

May 23, 1950

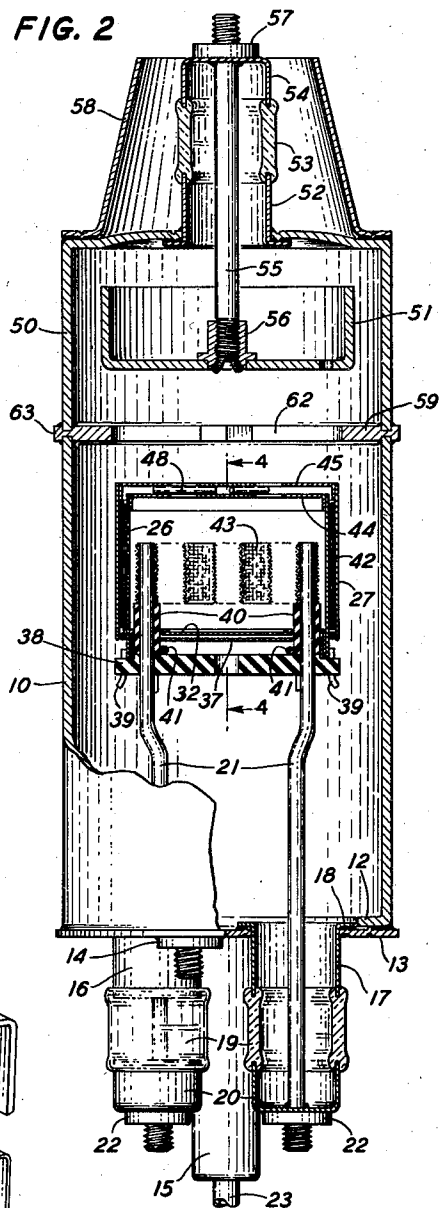
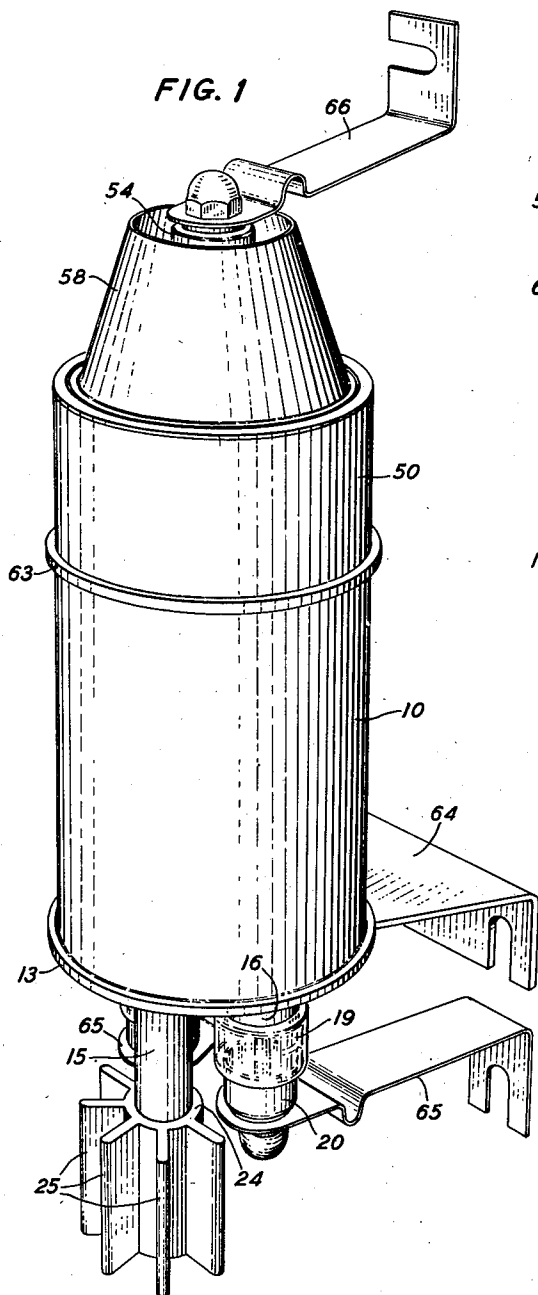
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2,508,529

GASEOUS ELECTRONIC DISCHARGE DEVICE

Filed March 6, 1948

3 Sheets-Sheet 1



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FIG. 6

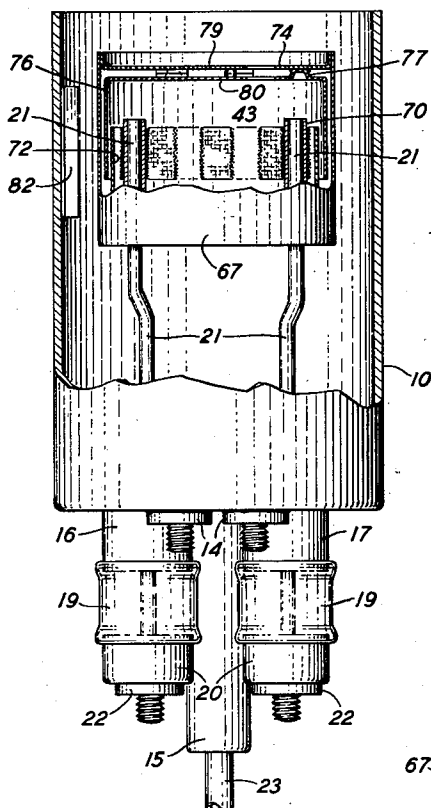


FIG. 7

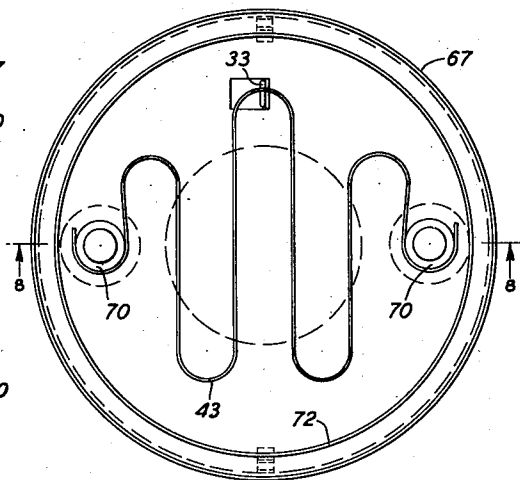


FIG. 8

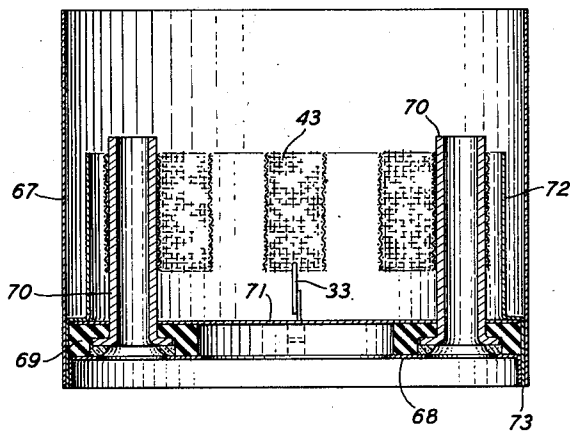
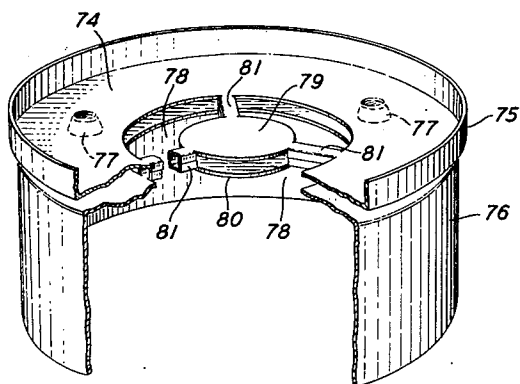


FIG. 9



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GASEOUS ELECTRONIC DISCHARGE DEVICE

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11 Claims. (Cl. 250-27.5)

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This invention relates to gaseous electronic discharge devices and more particularly to grid-controlled rectifier devices of high power rating.

In high power devices considerable heat is developed within the device due to a high current between the input and output terminals of the device. Since a trigger element or control electrode is interposed between the input and output electrodes of the device and constitutes a substantial baffle across the discharge path, heat energy is readily absorbed thereby and as the temperature increases, the trigger element becomes an emitter of electrons and these electrons create turbulence in the normal electron path of the device so that the characteristics of the device are altered. Another difficulty experienced in these high power devices is the release of active absorbed gases within the enclosure of the device due to the high temperatures developed during operation. These gases, unless trapped, may reduce the power handling capabilities of the device or impair the emissive properties of the primary electron source in the device.

An object of the invention is to increase thermal dissipation in high power electronic devices employing a trigger control element in the discharge path in order to eliminate emission from such element.

Another object of the invention is to reduce the internal impedance in the discharge path adjacent to the trigger control element between any points of the areas of the cathode and anode surfaces.

A further object of the invention is to prevent leakage in the final seal of the metal envelope of high power gaseous type electronic devices.

Another object of the invention is to facilitate the fabrication of the complete unit so that production may be expedited.

Another object of the invention is to reduce contamination of the internal electrodes in the device due to occluded active gases released during operation of the device.

A further object of the invention is to protect the active emissive coating on the cathode against destruction by gases or back-emission from the anode.

A still further object of the invention is to improve the mounting assembly of the device and prevent mechanical strains being conveyed to the hermetic seals of the electrode terminals of the device.

A further object of the invention is to im-

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prove the shielding of the high potential terminal of the device and to prevent leakage to the low tension electrodes of the device.

These objects are attained in accordance with features of the invention as embodied in a device having a substantially all-metal casing comprising an anode cylindrical section and a cathode cylindrical section, both hermetically joined to an intermediate heavy baffle plate grid or control element which is formed of considerable mass to conductively dissipate heat energy absorbed thereby and provided with a peripheral fin exposed to the outer surrounding air space so that efficient radiation is secured. The large mass of the control element increases the ability of the grid to readily dissipate the heat energy imparted to it during operation and facilitates the transfer of thermal energy to the cooler surrounding environment of the device, whereby the temperature of the control element is maintained at a minimum.

A feature of this construction resides in the final assembly of the device in which three integrated units are placed in cooperative junction and hermetically sealed simultaneously to complete the device. This is accomplished by centrally mounting the anode insulatingly from a terminal on the closed end of the anode section of the enclosing vessel, then supporting the filament unit on insulated terminals extending from the closed end of another section of the enclosing vessel and joining these sections to opposite sides of a heavy metallic baffle disc which forms a partition between the cathode and anode in the device.

Another feature of the same construction is the facility with which the final seal of the device is made to complete the assembly. This involves the juxtaposition of the anode and cathode assemblies in contraposed relation with their open ends fitting into aligned circular grooves formed on opposite sides of a thick metallic disc and sealing the sections therein simultaneously by a brazing operation employing high frequency induction heating to form an integral unit.

A further feature of this assembly relates to the precise location of the grid element in relation to the cathode and anode, which eliminates variations in spacial relation of the electrodes in devices made on a mass production basis since every unit will have the same spacial relation between the electrodes so that the units may be employed in matched groups or substituted one for the other without change in performance.

Another feature of the invention relates to the

configuration of the control path in the trigger element to reduce the internal impedance to the flow of electrons between any point on the cathode area to the anode surface. This is accomplished by forming a plurality of equally spaced crossing slots in the fixed baffle disc element which forms a uniform bifurcated multiarmed or star-shaped passageway for the projection of electrons along the discharge path between all portions of the cathode and anode areas. The restricted slots permit control of the electron discharge since the control potential developed in the field of the slots assures a positive blocking action on the electron flow yet permits direct flow of electrons when the grid is biased less negatively to allow the electrons to flow to the anode over a low impedance path between any point on the cathode area to any point on the anode area.

A further feature of the invention relates to the mounting assembly of the cathode to protect the active coating thereon from poisoning and deactivation. The highly emissive hot filament ribbon is enclosed in a heat conserving casing which is so constructed that copious electron flow is projected toward the anode but spurious back emission or bombarding electrons from the anode are substantially deflected before reaching the active coating on the filament. This is accomplished by providing a double-walled cage around the cathode, the cage having a baffle cover which permits egress of electrons from the filament through a restricted annular orifice. However, electrons projected toward the cage from the anode generally impinge on the casing and do not reach the filament to bombard the active coating.

A feature of this construction is embodied in further protection of the active cathode coating to eliminate poisoning by gases which quickly deteriorate the coating. In accordance with this feature, an active gas absorbing material is mounted within the casing and also close to the filament and operates at the optimum temperature to continually clean up spurious gases which might react with the active coating constituents on the filament or emission source. This arrangement prevents deactivation of the coating and achieves longer operating life for the device.

These and other advantages of the invention will be more clearly set forth in the following detailed description of a particular embodiment of the invention shown in the accompanying drawings. In the drawings:

Fig. 1 is a perspective view showing the external appearance of a device made in accordance with this invention and embodying the features set forth above;

Fig. 2 is a view in elevation showing the cross-section of the device of Fig. 1 and illustrating the detailed assembly of the components of the device;

Fig. 3 is a perspective view of portions of the main sections of the device, shown in exploded fashion to illustrate the details of the construction;

Fig. 4 illustrates a section view in elevation of the detailed assembly of the components of the cathode construction, taken on the line 4—4 of Fig. 2, showing the protective casing and the mounting of the filament therein;

Fig. 5 is a perspective view in exploded fashion showing the array of parts entering into the assembly of the cathode mounting as employed in the device of this invention;

Fig. 6 is a view in elevation, partly in cross-

section, of a modified construction of the cathode portion of the device of Fig. 2;

Fig. 7 is an enlarged plan view of the cathode casing with the cover removed and showing the configuration of the cathode ribbon;

Fig. 8 shows the cathode unit casing in elevation view, in section taken on the line 8—8 of Fig. 7, to illustrate the detail assembly of the elements therein, and

Fig. 9 is a perspective view of the cover and shielding assembly of the cathode casing of Fig. 6, with a portion broken away to show the detail construction.

Referring to the drawings, and particularly to Figs. 1 to 5, inclusive, a specific construction of one form of the invention is embodied in an all-metal thyratron or grid-controlled electronic discharge device of the vapor conduction type which is sturdily constructed to provide a highly efficient device having a long operating life at high power ratings.

The device, as developed, is composed of three elemental components, namely, a cathode section, an anode section, and a barrier control element, which are integrated in precise relation to facilitate the fabrication of the device on a mass production basis and to achieve dynamic characteristics which are uniform and efficiency which is stable over long operating periods.

The cathode section of the metal casing of the device is composed of a cylindrical steel shell open at one end and having an inturned flange at the other end, as shown in Fig. 3. A disc closure plate, of similar material, is welded to the exterior of the flange to form a deep cup receptacle for the mounting of the cathode therein. The closure is provided with a pair of large apertures in parallel relation across a main diameter of the disc and a smaller aperture offset from the center of the larger apertures, to provide the coupling of tubular extensions to the bottom of the cathode section, as will be described hereinafter. In addition, a pair of threaded studs are brazed to the plate in symmetrical relation on the opposite side of the large apertures. A deep-drawn steel well is brazed or welded to the plate and extends downwardly from the offset smaller aperture therein while a pair of nickel-iron-cobalt alloy sleeves and, preferably of a metal such as Kovar, are welded and brazed to the inner surface of the plate through the large apertures by means of flange portions on the contacting rims of the sleeves, as shown in Fig. 2.

The outer ends of the sleeves are hermetically sealed to short sections of hard glass tubing, preferably of boro-silicate glass, which has the same thermal expansion characteristics as the alloy sleeves and the short tubing is terminated by Kovar cup terminals also hermetically sealed to the outer ends thereof. The cup terminals are provided with centrally mounted long nickel rods brazed to the inner surface of the cups and a threaded stud is brazed to the outer surface of each cup terminal. The bottom of the well casing is provided with a tubular extension or tubulation for connection to a pumping station for evacuating the device and forms a seal-off after the desired filling of mercury is injected into the device. The tubulation is preferably formed of Kovar alloy to readily seal the device to a glass header on the pumping station, although any other metal may be used, such as steel, copper or brass if the facilities for connection to the pumping

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station header are suitable for attaining a tight joint at the junction of the tubulation and header. The device is inverted when connected to the pumping station so that the tubulation 23 is at the top. In this position, the desired amount of mercury may be injected into the device after the desired vacuum condition is secured therein and the mercury flows through the casing to the bottom. Upon sealing the tubulation and removal of the device from the station, the mercury flows back to the well 15. When the desired final processing of the device is attained, the tubulation 23 is pinch-sealed close to the bottom of the well 15 and a cooling radiator 24 having a plurality of fins 25, and advantageously of cast brass, is mounted on the well by brazing to enclose and protect the exhaust tubulation tip from damage to the seal.

The details of the elemental cathode assembly are shown more clearly in Figs. 4 and 5 while Fig. 2 shows the mounting of the cathode assembly in the cathode casing or section. This construction involves an emission source of large capacity enclosed in a double-walled protective and heat conserving housing or enclosure. The cathode assembly is composed of an inner cylindrical metallic shield 26 and an outer shield 27 of larger diameter and both advantageously formed of polished pickel. These shields are spaced in coaxial relation by a plurality of arcuate wire spacers 28 located between the bottom edges of the shields in such relation thereto that the inner shield is extended beyond the lower edge of the outer shield. The inner shield is closed at the bottom by a double-walled shielding having one portion formed of an inner flanged disc 29 having a large central opening 30 and a pair of smaller apertures 31 disposed symmetrically across one diameter between the periphery and the opening of the disc. The large opening is closed by a rectangular plate 32 of a gas-absorbing metal, such as zirconium, so that a large surface of the plate is exposed to the interior of the shield enclosure. An anchor hook 33 is also mounted on the inner shield disc and is equally spaced from the apertures 31. The other portion of the bottom shielding assembly is formed of a shield disc 34 having a short peripheral rim 35 and a pair of apertures 36 adjacent the edge in such relation that they are aligned with the apertures 31 in the inner disc. The disc 34 is mounted in nested relation within the inner disc so that their circular areas are in spaced relation equivalent to the spacing of the cylindrical shields of the housing. The nested discs are welded within the lower end of the inner shield 26 and the bottom disc 34 is provided with a plurality of perforations 37 to permit the release of entrapped gases or air within the space between the disc shields.

The assembled cathode shield housing, as above-described, is mounted on a ceramic plate 38 of generally rectangular form with arcuate recessed end portions to accommodate the cylindrical shield housing of the cathode which is secured thereto by stub wires 39 rigidly fixed to the inner cylindrical shield and project into the outer apertures of the insulating plate 38. This plate is also provided with holes to receive the terminal conductors 21 which pass through the apertures 31 and 36 in the shield discs and are insulated therefrom by ceramic sleeves or bushings 40. The plate 38 is affixed to the conductors by wire clips or staples 41, as shown in Fig. 4. The cylindrical space between the walls

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of the housing may be filled with nickel foil ribbon 42, as shown in Fig. 2, to increase the heat conserving properties of the housing.

A mesh ribbon cathode or filament 43 having an electron emissive coating, for example of barium and strontium oxides, is mounted within the housing and is formed in zigzag or serpentine fashion with the plane surface of the ribbon parallel to the axis of the housing and the ends formed to embrace the conductors 21 projecting into the housing. The ends of the filament are welded to the conductors and the center point thereof is secured to the anchor hook 33, to centrally mount the cathode in the shield housing. In this position, the mesh filament abuts against the insulating bushings 40 extending into the shield housing with the edgewise mounted folds distributed in spaced relation, so that a copious supply of electrons is emitted from the surfaces of the filament and the emission temperature is maintained substantially uniform by the heat conserving structure of the housing. A cover or closure portion is also provided for the cathode housing and includes a pair of annular discs 44 and 45 having flanged rims to fit within the walls 26 and 27, respectively. The depressed position of the inner shield 26 provides a space equal to the spacing between the side walls of the housing to complete the double-walled construction surrounding the filament 43 mounted therein. In addition, a pair of centrally spaced discs 46 and 47 are mounted within the aligned large openings in the closure members by three interposed spaced wires 48 to form an annular channel or passageway 49 for the egress of the electrons projected from the filament under the applied potentials employed in the operation of the device.

This construction not only conserves the heat energy within the housing for the efficient operation of the cathode but also eliminates contamination of the active coating material on the filament by the presence of the gas-absorbing metal plate 32. The latter is exposed to the interior of the casing, to readily attract spurious gases evolved by the metal parts when raised to elevated temperatures and prevents such gases poisoning the activity of the cathode coating. The emissive coating on the cathode is also protected from bombardment by high potential ionic emission from the other electrodes in the device, particularly the anode, since the construction of the housing closure forms a protective shield across the exposed cathode surfaces and the bombarding ions or electrons will strike the larger areas of the discs 45 and 47 and substantially no projected ions will enter the restricted annular orifice 49 in the closure shield portion of the housing. The highly active filament is therefore protected physically and chemically from injurious contamination so that a long life is attained in operation.

Another main component of the device which forms a part of the casing is the anode section which has a deep-drawn steel cup 50 with a central aperture in the closed end and is mounted in inverted position with respect to the cathode section of the device. This section is considerably shorter than the cathode casing since the anode 51 is a nickel cup member having its flat surface directed toward the cathode in the device. The anode is carbonized to increase the heat radiation properties of the nickel surface. A Kovar alloy sleeve 52 is welded and brazed within the aperture of the cup 50 so that a glass

ring 53 may be hermetically sealed to the opposite end, the ring being sealed to a Kovar cup terminal 54 similar to the cathode terminals, previously described. A long central rod 55 extends downwardly from the terminal and has a threaded portion which enters a bushing 56 on the anode, the rod being staked to secure it to the anode. A threaded stud 57 is fastened to the exterior of the terminal to provide attachment for the conductor for the anode. A conical hood shield 58 surrounds the anode lead-in construction and is welded to the closed end of the anode casing.

The final component of the device is the control or trigger electrode. This involves a relatively thick circular metallic disc 59, preferably of nickel, which forms a separating partition or baffle between the anode and cathode in the device. The disc is provided with circular recesses or grooves 60 and 61, as shown in Fig. 3, adjacent the outer edge and on opposite sides thereof, to receive the rim 11 of the cathode casing and the rim of the anode casing 50 to complete the junction of these casing sections into an integrated enclosure. The heavy disc is brazed to the electrode casings by copper rings inserted in the grooves and fused to the contacting surfaces of the disc and casing sections by heating. The baffle disc is also provided with a plurality of bisecting slots 62 which form a restricted multiarm passageway of special design in which the width and thickness of each radial arm of the slot provides a control gap having a high gradient characteristic. The discharge current path between the anode and cathode is accurately controlled by providing a conduction discharge gap between any point on the cathode and anode surfaces.

After the slots are formed in the baffle disc and prior to brazing the disc electrode between the other sections of the device, all the surfaces of the disc within the confines of the inner edges of the grooves 60 and 61 are carbonized to increase the heat radiation properties of the metallic electrode. Another distinguishing feature of the control electrode construction, is the exposure of the periphery of the baffle disc to the surrounding atmosphere through the rim 63 entirely external to the device whereby the heat dissipating properties of the disc are considerably improved so that the disc runs cooler during operation and secondary emission is decreased. This enhances the control characteristics of the electrode 59 so that a sharp negative cut-off is attained in the operation of the device. Furthermore, the sectional fabrication of the device provides a construction in which the spaced relation of the various electrodes can be accurately controlled during manufacture since the control electrode disc 59 may be held within close tolerance limits with respect to the cathode and anode and the over-all characteristics of the device will be consistently uniform and stable even though the devices are mass-produced.

Another feature of the construction of the device of this invention is concerned with the mounting support of the device during operation to facilitate the coupling of the device to spaced current conducting bus bars in operational equipment. While the cylindrical casings 10 and 50 surround and enclose the cathode and anode, respectively, within the container of the device, these sections are insulated from the main input and output electrodes by their terminal constructions and the sections form part of the control electrode 59 which is integrally joined

thereto at the common intermediate seal between the sections. Accordingly, the low voltage terminal of the control electrode may be positioned as far as possible from the high potential anode terminal. This is accomplished by placing the terminal studs 14 on the lower closure plate 13 of the device and attaching a heavy steel angle bracket 64 to the studs, as shown in Fig. 1, to form the main support for mounting the device in equipment. The filament studs 22 are connected to flexible copper straps 65 by crown nuts and the anode stud 57 is joined to a similar strap 66. The angle ends of the bracket and straps are all in line and are slotted to facilitate attachment to suitably spaced bus bars and to hold the device in vertical position with sufficient space all around the device to permit free circulation of a cooling medium which dissipates the heat energy expended in the device during operation.

While the complete construction, previously described, forms an efficient assembly of the device of this invention, some added improvements may be gained from a production standpoint in the fabrication of the cathode section of the device, as shown in Fig. 6. In this arrangement, the casing 10 and closure plate are formed integral by a deep-drawing operation of the steel shell, the closure portion being perforated, as previously described, to attach the terminal assemblies and mercury well thereto and affix the terminal studs 14 to the closed end of the shell.

An important feature of this embodiment is the prefabrication of the cathode shield housing as a separate unit, shown in Figs. 7 to 9, inclusive, prior to mounting the unit on the conductors 21 in the cathode section. This construction involves an outer cylindrical nickel member 67 which is partially closed at the bottom by a flanged metallic ring 68 having a large central aperture and a pair of oppositely disposed smaller apertures therein. A thick ceramic ring 69, of high dielectric material, such as a magnesium-silicate composition known as steatite, or other insulating composition, is mounted on the closure ring and carries a pair of metallic sleeves 70 having flanged ends cemented in the recessed apertures in the ceramic ring in alignment with the smaller apertures in the closure ring. A zirconium disc 71 is superimposed on the insulating ring and fitted over the sleeves and a short inner shield cylinder 72 of smaller diameter than the outer shield is concentrically mounted around the sleeves and provided with a flanged rim 73 which encloses the insulating ring and the flange of the closure ring. When the abutting flanges of the shield and ring are welded together, the disc 71 and insulator assembly are securely locked in position. After the folded mesh ribbon filament 43 is secured to the sleeves 70 the whole assembly is inserted into the bottom of the outer shield 67 and welded to the lower edge thereof. In this construction the disc 71 performs the same function as described in connection with the plate 32 in Fig. 5 since its surface is exposed to the interior of the shield housing close to the active cathode coating.

The cathode housing is completed by a closure disc 74 having a flanged rim 75 welded to the inner edge of the top of the outer shield 67 and carrying a depending inner shield cylindrical portion 76 which enters the housing and is in telescopic relation to the shield cylinder 72. The portion 76 is secured to the closure disc by raised embossments 77 distributed in spaced re-

lation on the top of the shield portion 76 and these embossments are welded to the lower surface of the closure disc in concentric relation so that the cylindrical wall of the shield is uniformly spaced with respect to the coaxial surfaces of the shield portion 72 and the outer shield cylinder 61. Both the closure disc 74 and depending shield portion 76 are provided with annular segmental aligned orifices 78, shown more clearly in Fig. 9, by central disc portions 79 and 80, respectively, which are integrally joined to their main parts by channel-shaped radial arms 81. These arms may be formed by bending the sides on each arm in opposed relation so that their meeting edges form a closed or split joint to increase the structural strength of the small spaced disc portions 79 and 80 and provide a discharge gap of annular configuration for the projection of the electrons from the cathode enclosed in the housing.

The cathode unit is mounted on the conductors 21 extending into the cathode section of the device by welding the sleeves 70 to the conductors. An additional gas-absorbing strip 82, preferably of pure zirconium metal, may be attached to the inner wall of the cathode casing, as shown in Fig. 6, to absorb gases given up by the casing walls and other elements and thereby preserve the purity of the vapor employed as the ionic conducting medium in the device.

While the disclosure is of certain specific embodiments to show the various features and advantages of this invention, it is, of course, understood that structural modifications may be made in the constructions shown to attain the results of this invention without departing from the scope and spirit of this invention as set forth in the appended claims.

What is claimed is:

1. A shielded cathode assembly for electronic discharge devices comprising a double-walled cylindrical metallic casing having apertured end closures, a folded ribbon filament mounted therein, supports for said filament extending through one of said closures, and a gas-absorbing metal element extending across an opening in said closure and exposed to the space within said casing.

2. A shielded cathode assembly for electronic discharge devices comprising a double-walled cylindrical metallic casing having end closures, a folded ribbon filament mounted therein, supports for said filament extending through one of said closures, and a strip of zirconium metal attached to one of said closures and exposed to the space surrounding said filament.

3. A shielded cathode assembly for electronic discharge devices comprising a metallic casing having spaced cylindrical double-wall portions, spaced disc platform members closing one end of said portions, said members having aligned pairs of apertures and the inner member having a central opening, spaced annular disc cover members extending across the opposite end of said casing portions, a pair of central baffle plates supported in concentric position in said cover members, a pair of supports projecting through said aligned apertures, a folded ribbon filament mounted on said supports and enclosed in said casing, and a layer of zirconium metal secured to the inner platform member and closing said central opening.

4. A high power grid-controlled mercury vapor rectifier device comprising a cylindrical metallic casing formed of two superimposed sec-

tions, an anode supported within one section and insulatingly mounted from a terminal at the closed end thereof, a shielded filament assembly extending into the other section and supported on insulated terminals projecting from the closed end remote from said anode terminal, a mercury well joined to the same closed end and offset with respect to said insulated terminals, a metallic grid disc having a central opening sealed between said sections and forming a part of said casing, terminal posts on the closed end of the filament supporting section for said grid, and offset angular mounting conductors secured to said anode terminal, offset angular mounting conductors secured to each of said filament terminals, and a heavy bracket secured to said grid terminal posts, said bracket being adjacent said second-mentioned mounting conductors.

5. A high power grid-controlled mercury vapor rectifier device comprising a cylindrical metallic casing formed of two superimposed sections, an anode supported within one section and insulatingly mounted from a terminal at the closed end thereof, a shielded filament assembly extending into the other section and supported on insulated terminals projecting from the closed end remote from said anode terminal, a mercury well joined to the same closed end and offset with respect to said insulated terminals, a metallic grid disc having a central opening sealed between said sections and forming a part of said casing, and a conical hood shield surrounding said anode terminal and secured to said casing.

6. A shielded cathode unit for electronic discharge devices, comprising a cylindrical metallic casing, a perforated closure on one end, an apertured insulating disc superimposed on said closure, a pair of sleeve members mounted in said disc and aligned with the openings in said closure, a gas-absorbing metal plate abutting against said disc, a folded ribbon filament disposed within said casing and attached to said sleeve members, and an apertured cover on the opposite end of said casing.

7. A shielded cathode unit for electronic discharge devices, comprising a cylindrical metallic casing, a perforated closure on one end thereof, an apertured insulating disc superimposed on said closure, a pair of sleeve members mounted in said disc and aligned with the openings in said closure, a zirconium plate abutting against said disc, a folded ribbon filament disposed within said casing and attached to said sleeve members, an apertured cover on the opposite end of said casing, and a cylindrical shield within said casing joined to the closure assembly.

8. A shielded cathode unit for electronic discharge devices, comprising a cylindrical metallic casing, a perforated closure on one end thereof, an apertured insulating disc superimposed on said closure, a pair of sleeve members mounted in said disc and aligned with the openings in said closure, a folded ribbon filament disposed within said casing and attached to said sleeve members, a plate of zirconium metal within said casing and opposite said filament, an apertured cover on the opposite end of said casing, and a pair of oppositely disposed telescoped shield members within said casing surrounding said filament.

9. A shielded cathode unit for electronic discharge devices, according to claim 8, in which

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said shield members are supported by said closure and cover respectively.

10. A shielded cathode unit for electronic discharge devices, comprising a cylindrical metallic casing, a perforated closure on one end thereof, an apertured insulating disc superimposed on said closure, a pair of sleeve members mounted in said disc and aligned with the openings in said closure, a gas-absorbing metal plate abutting against said disc, a folded ribbon filament disposed with said casing and attached to said sleeve members, an apertured cover on the opposite end of said casing, said cover having a central aperture and a flanged rim, an integral disc within said central aperture, and reinforcing arms extending radially between said latter disc and cover, said rim being joined to the inner wall of said casing.

11. A shielded cathode unit for electronic discharge devices, comprising a cylindrical shell, an apertured insulating disc extending across the bottom of said shell, a pair of metallic members having flanged rims disposed on opposite sides of said disc, the rim of one of said members overlapping said disc and the other member and

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being joined to the inner surface of said shell, a zirconium plate superimposed on said disc, a pair of metallic sleeves mounted on said disc and extending within said shell, a ribbon filament of zigzag formation attached to said sleeves, and a double-layer cover having an annular orifice connected to the opposite end of said shell, said cover having a depending shield portion surrounding said filament.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,078,123	Cage	Apr. 20, 1937
2,206,710	Tonks	July 2, 1940
2,292,081	Maser	Aug. 4, 1942
2,306,808	Hutchings	Dec. 29, 1942
2,356,566	Clark et al.	Aug. 22, 1944