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E. J. WALSH

2,509,947

MULTIUNIT ELECTRONIC DISCHARGE DEVICE

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FIG. 1

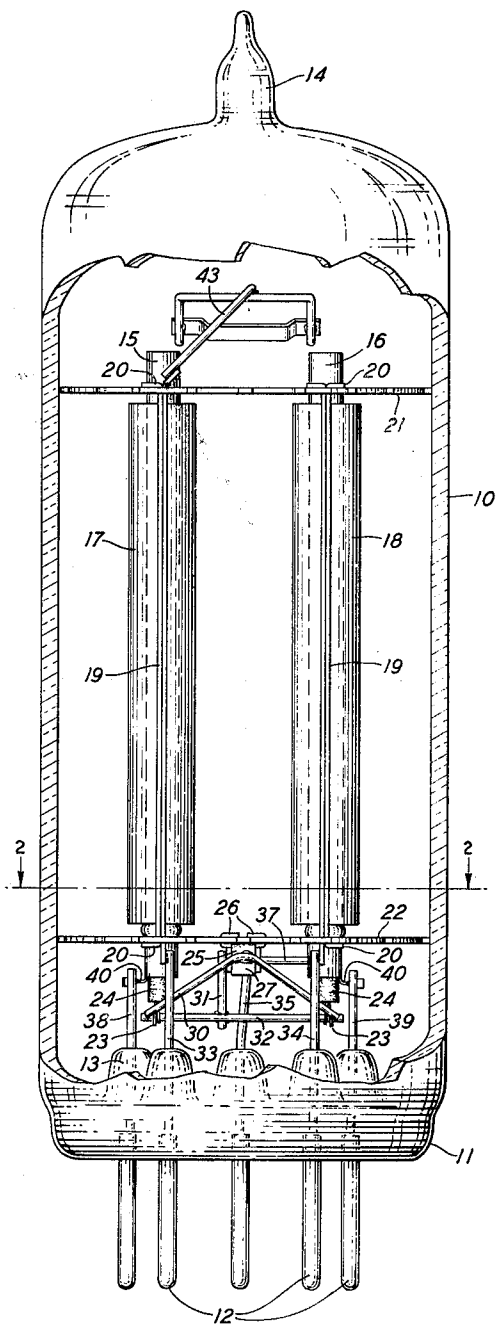


FIG. 2

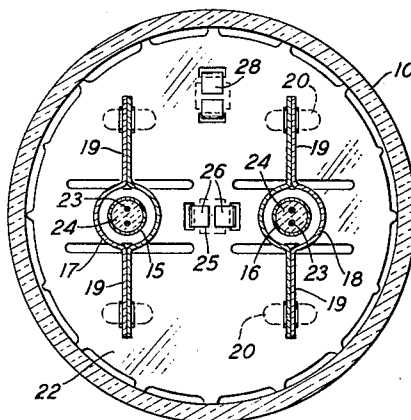


FIG. 3

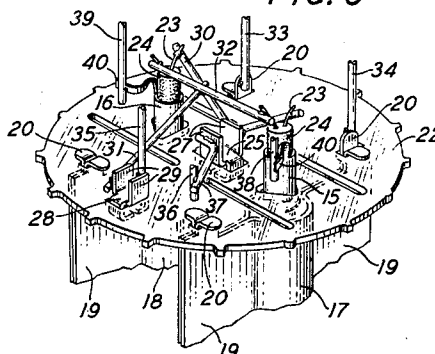
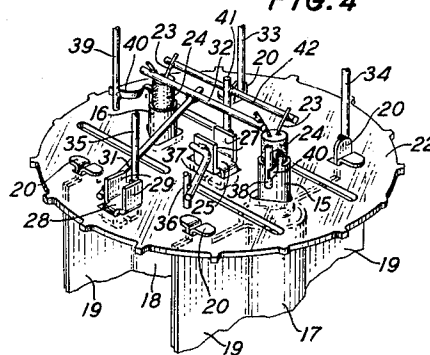


FIG. 4



INVENTOR
E. J. WALSH
BY *J. J. Hunter*
ATTORNEY

UNITED STATES PATENT OFFICE

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MULTIUNIT ELECTRONIC DISCHARGE
DEVICE

Edward J. Walsh, Tenafly, N. J., assignor to Bell
Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

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8 Claims. (Cl. 250—27.5)

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This invention relates to electronic discharge devices and more particularly to electrode assemblies therefor.

Principal among the objects of the invention are to facilitate the fabrication of multiple unit assemblies of electrodes in discharge devices and to expedite the efficient coupling of the electrodes to the terminals of the device.

Another object of the invention is to coordinate the connections of multiple units of electrodes in an integral assembly which may be readily mounted in an enclosing vessel.

A further object of the invention is to substantially eliminate defective or loose connections between the electrodes and the external terminals of the device.

Another object of the invention is to avoid damage to fragile and delicate components in the electrode assembly by shock or vibration acting on the direct junction of such components with rigid terminal elements in the stem of the device.

Still another object of the invention is to relieve strains between certain electrodes and the terminals in the device.

A further object of the invention is to increase the operating life of multiple electrode devices by providing a connector arrangement integral with the unitary assembly for joining the electrodes or elements thereof in multiple so that a pair of external terminal conductors will suffice to supply energy to the electrodes.

These objects are attained in accordance with general aspects of this invention by the association of similar functional electrodes, for example multiple electron emitters, particularly of the indirectly heated type, in a unitary assembly and providing auxiliary wire connectors at the terminal end of the unit which are carried by clips or metallic members anchored to the insulating spacer disc of the unit adjacent the basal end of the device. The clips provide integral connections on the unit assembly which are stable in relation to the unit so that the fragile ends of the heater elements of the emitters may be secured to the connectors without danger of disruption by shock applied to the terminal end of the discharge device in which the unit is mounted. In a specific embodiment, the invention relates to a full-wave rectifier device having a pair of sleeve cathodes surrounded by similar shaped anodes and mounted between insulating spacer discs. The cathodes are provided with internal heater elements in the form of fragile hairpin-shaped wires which are insulated from

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the cathode sleeves and the ends of which extend from the lower or terminal end of the cathodes.

Since damage to the heater wire elements will render the device inactive and thereby shorten the operating life, it is essential that the fragile wire be protected against rupture due to vibration or shock imposed through the enclosing vessel of the device. Accordingly, the terminal ends of the heater elements are not connected directly to the rigid terminals or external prongs in the stem or mounting end of the device but are joined to auxiliary connector arms which are supported by anchor clips secured to the lower spacer disc of the unitary electrode assembly.

A feature of this construction is the location of the clips with respect to the cooperating terminals of the heater elements in the stem of the device. One clip is centrally mounted on the disc and carries an elbow-shaped connector having the ends laterally in position close to the ends of the multiple heaters in the cathodes and the other clip is mounted in offset position on the spacer disc and carries a T-shaped connector with the ends thereof laterally adjacent the opposite ends of the elbow connector and oppositely positioned with respect to the ends of the heater elements extending from the cathodes.

Another feature of the invention relates to the coupling of the various electrodes in the unit, including the heater elements, to the rigid terminals on the base end of the device. Since standard practice usually groups the heater terminal pins in adjacent positions on a circular boundary with the other terminals of the electrodes in the stem of the device, the clips provide readily accessible means for coupling the heater elements to the terminals without introducing crossing wires which might reduce the insulation resistance between the electrodes in the device. The offset clip is in line with one of the heater terminal pins in the stem so that a direct connection may be made to join one side of the heater circuit to the external terminal. The adjacent terminal pin extends in parallel relation toward the unit and the central clip is joined thereto by a transverse strap wire extending radially between the clip and the terminal. The other terminals are connected to the cathodes and anodes directly aligned therewith.

The respective heater element connectors provide an efficient assembly of all the electrodes in a self-contained unit in which the fragile ends of the heaters are affixed to anchored wire arms included in the unitary assembly. Further-

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more, the coupling of the terminal pins in the vessel to the clips eliminates damage or distortion of the fragile heater elements and thereby improves the operating efficiency of the device.

These and other features and advantages of the invention will be apparent from the following detailed description when considered in connection with the various figures in the drawing in which:

Fig. 1 is a view in elevation of one device illustrative of this invention with the vessel partly broken away to illustrate the internal components of the multiple electrode assembly;

Fig. 2 is a plan view of the device on the line 2—2 of Fig. 1 in a direction toward the bottom insulator spacer, showing the positions of the clips and the relationship of the electrodes in the unitary mount;

Fig. 3 is a perspective view of a portion of the unitary mount in reverse relation to Fig. 1 in combination with the respective terminals of the base end of the device cooperating with the various elements in the mount; and

Fig. 4 shows a modified arrangement of the heater connections in a perspective view of the lower portion of the electrode unit.

Referring to the drawings and particularly to Figs. 1 and 2, the invention is illustrated in a multiple unit device, specifically a full-wave rectifier, the units are mounted as an integral assembly in a highly evacuated enclosing vessel 10 having a molded flat stem 11 at one end supporting a plurality of terminal pins 12. The pins are arranged in a circular boundary with the hermetic seals thereof reinforced within the vessel by molded glass abutments or pillars 13. The opposite end of the vessel is closed by a sealing tip 14 after the electrode mount is located therein and the device evacuated to a high degree to insure that the discharge is of the pure electron type. A pair of sleeve cathodes 15 and 16 and a pair of coaxial anodes 17 and 18 are mounted in parallel relation by transverse spacer members extending across opposite ends of the main electrode assembly. Each anode is provided with oppositely disposed lateral heat radiating fins 19 extending across one diameter of the anode with the ends of the fins provided with bent ears 20 which lock the anodes to the transverse mica spacer discs 21 and 22 located at opposite ends of the assembly. The cathodes 15 and 16 extend through triangular-shaped apertures in the mica discs to provide a limited contact between the cathode and mica discs so that heat dissipation from the cathodes is minimized. Each cathode surrounds a cylindrical ceramic insulating mass 24 which forms the support for an internal heater element 23 in the form of a hair-pin-shaped tungsten wire for heating the cathodes by conduction to energize the usual emissive coating on the cathodes.

All of the electrodes except the heater elements involved in the electrode mount are sufficiently rugged to withstand shocks and vibrations imparted to the enclosing vessel due to handling in use or in transit and in operation. However, the fragile heater wire elements present certain difficulties in coupling the ends thereof to the terminal pins of the device, since the direct connection between heavy terminal pins and the fragile wire elements creates severe strain when the device is subjected to vibration or shock. Furthermore, the coupling of the delicate heater elements to the terminal pins in the device when the mount is assembled during manufacture entails con-

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siderable difficulty in securing a strong joint between the large diameter terminal pins and the frail wire employed for the heater elements.

In accordance with features of this invention, these difficulties are overcome and an efficient assembly is realized whereby the delicate heater elements are coupled to the terminal pins of the device without danger of mechanical strain being imparted to them or the liability of insecure joints between the ends of the heater elements and the terminal pins of the device. Furthermore, the construction of this invention provides coupling for the ends of the heater elements which are integral with the unit as a whole so that the connections for the heater elements are joined to the unitary mount of the electrode assembly to form a rigid structure and then connection to the terminal pins is expediently provided by coupling connections on the mount. In this manner, the terminal pins for the heater elements are connected to rigidly mounted anchoring components on the unit and these components are joined to the heater elements through coupling connectors so that the heaters are indirectly attached to the terminal pins of the device whereby shock and vibration imparted to the terminal pins do not affect the delicate wire elements extending within the cathodes.

As shown in Figs. 2 and 3, a central clip 25 formed of a cruciform metallic punching it attached to the lower mica disc 22 by a pair of oppositely disposed bent lugs 26 and the remaining lugs or ears 27 are bent in parallel relation in the opposite direction away from the lower surface of the disc 22. A similar clip 28 is mounted in offset relation across one diameter of the disc 22 and secured to the disc as shown, with the depending ears 29 extending in a transverse direction with respect to the ears 27 of the central clip. The arrangement of the clips provides parallel rigid ears on the central clip in parallel relation to the terminal ends of the heater elements and parallel rigid ears on the offset clip perpendicular to the terminal ends of the heater elements in the cathodes.

One of the ears 27 on the central clip forms a base support for an angular-shaped connector arm 30, shown in Figs. 1 and 3 as an elbow-shaped connector, centrally attached to one of the ears 27 and the angular arms extending toward and parallel to one end of each heater element mounted within the cathodes, the terminal ends of the heater elements on one side of the circuit being connected by welding to the arms of the connector 30. A T-shaped connector 31 extends from one ear 29 of the offset clip and carries a transverse arm 32 having the ends thereof parallel to the elbow-shaped connector 30 and adjacent to the other ends of the heater elements on the opposite side thereof, to facilitate the welding of the remaining ends of the parallel heater elements to this connector. This arrangement provides rigid connectors on the unitary assembly of electrodes for coupling the heater elements in parallel relation in the mount of the assembly and eliminates the transmission of vibration or shock to the delicate heater elements.

After the heater connections are completed on the unitary mount, the assembly in the enclosing vessel of the device is readily made to support the unit on the stem and connect the various electrodes to the terminal pins. This is accomplished by welding a pair of wire extensions 33 and 34, which form continuations of a pair of adjacent terminal pins in a circular boundary on

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the stem of the device, to the upstanding lugs 20 of the anodes projecting from the bottom of the lower insulator 22. Another extension 35 is welded to the remaining ear 29 on the offset clip to connect one side of the heater elements in parallel to the external circuit, the extension 35 being in alignment with the clip, as shown in Fig. 1. An adjacent terminal pin extension 36 is connected to the remaining ear 27 of the central clip by a transverse strap wire 37 to complete the connections of the heater elements in the external circuit without the danger of crossing wires between opposite ends of the heater elements which would be apt to cause difficulties between the various connections of the elements in the device by leakage or short circuits due to contact. The remaining upright extensions 38 and 39, oppositely disposed between the previously described pairs of extensions in a circular boundary, are connected to the cathodes 15 and 16, respectively, by short flexible straps 40, to complete the coupling of all the elements in the mount assembly to the external terminal pins on the base end of the device.

As shown in Fig. 4, the connector assembly of the heater elements may be modified by attaching an additional T-shaped connector 41 to one ear of the central clip, the transverse arm 42 of the connector being parallel to the arm 32 of the other connector and both being parallel to the heater elements which are connected to the ends thereof.

Before the unit is assembled in the enclosing vessel 10, a getter mounting 43 is attached to an upturned ear 29 on one of the anode assemblies and the getter is flashed in the final processing of the device to fix residual gases not removed by the usual pumping procedure.

While the invention has been disclosed in connection with various embodiments of a full-wave rectifier device, it is, of course, understood that the coupling connectors may be embodied in other devices employing multiple electrodes in which a plurality of heatable elements are connected in parallel for coupling to a pair of terminal pins of the device. Also, while specific embodiments of the clips and connectors are shown, it is, of course, understood that various modifications may be made in the detailed assembly without departing from the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel having a base end including a plurality of terminal pins, a multiple electrode unit supported in said vessel including a pair of sleeve cathodes and coaxial anodes, spacer insulating discs supporting said cathodes and anodes in parallel relation therebetween, individual hairpin-shaped heater elements extending through said cathodes with the terminal ends thereof projecting towards the base end of said vessel, a metallic clip centrally secured to one of said spacer members, another clip secured to the same spacer member in offset position with respect to the central clip, angle-shaped connectors extending from said clips with the ends thereof laterally adjacent the terminal ends of said heater elements, said terminal ends being fastened to the ends of said connectors, and leads joining a pair of said terminal pins to said clips.

2. An electron discharge device comprising an

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enclosing vessel having a base end including a plurality of terminal pins, a multiple electrode unit supported in said vessel including a pair of sleeve cathodes and coaxial anodes, spacer insulating discs supporting said cathodes and anodes in parallel relation therebetween, individual heater elements extending through said cathodes and having terminal ends projecting towards the base end of said vessel, a metallic clip centrally secured to one of said spacer members, another clip secured to the same spacer member in offset position with respect to the central clip, an elbow-shaped connector projecting downwardly from said central clip, a T-shaped connector extending from said other clip, the ends of both connectors being positioned alongside the terminal ends of said heater elements and attached thereto, and leads extending between a pair of terminal pins and said clips.

3. An electron discharge device comprising an enclosing vessel having a base end including a plurality of terminal pins in a circular boundary, a multiple electrode unit including a pair of sleeve cathodes and coaxial anodes, spacer insulating discs supporting said cathodes and anodes in parallel relation therebetween, individual hairpin-shaped heater elements extending through said cathodes with the terminal ends thereof projecting towards the base end of said vessel, a metallic clip centrally secured to one of said spacer members, another clip secured to the same spacer member in offset position with respect to the central clip, an elbow-shaped connector projecting downwardly from said central clip, a T-shaped connector extending from said other clip, the ends of both connectors being positioned alongside the terminal ends of said heater elements and attached thereto, said anodes being directly connected to a pair of adjacent terminal pins, another pair of adjacent terminal pins being directly connected to said clips, and oppositely disposed terminal pins intermediate said pairs being directly connected to said cathodes.

4. An electron discharge device comprising an enclosing vessel having a base end including a plurality of terminal pins, an electrode unit supported in said vessel including a pair of sleeve cathodes, a pair of transverse spacer discs supporting said cathodes in parallel relation, heater elements extending through said cathodes, each of said elements having a pair of terminals projecting beyond the adjacent spacer disc towards the base end of said vessel, a metallic clip centrally attached to said adjacent spacer disc and having a pair of parallel ears projecting therefrom, another similar clip attached to the same spacer disc in offset relation, an angular wire connector attached to one ear of said central clip, a T-shaped wire connector attached to one ear of the offset clip, the ends of the transverse arm of the T-connector and the angular connector being in parallel relation adjacent the terminal ends of said heater elements and attached thereto, one of said terminal pins being in direct alignment and attached to the other ear of said offset clip, and a transverse wire joining the remaining ear of said central clip to an adjacent terminal pin.

5. A discharge device assembly, in accordance with claim 4, in which the ears of said clips extend in perpendicular relation with respect to the diametral dimension of said spacer disc.

6. A discharge device assembly, in accordance with claim 4, in which the ears of said central

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clip are parallel to said angle connector and the ends of the heater elements attached thereto.

7. An electron discharge device comprising an enclosing vessel having a base end including a plurality of terminal pins, a multiple electrode unit mounted in said vessel, said unit including a pair of sleeve cathodes, and parallel folded heater elements extending individually within said cathodes, said cathodes and elements being mounted between transverse spacer discs in parallel relation, said elements having their terminal ends extending beyond the spacer disc adjacent the base end of said vessel, a pair of bent metallic angular clips attached to the latter spacer member and projecting towards said base end, and a pair of similar-shaped connectors attached to said clips and extending laterally with respect to the terminal ends of said heater elements, the latter being attached to said connectors in parallel relation, said clips being joined to a pair of adjacent terminal pins in said vessel.

8. An electron discharge device comprising an enclosing vessel having a base end including a plurality of terminal pins, a multiple electrode unit mounted in said vessel, said unit including a pair of sleeve cathodes and folded insulated heater elements extending therein, said cathodes being mounted in parallel relation between up-

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per and lower spacer members extending across said vessel, said elements having their terminal ends extending beyond said lower spacer member, a pair of metallic U-shaped clips attached to said lower spacer member and projecting towards said base end of said vessel, and a pair of T-shaped connectors extending from said clips, the free ends thereof being laterally positioned with respect to the terminal ends of said elements and attached thereto in parallel relation, said clips being joined to a pair of adjacent terminal pins in said vessel.

EDWARD J. WALSH.

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