June 11, 1946. B. R. CORSON 2,401,911

ELECTRON TUBE

Filed Feb. 2, 1944

Fig. 1.

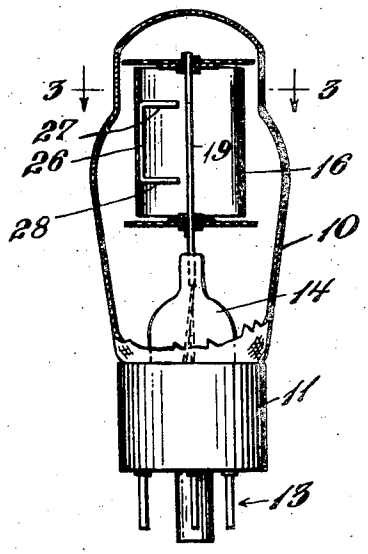


Fig. 2.

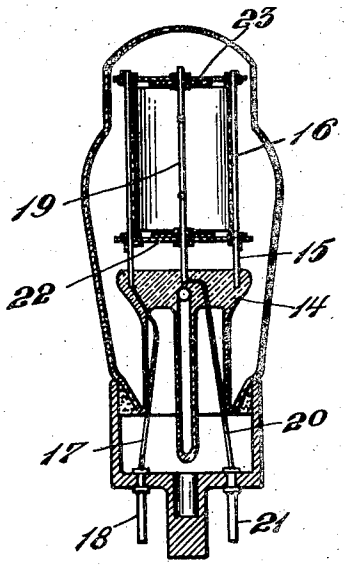


Fig. 4.

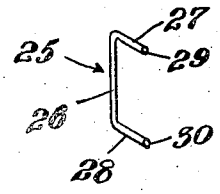
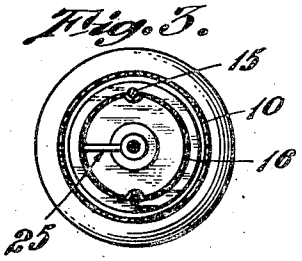


Fig. 3.



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UNITED STATES PATENT OFFICE

2,401,911

ELECTRON TUBE

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4 Claims. (Cl. 250—27.5)

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This invention relates to an electron tube and more particularly to a voltage regulator tube.

A normal voltage regulator may have a cylindrical cathode, with a cylindrical anode mounted inside the cathode and coaxial therewith. A starting electrode comprising a small piece of wire is mounted with its base on the inside of the cathode and is so bent that it extends appreciably nearer the anode than the cathode surface as a whole. In an appropriate gas or mixture of gases the current voltage characteristic of this device is such that as voltage is increased there is a negligible current flow until the starting voltage is reached. At the starting voltage ionization starts and as long as ionization is maintained the voltage across the tube is a function of the current. In general the current voltage characteristic of a voltage regulator is fairly definite and will reproduce itself if the current is turned off and on. However, this does not always hold true for the starting voltage of the tube.

It is found that two starting electrodes instead of one produce a more uniform and reproducible starting voltage. However, a further difficulty exists in the use of two starting electrodes each of an L-shaped character, one being a duplicate but with its base extending in an opposite relation to the other in that some tubes will oscillate in operation. Such oscillation does occur in tubes with a single starting electrode but is usually unimportant because the value of the current at which the oscillation takes place is outside of the operating range of current. However, when two starting electrodes are used there may be another current value at which oscillations will take place and this may fall inside of the range of the operating current.

One of the objects of this invention is to so construct a pair of starting electrodes that the starting voltage will be more nearly uniform and at the same time eliminate the oscillations which will take place at a current which is within the operating range of the tube.

Another object of this invention is to eliminate these oscillations at both the lower and higher current values as well as throughout the operating range of the tube.

Another object of this invention is to provide a simple means from a construction and assembly standpoint of accomplishing this result.

A further object of this invention is to provide a construction which will permit of low construction costs.

With these and other objects in view, the invention consists of certain novel features of construction, as will be more fully described and particularly pointed out in the appended claims.

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In the accompanying drawing:

Fig. 1 is a vertical section through the tube;

Fig. 2 is a similar view at right angles to the section of Fig. 1;

Fig. 3 is a section on line 3—3 of Fig. 1;

Fig. 4 is a perspective view of the starting electrode.

In proceeding with this invention I have found that if I provide two starting electrodes extending from the same base each substantially the same distance from the anode and attach this base to the cathode, the random starting voltages are reduced and oscillations within the operating range are eliminated. By this arrangement the construction is simplified and also manufacture and assembly costs are kept at a minimum.

With reference to the drawing an envelope 10 is mounted on a base 11 carrying contacts 13. A stem press 14 mounts supporting wires 15 which carry the cylindrical shaped cathode 16 which is connected by the lead 17 to one of the contacts 18, while the anode 19 is mounted in the stem press 14 and is connected by a lead 20 to the contact 21. Suitable insulation such as mica 22 and 23 serve to space and support the anode and cathode elements from each other.

A starting electrode is designated generally 25 and consists of a base portion 26 with projections 27 and 28 as shown in Fig. 4. The base is so mounted on the cathode 16 that the projections 27 and 28 extend radially toward the anode 19. The tip ends 29 and 30 of these projections are equally spaced from the anode a distance which is usual in spacing a single extension. This electrode 25 is formed by bending a single piece of wire in the shape shown. The distances between projections 27 and 28 is not critical and may be varied.

The basic reason for the oscillations at both the lower current and higher current values, and the elimination of the oscillation at the higher current value, may be explained best by describing the appearance of the glow on the elements of the tube as the current through the tube increases from a value which causes a glow at the tip of one starting electrode to a value which causes a glow over the whole inside surface of the cathode.

At some very low current value, the glow is merely a small round head on the tip of one starting electrode. As the current is increased the glow is enlarged in area, moving back along the starting electrode towards the base 26 and

cathode 16. Sometimes the glow will enlarge and progress beyond the bend on to the base of the electrode in a uniform continuous manner. Often this is not the case, for the glow may progress to some point, between the tip as 29 and the bend of the starting electrode, and then jump to some point on the base of the starting electrode in entirely discontinuous manner. This condition may be unstable; in some cases the glow strikes across and then falls back and then the process repeats. This is a sustained oscillation. In a tube with one starting electrode this oscillation takes place at a current which is lower than the normal operating current, and in a tube with two starting electrodes this is also possible. But when two electrodes are used each with its own base, the glow at first may enlarge on one electrode only and may cover the base of that electrode and part of the cathode before the glow starts to enlarge on the other electrode. This means that a discontinuous jump on the second electrode may cause an oscillation which is within the normal operating range of the tube.

The electrode of a single U-piece of material as in Fig. 4 eliminates the higher current oscillation. Using this shape of electrode, the glow from the first of the starting points to start will progress with increasing currents, as described in the case of the single electrode, and there may be an oscillation if the glow jumps the bend at the base of this point. From there, a further increase in current causes the glow to extend along the base of the electrode towards the other starting point. When the glow starts to progress from the second starting point towards the base, the base is already covered with the glow. In this circumstance there is no

tendency for the glow on the second starting point to make an unstable jump to the base of the electrode, and hence there is no tendency towards oscillation at this point.

The normal starting of a tube of this character may vary and normal operating range may also vary. One normal operating range which I utilize is from 5 to 30 milliamperes.

I claim:

1. In an electron tube, a cylindrical cathode, an anode within the cathode, a starting electrode comprising a base fixed to the cathode and provided with two spaced projections of the same piece of material as the base extending toward the anode and terminating substantially the same distance therefrom.

2. In an electron tube a cylindrical cathode, an anode mounted within the cathode and coaxial with it, a starting electrode comprising a base fixed to the cathode and provided with two spaced projections of the same piece of material as the base extending toward the anode to the same distance from the anode.

3. In an electron tube a cylindrical cathode, an anode within the cathode, a starting electrode comprising a U-shape piece of material with the bridging portion of the U fixed to the cathode and the legs extending toward the anode and terminating substantially the same distance therefrom.

4. In an electron tube a cylindrical cathode, an anode within the cathode, a starting electrode comprising a U-shape piece of material with the bridging portion of the U fixed to the cathode and the legs extending toward the anode to the same distance from the anode.

BAYARD R. CORSON.