

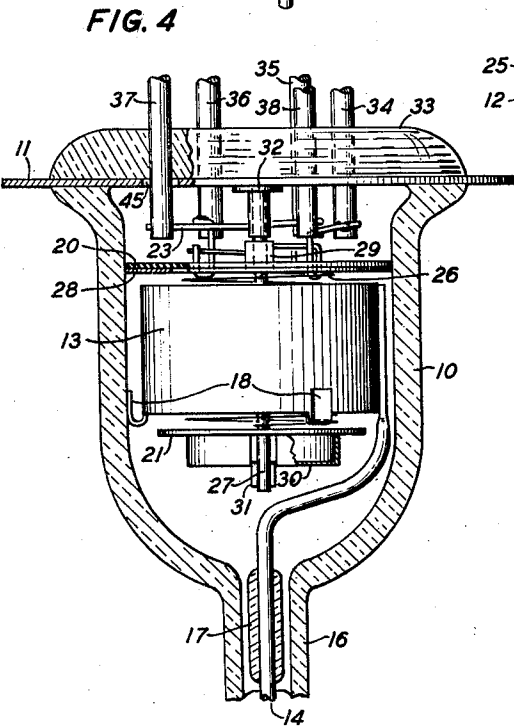
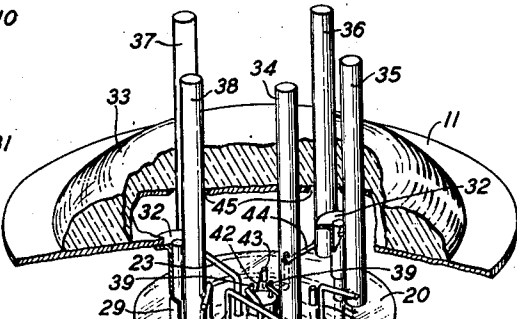
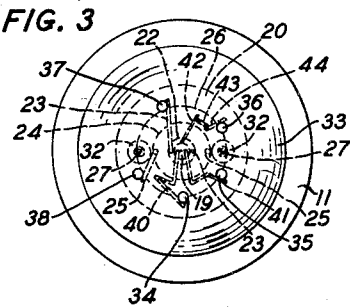
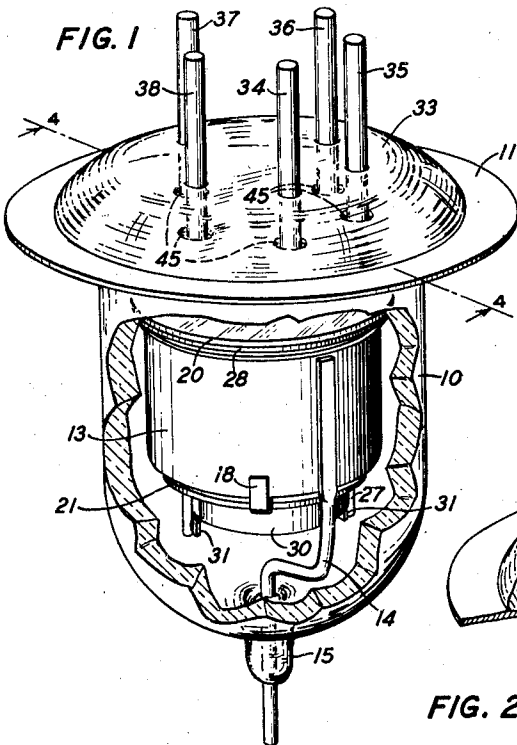
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J. P. LAICO

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ELECTRON DISCHARGE DEVICE

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INVENTOR
J. P. LAICO
BY
Walter C. Kiesel
ATTORNEY

UNITED STATES PATENT OFFICE

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ELECTRON DISCHARGE DEVICE

Joseph P. Laico, Brooklyn, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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6 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices employed in ultra-high frequency systems.

In such systems it is essential to shield the electrode terminal conductors from interacting stray electrostatic fields and an efficient assembly for accomplishing this purpose involves a structure in which the shield forms part of the enclosing vessel as set forth in United States Patent No. 2,125,317, issued August 2, 1938, to V. L. Ronci. When the mass of the shield is sufficient to withstand the different pressures acting on the shield, no detrimental effects are liable to occur. However, if it is necessary for physical or electrical requirements to reduce the mass of the shield or increase the size of the shield to a point where it is ineffective to overcome the counteracting pressures, serious "diaphragm action" occurs and difficulty may be experienced in the operation of the device due to variations in the space relationship of the elements supported by the thin shield.

An object of this invention is to overcome "diaphragm action" in electron discharge devices.

Another object of the invention is to strengthen the shield material in such manner that the physical and electrical requirements are not jeopardized.

In accordance with one aspect of this invention, the shield portion of the discharge device is reinforced by a pressure resistant material which overcomes diaphragm action in the shield and thereby insures accurate and stable spacing of the elements in the discharge device.

In a specific embodiment of the invention, the discharge device comprising a vitreous shell for substantially enclosing the electrodes of the device, the shell being closed by a metallic shield which is sealed to the edge of the shell. The external surface of the shield is covered or coated with an insulating mass which is rigid and therefore resists the force of the external pressure against the thin shield.

A feature of the invention relates to the assembly of the device in which the insulating mass also supports the conductors for the various electrodes of the unit.

Another feature of the invention relates to the electrode assembly being mounted on the disc shield as a unit to facilitate centering of the unit and shield with respect to the enclosing shell. This is accomplished by providing the electrode unit with a disc spacer which engages the internal wall of the vessel and since the unit is

attached to the disc shield the assembly may be accurately centered in the enclosing vessel without the aid of gauges. This arrangement facilitates assembly, reduces manufacturing cost and materially increases quantity production.

These and other features of the invention will be more clearly understood from the following detailed description when considered with the accompanying drawing:

Fig. 1 is an enlarged perspective view of a discharge device made in accordance with this invention with a portion of the enclosing vessel broken away to show details of the internal electrode assembly;

Fig. 2 is an exploded perspective view of the discharge device shown in Fig. 1 with portions of the elements broken away to show the assembly of the unitary electrode mount and the relationship of the various elements entering into the complete assembly of the discharge device;

Fig. 3 is a plan view of the top of the discharge device, as illustrated in Fig. 1, showing the connections of the various internal elements of the discharge device to the terminal conductors extending through the top of the device; and

Fig. 4 illustrates in cross-section the relationship of the various elements shown in Figs. 1 and 2 in accordance with the teachings of this invention and illustrates an arrangement for evacuating the device after complete assembly.

Referring to the drawing, the discharge device of this invention, which is shown enlarged approximately five times to clarify the disclosure since the actual device strikingly simulates an "acorn" in configuration and size, is highly efficient in ultra-high frequency systems, due to the compactness of the electrode assembly and the provision of short conductors which satisfy the electrical requirements for the operation of the device at definite wave-lengths.

The device embodies an enclosing vessel having a vitreous cup-shaped portion for open-ended shell 10 and a metallic disc closure 11, preferably of copper, hermetically sealed to the rim 12 of the shell, preferably in accordance with a method disclosed in a United States Patent to V. L. Ronci, No. 2,125,316, issued August 2, 1938. A cylindrical metallic anode or output electrode 13 is situated within the cylindrical portion of the shell 10 and is provided with a leading-in conductor 14 which is sealed in the closed end of the shell at a central point as shown at 15. A convenient method of sealing the anode in position is shown in Fig. 4 in which a glass tube-

lation 16 extends from the shell 10 and may be sealed to a header, not shown, of an evacuating or pumping station. The anode conductor 14 is provided with a glass bead 17 located within the tubulation 16 so that upon completion of the pumping procedure the glass tubulation may be heated and collapsed about the bead 17 and fused thereto to form a hermetically sealed joint for the conductor 14. Prior to the sealing of the conductor 14 in the shell, the anode 13 is held in suitable relation to the inner wall of the shell by a plurality of bent ears 18 which engage the wall of the shell and center the anode 13 in the device. After the completion of the sealing of the anode in the device it is, of course, apparent that the extending ears of the anode maintain the anode in proper relation to the wall of the enclosing vessel.

The remaining electrodes of the device are assembled in a unitary mount, as shown more clearly in Fig. 2, and inserted in the shell 10 through the open end thereof prior to the sealing of the metallic disc closure 11 to the shell. The unitary mount or electrode assembly includes the following elements: A central cathode 19 which may be of the equi-potential type provided with the usual internal heater, is mounted in an axial position and embraced at opposite ends by individual mica spacer discs 20 and 21. A helical control grid 22 closely surrounds the cathode and is supported by a pair of parallel wires 23 which extend through the mica spacers 20 and 21. A second or screen grid 24 of larger diameter coaxially surrounds the cathode and the inner grid and is spaced in suitable relation thereto by a pair of parallel wires 25 having their ends extending through suitable apertures in the mica spacers in alignment with the supporting wires 23 of the inner grid. A third or suppressor grid 26 coaxially surrounds the aforementioned electrodes in the unit and this grid is supported by parallel rigid wires 27 which extend beyond the spacer discs 20 and 21 further than the wires 23 and 25 of the smaller grids. The mica spacer disc 20 is held rigidly in position by a metallic ring shield 28 which lies in face-to-face relation with the disc 20. The ring 28 is provided with bent ears 29 at opposite positions on the inner periphery thereof to fit into slots in the mica disc 20, the ears being secured to the outer grid support 27, as by welding. The mica spacer 21 is held rigidly in position by a metallic cap shield 30 which encloses the projecting ends of the cathode and the wire supports of the inner control grid and screen grid 22 and 24 and is secured to the support wires 27 of the outer or suppressor grid 27 by bent tabs 31.

The unitary mount is rigidly secured to the metallic disc closure shield 11 by metallic eyelets 32. The electrode assembly or unitary mount is accurately spaced in the vessel 10 with respect to the anode by forming the mica spacer 20 with the same diameter as the internal diameter of the shell 10 and sliding the unit into the shell to locate the unit in lateral relation to the surface of the anode as shown clearly in Fig. 4. It will also be apparent in this figure that the metallic ring shield 28 forms a magnetic shield between the anode 13 and the terminations of the input electrodes, namely, the cathode and control grid. In a similar manner the cap shield 30 protects the input electrodes from the electric fields of the anode and its conductor 14 lying adjacent to the unit.

In order to provide an efficient and permanent

seal between the shell 10 and the metallic shield 11, one of the primary considerations is to employ a metallic disc of thin material so that the glass is thoroughly wetted to the surface of the copper. When such a seal is completed and the device highly evacuated to obtain a pure electron discharge certain difficulties arise due to the difference in pressure within the device and external to the metallic shield or disc closure. The external pressure may produce a "diaphragm action" on the thin disc shield thereby causing variations in the space relationship of the electrode unit and the anode which may seriously affect the operating efficiency of the device.

In accordance with this invention, the objectionable "diaphragm action" of the disc shield is completely overcome by coating or affixing a pressure resistant mass or layer over the disc shield surface equivalent to the diameter of the shell. An embodiment of the invention is shown in which a mass of glass or other vitreous material 33 is formed on the metallic closure 11 and sealed to the exterior surface of the disc 11 so that the mass extends over the area of the disc sealed to the rim 12 of the shell 10 and also over the area of the disc within the boundary of the shell. A sufficient annular rim of metal is thereby provided by the disc 11 to form a contact surface for applying a suitable potential to the suppressor grid and to associate an external shielding support with the disc shield 11 of the discharge device.

When the pressure resistant mass is formed of vitreous material, the terminal conductors of the electrode unit may be conveniently sealed therein to support these conductors and insure the provision of relatively short leading-in wires for the electrodes which materially increases the efficiency of the device due to the low conductance of the leading-in wires. As shown in the drawing, five parallel conductors project from the mass 33 and are arranged on a circumference of a circle as shown in Fig. 3 so that the external connections for the heater element are segregated from the external connection for the control grid to provide adequate insulation paths between these elements external to the device. The internal heater element of the cathode 19 is provided with two parallel terminations 39, as shown in Fig. 2, which are connected to the ends of bent connecting wires 40 and 41 which are locked in the mica spacer 20, the wires being connected at the other end to the terminal conductors 34 and 35, respectively. The cathode 19 is connected to a flexible wire 42 having its end welded to a U-shaped wire 43 locked in the insulating disc 20. A connecting wire 44 coupled to the wire 43 and the conductor 36 completes the connection of the cathode to the external leading-in wire 36. The control grid 22 has one of its supporting wires 23 made relatively long beyond the mica disc 20 and this wire is connected to the terminal conductor 37 and the long extending wire 25 of the screen grid 24 is bent at an angle and connected to the terminal conductor 38. The five conductors sealed in the vitreous cap 33 extend through large apertures 45 in the disc closure 11 to avoid a conductive connection to the disc shield 11 and prevent interference between the suppressor grid circuit and the input electrodes.

While the main principle of this invention has been disclosed in relation to an "acorn" type device it is, of course, understood that the pressure resistant mass element of this invention may be applied to other types of devices in which a

wall of the enclosing vessel is formed of a metallic member of insufficient strength to withstand external pressure and thereby overcome the serious difficulty of "diaphragm action" in the metallic wall of the device. Furthermore, various other changes may be made in the details of the assembled structure as disclosed without departing from the scope of the invention as defined in the appended claims.

10 What is claimed is:

1. An electron discharge device comprising a shell open at one end, a metallic disc shield sealed to the edge of said open end shell, a plurality of electrodes within said shell, conductors connected to said electrodes and extending through said disc shield, and a pressure resistant mass sealed to said disc shield over an area defined by the outer boundary of said shell.

2. An electron discharge device comprising a shell open at one end, a metallic disc shield sealed to the edge of said open end shell, a plurality of electrodes within said shell, conductors connected to said electrodes and extending through said disc shield, and a pressure resistant mass in contact with said disc shield over substantially the entire surface thereof, said mass being sealed to said disc.

3. An electron discharge device comprising a shell open at one end, a metallic disc shield sealed to the edge of said open end shell, a plurality of electrodes within said shell, and supported by said

disc shield, conductors connected to said electrodes and extending through said disc shield, and a pressure resistant mass sealed to that area of said disc shield within the boundary of the inner edge of said shell.

4. An electron discharge device comprising a shell open at one end, a metallic disc shield sealed to the edge of said open end shell, a plurality of electrodes within said shell, conductors connected to said electrodes and extending through said disc shield, and a vitreous cap engaging the external area of said disc shield substantially equal to the circular area of said shell.

5. An electron discharge device comprising a vitreous shell open at one end, an internal electrode supported thereby, an apertured metallic disc sealed to the open end of said shell, a plurality of electrodes within said internal electrode, conductors for said electrodes extending through said apertured disc, and a pressure resistant layer sealed to the external surface of said disc.

6. An electron discharge device comprising a vitreous shell open at one end, an internal electrode supported thereby, an apertured disc sealed to the open end of said shell, a plurality of electrodes within said internal electrode, conductors for said electrodes extending through said apertured disc, and a layer of vitreous material engaging the external surface of said disc, said layer embracing and supporting said conductors.

JOSEPH P. LAICO.