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ELECTRIC DISCHARGE DEVICE

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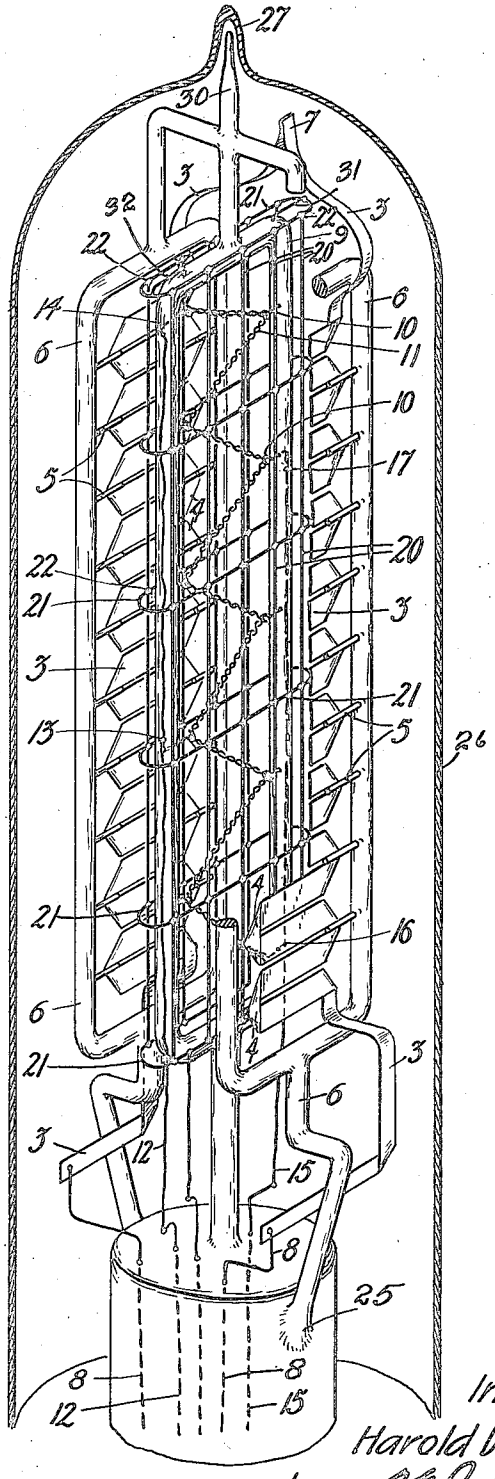

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UNITED STATES PATENT OFFICE.

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ELECTRIC DISCHARGE DEVICE.

Continuation of application Serial No. 27,222, filed May 10, 1915. This application filed February 17, 1919. Serial No. 277,578.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Electric Discharge Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to electric discharge devices and in particular to an improved construction and arrangement of electrodes for the purpose of producing a large current output therefrom.

In designing devices of this type for large current output it is sometimes essential among other things that the tube or vessel enclosing the various electrode elements should be evacuated to as high a degree as possible; a process which involves driving out any gases which may be occluded by the various metallic surfaces within the tube. This can best be done by heating the various electrode elements by some external means during the process of evacuation. Where large electrode surfaces are employed the problem of heating them to a sufficient degree to drive out these occluded gases becomes a matter of some difficulty. This is particularly true in the case of the anode or output electrode, which is customarily in the form of a plate and cannot readily be heated by passing current through it owing to its low resistance and the consequently high currents which would therefore be necessary.

This invention provides an output electrode which is made up of a plurality of bands or strips serially connected and thereby capable of being heated by the passage of an electric current through its length, thus making possible the heating of the anode during the process of evacuation without the employment of unduly high currents.

A further object of this invention is to provide a substantially continuous anode surface composed of a plurality of serially connected sections.

A further difficulty which has arisen in the design of devices of the type in question is that where a filamentary cathode is employed and the length of such cathode is increased for the purpose of obtaining a large electron-emitting area, the potential drop in the filament, due to the passage of heating current therethrough, develops a considerable difference of potential between the two ends of the filament so that when an electromotive force is impressed between one end of the filament and the anode, for example, a greater difference of potential will exist between the negative end of the filament and the anode than between the positive end of the filament and the anode. This results in an uneven distribution of the space current over the surface of the cathode and anode and prevents the operation of the device as a whole at its maximum efficiency.

In the present invention this difficulty is largely overcome by leading the heating current into and out of the filament at a plurality of points, whereby the filament is in effect divided into a number of sections connected in multiple with respect to the heating battery, and the consequent difference in potential between any two sections of the filament due to the drop therein is greatly diminished.

It has been found, however, when large electrodes are employed that the usual way of maintaining the positions of electrodes by a glass arbor supported at one end of the container is not sufficient to withstand the strains to which the arbor is subjected. In accordance with this invention, the electrodes are mounted on an insulating framework which is so supported at both ends of the container that while allowing the framework to expand and contract under heat, it still prevents any substantial lateral vibration of the structure. One way this may be accomplished is to have located at the upper end of the insulating framework, which is the end hitherto unsupported, a projecting tip or arm preferably of insulating material that fits snugly in a constricted portion or neck of the container.

Other features of this invention contributing to a high current production will appear from a consideration of the accompanying drawing, which shows in fragmentary perspective form a thermionic amplifier employing the features above mentioned. In the drawing, 3 is a metallic ribbon which is folded back and forth in zigzag formation in a plane and supported at its various folded

portions 4 by being soldered or welded to the metal pins 5, which are fused into the vertical legs of a glass supporting frame 6. The structure thus produced forms the anode member, the width of the strips comprising the anode being greater than the thickness thereof and the distance between the edges of adjacent strips being small in comparison to the width of the strips, as clearly shown in the drawings. In the case in question two of such anode elements are employed, the ribbon 3 passing serially from one anode element to the other as at 7. The two ends of the ribbon 3 are connected to leading-in wires 8, through which current can be passed to heat the ribbon 3 to the necessary temperature to drive out occluded gases.

As illustrated, the back framework 6 is supported at a definite distance from the framework 9 by means of a supporting connection which in the drawings is shown as forming a U-shaped continuation of the frameworks, the tip 30 being connected to this U-shaped portion. A similar supporting connection is provided between the framework 9 and the front framework 6. The frameworks and the electrodes supported thereby are maintained at their proper relative distances near the squash 25 by means of the supporting connections between the lower ends of these frameworks and the squash. The supporting connection provided at the outer ends of the frameworks aids in maintaining the electrodes properly positioned.

Midway between the two glass frames 6 is a third glass frame 9 having a number of supporting points 10 fused into its vertical legs and regularly spaced in such a manner that a filament 11 may be threaded back and forth thereon in the manner shown. A leading-in wire 12 is connected to the filament 11 at points 13 and 14. Another leading-in wire 15 is connected to the filament at points 16 and 17.

When a heating battery, (not shown) is connected between wires 12 and 15 current will pass through the filament, through three paths, one from point 13 to point 16, another from point 13 to point 17 and still another from point 14 to point 17. Thus, assuming a given current flow through any section of the filament, it is seen that the potential difference, due to this current flow, between any two points in the filament will not be more than one-third the potential drop which might obtain were the heating current to flow through the entire filament in series. It is obvious that a greater uniformity of potential could be obtained by dividing the filament into a greater number of sections.

A cage-like grid or input electrode surrounds the frame 9 and is formed of the vertical wires 20 and the horizontal wires 21 which are welded together at their points of intersection 22 or connected in any other suitable manner. The straight vertical wires and the turns of wire are preferably of substantially the same size as shown, although this is not essential. The curved portions 21 of the grid turns extend beyond the rods forming the frame 9. Since the cage-like grid is a rigid construction which retains its shape without additional support, the grid need not closely embrace the frame 9 as shown. Between the bends 21 and the frame 9 are the conductors 12 and 15 which connect the cathode sections in parallel. Supporting connections such as 31 and 32 may be provided between the grid and the framework 9.

The whole electrode assembly is suitably mounted on the squash 25 which is sealed into the glass vessel 26 in the usual manner (not shown) and the vessel thereupon exhausted and sealed at 27. Projecting from the framework 6 is a tip or arm 30, preferably of insulating material, that projects into the constricted portion 27 in such a manner as to prevent substantial lateral vibration of the framework 6 while still permitting this framework to expand longitudinally. This tip 30 also serves as a guide for determining and fixing the position of the framework during the process of sealing the squash 25 to the vessel.

This application is a continuation of Arnold application No. 27,222, filed May 10, 1915, for "thermionic amplifiers."

What is claimed is:

1. An electric discharge device comprising an anode composed of a plurality of parallel strips serially connected, the width of each of said strips being greater than its thickness.

2. An electric discharge device comprising a cathode, an anode and an auxiliary electrode, said anode being composed of a plurality of parallel strips lying in the same plane and connected in series, the distance between the edges of adjacent strips being small in comparison to the width of said strips.

3. An electric discharge device having a filamentary cathode composed of a plurality of zigzag sections lying in the same plane and connected in parallel.

4. An anode surface for an electric discharge device comprising a plurality of serially connected sections so arranged that the distance between adjacent sections is small in comparison to the width of one of said sections.

5. In an electric discharge device, a glass supporting frame, a plurality of supporting points thereon, a filamentary cathode supported on said points in zigzag formation, a cage-like grid surrounding said frame, a second supporting frame parallel to said

first mentioned frame, and an anode supported thereon and composed of a plurality of parallel metal strips connected in series, said strips being so arranged as to form a substantially continuous surface.

6. An electric discharge device comprising an evacuated vessel having a squash, a plurality of electrode supports independently supported at one end from said squash and means connecting the other ends of said supports to maintain said ends in fixed spaced relation.

7. An electric discharge device comprising an evacuated vessel having a squash, an anode, a cathode, a control electrode, a framework on which said anode is mounted, a second framework on which another of said electrodes is mounted, connections between said frameworks and said squash, means remote from said squash for preventing relative movement of said frameworks, and means for preventing substantial vibration of said frameworks within said vessel.

8. An electric discharge device comprising an evacuated vessel having a squash, an anode, a cathode, a control electrode, a framework on which said anode is mounted, a second framework on which another of said electrodes is mounted, connections between said frameworks and said squash, means remote from said squash for preventing relative movement of said frameworks, said vessel having a constricted portion, and an arm extending from said frameworks into said constricted portion.

9. An electric discharge device comprising a plurality of parallel electrode surfaces, each comprising a plurality of parallel strips, the distance between the edges of adjacent strips being small in comparison to the width of said strips, a framework for each of said surfaces, and means for holding said frameworks apart.

10. In an electric discharge device, an electrode comprising intersecting wires secured together at their intersections forming a flattened cylinder.

11. A thermionic device comprising an anode, a cathode, a grid enclosing said cathode, said cathode extending laterally beyond the longitudinal centre of said grid, and said grid comprising a plurality of turns, surrounding said cathode and a wire crossing said turns and welded thereto.

12. An electric discharge device, an electrode comprising a plurality of relatively widely spaced turns of wire, a plurality of supporting wires intersecting said turns and secured thereto to maintain the spaced relation between said turns.

13. An electric discharge device comprising an anode, a cathode and a grid, said grid having turns surrounding said cathode, a support for said grid and cathode comprising a rod within said turns, said turns extending beyond said rod, and means for supporting said grid by said rod.

14. An electric discharge device comprising an anode, a cathode and a cage-like grid, a support comprising a rod with in said grid, a cathode supported by said rod, said grid loosely embracing said rod, and a supporting connection between said rod and said grid.

15. An electric discharge device comprising a cathode having a plurality of sections adapted to be connected in parallel, a grid having turns surrounding said sections, a rod adapted to support said turns but spaced therefrom, a supporting connection between said rod and said grid, a conductor supported by said rod and connected to a plurality of said sections, and a cooperating anode.

16. An electric discharge device comprising a cathode having a plurality of sections connected in parallel, a grid having turns surrounding said sections, a pair of parallel rods adapted to support said turns but spaced therefrom, a supporting connection between said rods and said grid, a plurality of parallel extending conductors connecting said sections in parallel, and a cooperative anode.

17. In an electric discharge device, an electrode comprising a ribbon of conducting material folded back and forth on itself to provide a plurality of sections of ribbon lying in a substantially plane surface.

In witness whereof, I hereunto subscribe my name this 7th day of February, A. D. 1919.

HAROLD D. ARNOLD.