Sept. 19, 1933. C. A. SABBAH 1,927,807

SPACE DISCHARGE APPARATUS

Filed Sept. 22, 1926

Fig. 1.

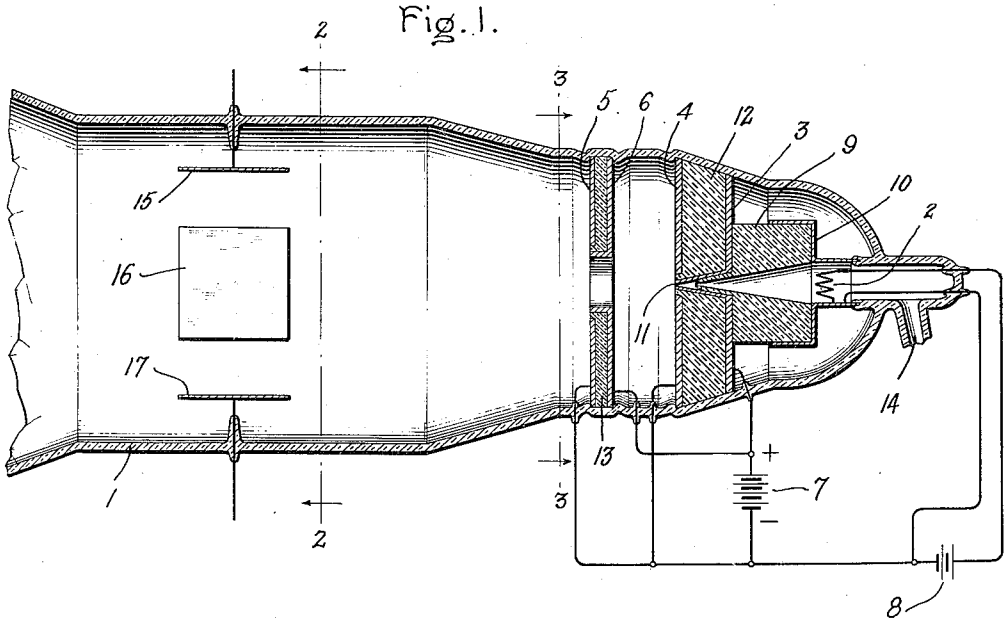


Fig. 2.

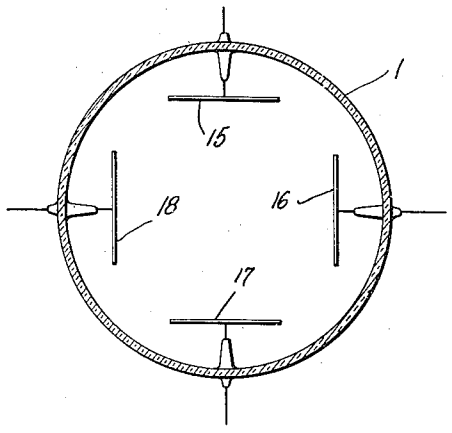
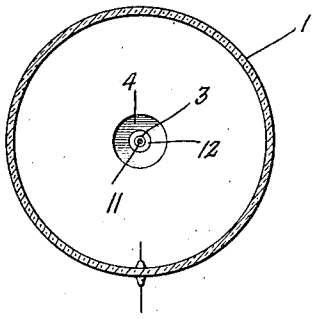


Fig. 3.



Inventor:
Camille A. Sabbah,
by Alexander F. Lane
His Attorney.

Patented Sept. 19, 1933 1,927,807

UNITED STATES PATENT OFFICE

1,927,807

SPACE DISCHARGE APPARATUS

Camille A. Sabbah, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application September 22, 1926
Serial No. 137,150

10 Claims. (Cl. 250—27.5)

My invention relates to space discharge apparatus of the type wherein current is transmitted between a cathode and anode mounted within an evacuated chamber, and has for its principal object the provision of an improved apparatus that may be sensitively operated at a comparatively low voltage to produce a very intense cathode ray, or discharge of electrons, such as is required for indicating or recording on a photographic film variations in the voltage, or other electrical conditions, of an electrical circuit.

Various devices have been provided in the past for producing a small, thin cathode ray adapted to have its position in space controlled in accordance with variation in the voltage of an electrical circuit. When such a cathode ray is utilized to record transient phenomena on a photographic film or the like, the energy communicated by the ray to each unit area of the film along the path of the bright spot which the ray produces should be maintained above a certain definite value. Since the sensitivity of the cathode ray to deflection is inversely proportional to the square of the velocity of the electrons or to the driving voltage, a low driving voltage is particularly desirable in cases where weak impulses are to be indicated or recorded. Heretofore it has been customary to maintain this required concentration of energy at the bright spot by subjecting the ray to an intense electrostatic field. This method of control, however, involves the difficulty that a comparatively high voltage must be applied between the cathode and anode of the device, thus impairing the sensitivity of the apparatus and increasing the danger of injury to the operator. In accordance with my invention, this difficulty is avoided by the provision of means arranged to produce a cathode ray of such high electronic density that sufficient energy is produced when the ray is subjected to a comparatively weak electrostatic field.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 shows a part of a sectional view of an apparatus wherein my invention has been embodied; and Figs. 2 and 3 show different sectional views of this apparatus on lines 2—2 and 3—3 of Fig. 1 respectively.

The figures illustrate a vessel 1 within which are mounted a main cathode 2, a main anode 3, auxiliary cathodes 4 and 5, and an auxiliary anode 6. Any suitable source of electrons, other than the heated filament 2, may of course be utilized. It will be observed that the anodes 3 and 6 are connected to the positive terminal of a source of current, shown as a battery 7; that the cathodes 2, 4 and 5 are connected by an equipotential conductor to the negative terminals of the source 7; and that heating current is supplied from a source 8 to the main cathode 2. An insulation or glass guide member 9 surrounded at one end by a metallic cover 10 and provided at the other end with a funnel-shaped extension is provided for directing the electrons from the cathode 2 into the minute funnel-shaped opening 11 of the main anode 3. The auxiliary cathode 4 surrounds the opening of the main anode 3, is spaced therefrom by an insulation member 12, and functions to prevent spreading and deceleration of the electronic stream, or cathode ray, as it emerges from the funnel-shaped opening of the main anode. The auxiliary anode 6 is spaced from the auxiliary cathode 4 at a distance which is preferably not greater than the mean free path of the electrons in the vessel and serves to accelerate the electrons. The auxiliary cathode 5 is insulated from the auxiliary anode 6 by means of an insulation member 13 and, like the auxiliary cathode 4, functions to prevent spreading of the ray and deceleration of the electrons as they emerge from the comparatively large opening of the auxiliary anode 6.

A connection 14 may be connected to a suitable pump for producing the required vacuum with the vessel 1. A plurality of members 15, 16, 17 and 18 are mounted within the vessel 1 for producing an electrostatic field whereby the position of the cathode ray is controlled in accordance with variation in the voltage of one or more circuits to which these members are connected. The indicating or recording part of the apparatus is located at the left hand end of the vessel 1 but has not been illustrated because it forms no part of my invention and will be readily understood by those skilled in the art.

The operation of the apparatus will be readily understood if it be assumed that the vessel 1 is evacuated and the connections are as illustrated. Under these conditions, the electrons emitted by the main cathode 2 are accelerated by the electrostatic field produced between the main cathode and anode by the source 7 and are directed into the funnel-shaped outlet of the main anode by the insulation member 9. As the electrons emerge from the opening of the main anode, they tend to spread into a large and less dense ray but are held in comparatively close proximity

to one another by the electrostatic field of the auxiliary cathode 4 and are further accelerated by the electrostatic field of the auxiliary anode 6 which tends to spread the ray but is prevented from doing so. The cathode ray is thus maintained at a density per unit of its sectional area which obviates the necessity of applying a high voltage between the main cathode and anode of the device and makes the ray extremely sensitive to weak impulses.

A small amount of potassium may be placed within the device so that any electrical charge produced on the interior surface of the insulation member 9 will tend to be dissipated by the light which emanates from the cathode 2. This result may also be effected by drawing mercury vapor or the like into the space surounding the cathode 2, thus producing a supply of positive ions whereby the charge is neutralized.

The embodiment of the invention illustrated and described herein has been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that the invention is susceptible of being modified to meet the different conditions encountered in its use and I therefore aim to cover by the appended claims all modifications within the true spirit and scope of my invention.

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

1. A space discharge device comprising an envelope enclosing a main cathode, a main anode provided with an opening, an auxiliary cathode mounted adjacent said opening, an auxiliary anode provided with an opening spaced from and alined with the opening of said main anode and a second auxiliary cathode mounted adjacent the opening of said auxiliary anode.

2. A space discharge device comprising an envelope enclosing a cathode, a funnel-shaped anode having an opening therethrough and mounted with its larger end opposed to said cathode, and a member forming a funnel-shaped passageway between said cathode and said opening.

3. A space discharge device comprising an envelope enclosing a main cathode, an anode having a funnel-shaped opening mounted with its larger end opposed to said cathode, an auxiliary cathode mounted adjacent the smaller end of said funnel-shaped anode to prevent spreading of the electrons transmitted through said opening, said auxiliary cathode and said main cathode adapted to be connected electrically by an equipotential conductor externally of the device.

4. A space discharge device comprising an envelope enclosing a cathode, an anode having a funnel-shaped passageway mounted with its larger end opposed to said cathode, electrostatic control means, an electrode mounted adjacent said passageway to control the density of the stream of electrons transmitted through said passageway, said electrode and said cathode adapted to be electrically connected by an equipotential conductor externally of the device.

5. A space discharge device comprising an envelope enclosing a cathode, an anode having a funnel-shaped passageway therethrough mounted with its larger end opposed to said cathode, electrostatic control means mounted adjacent said passageway to control the density of the stream of electrons transmitted through said passageway, and a member forming a funnel-shaped passageway between said cathode and said anode.

6. A space discharge device comprising an envelope enclosing a main cathode, a funnel-shaped anode having an opening therethrough and mounted with its larger end opposed to said cathode, an electrode mounted adjacent said opening, said electrode and said cathode adapted to be electrically connected by an equipotential conductor externally of the device and an auxiliary anode provided with an opening spaced from and alined with the opening of said main anode.

7. An electric discharge device comprising an envelope enclosing a main cathode, an anode having an opening presented to the cathode for accelerating the electrons emitted by the cathode and means for preventing the spreading and deceleration of the electron stream as it emerges from the anode opening, an auxiliary anode for accelerating the stream, said auxiliary anode having an opening through which the electron stream moves, and means for preventing the spreading and deceleration of the electron stream after it emerges from the last-mentioned opening whereby a cathode-ray stream of high electronic density is obtained.

8. An electric discharge device comprising an envelope enclosing a main cathode, an anode having an opening presented to the cathode for accelerating the electrons emitted by the cathode, and an auxiliary cathode for preventing the spreading and deceleration of the electron stream after it emerges from the anode opening, an auxiliary anode for accelerating the stream, said auxiliary anode having an opening through which the electron stream moves, and a second auxiliary cathode for preventing the spreading and deceleration of the stream after it emerges from the last-mentioned opening, each of said auxiliary cathodes being adapted to be electrically connected to the main cathode externally of the device.

9. An electric discharge device comprising an envelope enclosing a main cathode, an anode having a funnel-shaped opening with its larger end presented to said cathode, an auxiliary cathode provided with an opening which surrounds the smaller end opening of the anode, an auxiliary anode spaced from said auxiliary cathode and having an opening which is larger than the smaller end opening of the main anode and is aligned therewith, a second auxiliary cathode surrounding the opening in said auxiliary anode.

10. An electric discharge device comprising an envelope enclosing a main cathode, an anode having a funnel-shaped opening with its larger end presented to said cathode, an auxiliary cathode provided with an opening which surrounds the smaller end opening of the anode, an auxiliary anode spaced from said auxiliary cathode and having an opening which is larger than the smaller end opening of the main anode and is aligned therewith, a second auxiliary cathode surrounding the opening in said auxiliary anode, said auxiliary cathodes being adapted to be electrically connected by an equi-potential conductor to the main cathode externally of the device.

CAMILLE A. SABBAH.