

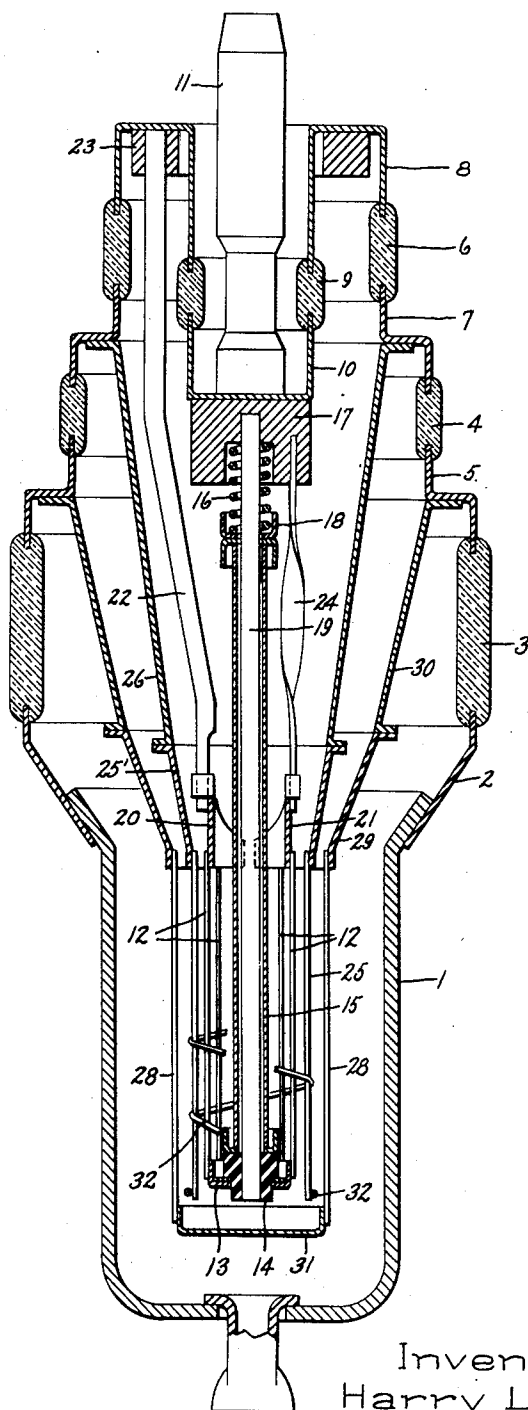
Nov. 29, 1949

H. L. THORSON

2,489,873

ELECTRIC DISCHARGE DEVICE

Filed Sept. 21, 1946



Inventor:
Harry L. Thorson,
by *Merton D. Morse*
His Attorney.

UNITED STATES PATENT OFFICE

2,489,873

ELECTRIC DISCHARGE DEVICE

Harry L. Thorson, Schenectady, N. Y., assignor
to General Electric Company, a corporation of
New York

Application September 21, 1946, Serial No. 698,495

1 Claim. (Cl. 250—27.5)

1

My invention relates to electric discharge devices and more particularly to improved high-frequency, high-power discharge devices.

In copending Elder and Crawford application, Serial No. 650,701, filed February 27, 1946, now United States Patent No. 2,489,872 issued November 29, 1949, and assigned to the assignee of the present invention is described and claimed an electric discharge device which is particularly adapted for high power applications at moderately high frequencies. The present invention is in the nature of an improvement on the invention disclosed and claimed in the Elder et al. application and relates particularly to an improved seal and envelope structure which facilitates installation and removal of the discharge device. The present invention also contemplates a discharge device employing a screen grid which together with the control grid are mounted in a novel manner from an improved envelope construction.

It is an object of my invention to provide a new and improved electric discharge device.

It is another object of my invention to provide a new and improved high power electric discharge device for operation at high frequencies.

It is a still further object of my invention to provide a new and improved electric discharge device which is easily installed and removed from the co-operating circuit elements.

Further objects and advantages of my invention will become apparent as the following description proceeds, reference being had to the accompanying drawing, and its scope will be pointed out in the appended claim. In the drawing, the single figure is an elevational view, in section, of a transmitting type electric discharge device embodying my invention.

Referring now to the drawing, the illustrated embodiment of my invention comprises an envelope including an anode 1, in the form of a copper tube closed at one end and outwardly flared at the opposite end. The flared end is joined to a conical sealing member 2 which may to advantage be formed of one of the iron-nickel-cobalt alloys. The member 2 is sealed at its upper end to the lower edge of a cylindrical insulator 3 which is preferably of glass having an expansion characteristic matching that of the sealing member 2. A second cylindrical insulator 4, having a diameter somewhat less than that of the first insulator, is sealed thereto by a cylindrical sealing member 5 which has a generally stepwise configuration in a transverse plane. As will become apparent at a later point in the specification, the member 5 provides a ring terminal

2

for the screen grid of the device. In a similar manner, a still smaller hollow cylindrical insulator 6 is sealed to the insulator 4 by a cylindrical member 7 having a stepwise transverse section and which provides a terminal for the control grid of the device. The cathode terminal, which also serves as a terminal for one side of the heater current supply voltage, is provided by a portion of the envelope provided by an annular metal member 8 which, as clearly shown in the drawing, has a substantially inverted U-shaped section in a transverse plane. The member 8 has one arm of the U-shaped section sealed to the upper end of the cylindrical insulator 6 and the inner arm sealed to the upper end of a smaller glass insulating ring 9. The inner arm of the member 8 and the insulating ring 9 define a reentrant portion of the envelope which is closed at its lower end by a cup-shaped metal member 10 sealed to the lower end of the ring 9. A second terminal for supplying heating current to the filament of the device is provided by a conducting stud 11 which is brazed, or otherwise bonded, to the bottom of the cup-shaped member 10. As will be apparent from the drawing, the insulating ring 9 insulates the terminals 8 and 11 which provide the heating current supply terminals.

A source of electrons is provided in the device by a cage-type cathode including a plurality of rod-like elements 12 which are supported concentrically within the tubular anode 1 and which are joined at one end to a cup-like metal member 13. The member 13 is apertured centrally to receive an insulator 14 which transmits force to the lower end of the filamentary members 12, and which is engaged by a force-transmitting tubular member 15. The member 15 is biased downwardly by a compression spring 16 having one end received in a recess formed in the lower end of a block 17 of conducting material which is bonded to the inner face of the cup-like member 13 and which, in effect, forms a continuation of the conducting stud 11. As illustrated in the drawing, the compression spring engages a cup-like enlargement 18, formed on the upper end of the sleeve 15, and surrounds a guide rod 19 which is secured in fixed relation at one end to the block 17 and which is slidably received in an opening in the insulator 14 to maintain the filamentary cathode structure centrally positioned. The cathode structure includes two groups of parallel rod-like members 12 having the upper ends thereof connected with a pair of generally circular conducting members 20 and 21 which are supported in spaced and insulated relation from the mem-

bers 8 and 17. The member 20 is connected by an elongated conductor 22 to a conducting ring 23 bonded to the inner base portion of the U-shaped terminal 8. In a similar manner, the other group of cathode conductors 12 is connected with the body 17, and as a result with the stud 11, by an elongated conductor 24. As illustrated, the conductor 24 is formed from flat stock and provided with a half turn in the central portion thereof. This construction equalizes the resilience of supporting conductor 24 and the longer support 22, with the result that damage to the filament by mechanical shock is substantially eliminated.

The control and screen grids are of similar construction and are mounted in a similar manner from the ring terminals provided by the members 5 and 7 of the envelope. The grids are each of the rod type; that is, they comprise a plurality of generally parallel rods arranged in a cylindrical array. In order to reinforce the structures, however, an open spiral is wound about the cylindrical structure and bonded to the individual grid conductors at each cross-over point. As illustrated in the drawing, the control grid includes a plurality of rods 25 arranged in a cylindrical array and secured at their upper ends to a conical sleeve 25' which is flanged at its upper end. The sleeve 25' is connected with the transverse portion of the step-like metal member 7 by an additional conical sleeve 26 which is flanged at either end with the flanges being bonded respectively with the flange of the sleeve 25' and the transverse portion of the member 7. In a similar manner, the screen grid includes a plurality of elongated conductors 28 joined at their upper ends to a flanged conical sleeve 29 and supported from the transverse portion of the member 5 by a second conical sleeve 30. The screen grid is provided with a continuous cup-like end cap 31 which provides more complete shielding between the control grid and anode circuits. The reinforcing helical wire 32 has been illustrated only on the control grid structure. It will be understood that it may be employed on the screen grid structure as well.

From the foregoing detailed description, it will be apparent that terminals for the cathode heater supply are provided by the stud 11 and the annular terminal 8 which are concentrically arranged at one end of the device. The member 8 also provides a high frequency terminal for the cathode circuit. In a similar manner, the members 5 and 7 provide ring terminals of relatively large area for the screen and control grids, respectively. The anode being of cylindrical structure and forming part of the envelope provides a directly accessible connection for the anode circuit which may be completed through a cylindrical radiator (not shown) surrounding the anode. This construction provides extensive contact area and as a result of the stepwise configuration of the envelope, the installation and removal of the discharge from associated circuit components is facilitated. The particular shape of the sealing members 5 and 7, in addition to providing the stepwise configuration of the envelope, provides means for supporting the control and screen grid structures by means of the conical supports. As a result, the electric discharge device is easily assembled and has desirable electrical characteristics for relatively high frequency operation in that the inductance of the internal connections with the various ele-

ments of the tube is kept at a minimum and the internal shielding is very complete. By making the supporting structures for the screen and control grids in two parts, assembly of the discharge device is facilitated. For example, it is possible to assemble the upper portions 26 and 30 of the conical supports in the envelope and to secure the grid assemblies including the lower portions 25' and 29 of the supports before making the final seal in the envelope structure which may, for example, be made between the parts 2 and 3. As will be readily understood by those skilled in the art, it is difficult to obtain desirable high frequency operating characteristics in electric discharge devices of relatively high power rating. The features of the present invention contribute to a marked degree to a desirable combination of operating characteristics at high frequencies and high power output.

While I have shown and described a particular embodiment of my invention, it will be apparent to those skilled in the art that changes and modifications may be made without departing from the features of my invention, and I, therefore, aim in the appended claim to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

An electric discharge device comprising an envelope including a three hollow cylindrical insulators of progressively decreasing diameter arranged in axially spaced relation, a pair of sealing members each positioned respectively between successive ones of said cylindrical insulators in said envelope wall and each including cylindrical portions of different diameters corresponding respectively to the diameters of the insulators to which they are joined and an intermediate transverse portion, a hollow cylindrical anode supported from one end of the largest of said insulators, a cathode extending into said anode and including two terminals, an annular metal member having the larger edge thereof sealed to one end of the smallest of said cylindrical insulators and the smaller edge sealed in insulated relation to a terminal member received within the opening of said annular member, the terminals of said cathode being connected respectively with said annular member and said terminal member and a pair of control electrodes including generally cylindrical metal supports interposed between said anode and said cathode with said supports each joined at one end to the transverse portion of one of said metal sealing members.

HARRY L. THORSON.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,411,046	Liimatainen	Nov. 12, 1946
2,416,315	Hartman	Feb. 25, 1947
2,419,578	Litton	Apr. 29, 1947
2,423,819	Chevigny	July 8, 1947

OTHER REFERENCES

RCA Review, June 1946, vol. VII, No. 2, article on "Development of pulse triodes and circuit to give one megawatt at 600 megacycles," by Law, Burnside, Stone and Whalley.