. By reason of the improved construction of our tube the condenser discharges fully down to the quenching voltage of the tube which may be approximately 25 volts. By reason of this arrangement the condenser is almost fully discharged and a very efficient circuit is provided for the purposes set forth.

In Fig. 5 we show a similar circuit in which our improved device having the electrodes **14** and **16** is used for photo-flash purposes. In this arrangement we provide a relay **36** which controls the circuit through the conductor **33**. The circuit through the relay is controlled by a switch element **37** which is shutter controlled.

In Fig. 6 we show our improved tube having the electrodes **14** and **16** in connection with the grid **18**. In this circuit the rectifier **27***a* utilizes both half-waves of the current, the condenser **35** is again connected across the conductors **33** and **34**, but a resistance **38** is included in the conductor **34**. A condenser **39** bridges the two conductors **40** and **41** which are connected to a portion of the resistance **38** and this condenser is bridged by the shutter controlled key **37**. The grid **18** is negatively biased by being connected through a resistance **38**. In this arrangement the grid **18** controls the discharge of the tube and an energization discharge of the tube is brought about whenever the switch **37** short circuits the condenser **39**, thus to eliminate the negative bias theretofore existent upon the grid **18**.

From the above description the nature of our invention will be apparent as will also the fact that various modifications may be made from the specific embodiment shown without departing from the spirit of our invention as set forth in the accompanying claims.

What we claim as new and desire to secure by Letters Patent is:

1. An electron discharge device having an enclosing vacuous shell, an insulating tube having a closed bottom mounted therein partially defining the discharge path, an electrode within said tube terminating short of the free open mouth of said tube, a second electrode exteriorly of said tube at substantially the upper edge of said interior electrode, and a grid between the open mouth of said tube and said second electrode collaborating with said electrodes to determine, in accordance with its degree of energization, the breakdown potential of said device.

2. An electron discharge device having an enclosing vacuous shell, an insulating tube having a closed bottom mounted therein partially defining the discharge path, two electrodes between which the discharge occurs, one of said electrodes being interiorly of said tube and the other exteriorly thereof, said electrodes being so arranged relative to the upper open end of said tube that the plane of greatest electrical stress is substantially transverse to said tube, and a grid between the open mouth of said tube and said second electrode collaborating with said electrodes to determine, in accordance with its degree of energization, the breakdown potential of said device.

3. An electron discharge device having an enclosing vacuous shell, an insulating tube having a closed bottom mounted therein partially defining the discharge path, an electrode within said tube terminating short of the free open mouth of said tube, a second electrode exteriorly of said tube at substantially the upper edge of said interior electrode, and a grid between the open mouth of said tube and said second electrode collaborating with said electrodes to determine, in accordance with its degree of energization, the breakdown potential of said device, said grid having a hole through which the discharge passes.

4. An electron discharge device having an enclosing vacuous shell, an insulating tube having a closed bottom mounted therein partially defining the discharge path, two electrodes between which the discharge occurs, one of said electrodes being interiorly of said tube and the other exteriorly thereof, said electrodes being so arranged relative to the upper open end of said tube that the plane of greatest electrical stress is substantially transverse to said tube, and a grid between the open mouth of said tube and said second electrode collaborating with said electrodes to determine, in accordance with its degree of energization, the breakdown potential of said device, said grid having a hole through which the discharge passes.

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