April 5, 1949. P. L. SPENCER 2,466,059

LAMINATED MAGNETRON

Filed Sept. 3, 1943

FIG. 1.

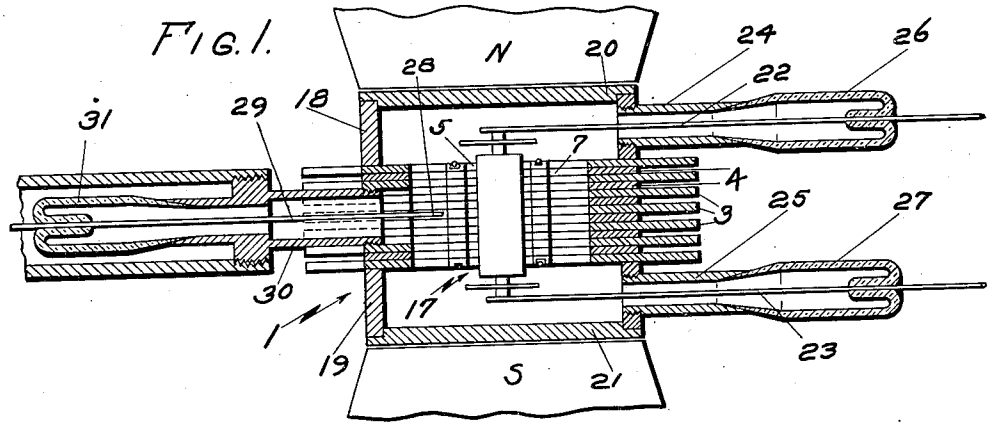
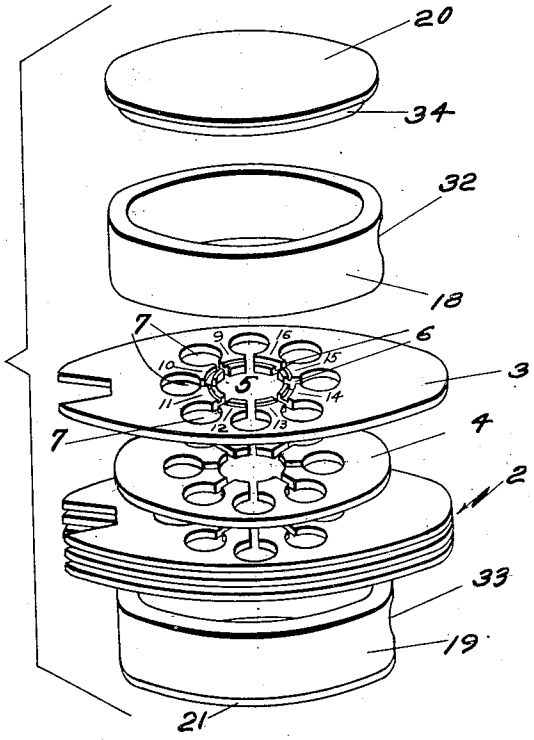


FIG. 2.



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LAMINATED MAGNETRON

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5 Claims. (Cl. 250—27.5)

1

This invention relates to a magnetron, and more particularly to a magnetron in which the dimensions and conformation of the internal structure determine the frequency of the oscillations generated.

In the construction of magnetrons of the type to which the invention relates, many difficulties have heretofore been encountered. Since the frequencies generated by such magnetrons are of wave lengths of the order of centimeters or less, minute changes in the dimensions of any part of the anode produce large changes in the frequencies generated. In my copending application, Serial No. 436,891, filed March 30, 1942, and now U. S. Patent No. 2,458,802, granted January 11, 1949, I have shown how the usual slow and expensive machining previously required to be carried out with great accuracy can be avoided by building the anode structure of a plurality of laminas soldered to each other along adjacent faces. The present invention relates to improvements in such structures, particularly with respect to the construction of the end caps and other parts associated with the body of the anode structure and forming therewith the envelope magnetron.

An object of the invention is to provide an improved magnetron structure in which the end portions thereof, as well as the body structure forming the anode, can be made rapidly and inexpensively without sacrificing the accuracy required in the completed assembly.

Another object of the invention is to provide a magnetron, the parts of which can be more readily manufactured and assembled than has heretofore been possible in the construction of devices of this type.

Another object of the invention is to provide a magnetron having greater rigidity in the portions by which the cathode lead-in conductors are supported to the end that these conductors will be less subject to vibration.

The foregoing and other objects and features of the invention will be made fully apparent to those skilled in the art from a consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a longitudinal sectional view of a magnetron constructed in accordance with this invention; and

2

Fig. 2 is an expanded view showing, in perspective, details of the construction of the envelope of the magnetron.

In the embodiment of the invention illustrated in the drawings, the magnetron comprises an envelope 1 having a body portion 2 built up of a plurality of laminas 3 and 4 of conductive material, such as copper, in a manner disclosed in my copending application, Serial No. 436,891. The laminas 3 are of greater external diameter than the laminas 4 providing projecting heat radiating fins on the body portion. Each of the laminas 3 and 4 has a central opening 5 and slots 6 extending radially from the central opening 5. Each of said slots 6 terminates in a circular opening 7. A plurality of wedge-shaped arms 9—16 are thus provided in each of the laminas 3 and 4.

When assembled, the conformation of the laminas 3 and 4 provides a central bridge structure in the body portion 2 in which the openings 5 coincide to form a central chamber extending longitudinally therethrough. A cathode structure 17 extends through the chamber formed by the openings 5. The wedge-shaped arms 9 and 16 of the laminas 3 and 4 coincide to provide anode faces which cooperate with the cathode structure 17.

The construction and arrangement of the parts above-described have been fully explained in the above-mentioned copending application and need not be here further described.

The body of portion 2, comprising the laminas 3 and 4, is provided with end rings 18 and 19 also of highly conductive material at the ends thereof. The rings 18 and 19 are hermetically sealed to the body portion 2, preferably by soldering, in the same operation in which the laminas 3 and 4 are soldered together. The end sections are closed by caps 20 and 21, of highly conductive material, and hermetically sealed to the rings 18 and 19. The hollow end sections, formed by the rings 18 and 19, provide chambers between the bridge structure formed by the arms 9—16 in the body 2 and the end caps 20 and 21 through which chambers the cathode lead-in conductors 22 and 23 extend. Pipes 24 and 25 extend through openings in the end rings 18 and 19 and are hermetically sealed thereto. The cathode

lead-in conductors 22 and 23 extend through the pipes 24 and 25 and are sealed in glass seals 26 and 27 at the outer ends of said pipes.

A coupling loop 28, extending into one of the cylindrical chambers provided by the circular openings 7 of the laminas 2 and 3, has one end thereof fastened to the inner wall of said chamber. The other end of the coupling loop 28 is connected to a lead-in wire 29 which extends through and is sealed in the outer end of a pipe 30 by glass seal 31. The heat radiating fins, provided on the outer surface of the body portion 2, are cut away to accommodate the pipe 30 which is hermetically sealed in an opening in the lateral wall of said body.

Devices of this type are intended to operate so that each of the cylindrical chambers formed by the circular openings 7 and its adjacent arms form a circuit tuned to the frequency at which each of the other chambers 7 and its adjacent arms oscillate.

As pointed out in the above-mentioned copending application, magnetrons of this type have heretofore been made of carefully machined parts, thus rendering the manufacture slow and expensive. I have shown in that application how the magnetron may be constructed of all stamped parts, the body of the anode structure being made up of a plurality of flat stamped laminas. The end caps may likewise be stamped from sheet copper, and as shown in said application each end cap may be stamped in the form of a cup-shaped member to provide the desired chamber at each end of the body portion of the anode through which the cathode lead-in conductors and, if desired, other conductors may be introduced. If the end pieces are cup-shaped members of integral construction, these pieces must be of relatively thin sheet metal. Otherwise the stamping operation would be difficult and costly. I have found that these manufacturing difficulties may be overcome and a more rugged construction provided by forming the end pieces in the manner shown herein. In this construction the end rings 18 and 19 may be cut from seamless copper tubing of sufficient thickness to provide a rigid support for the pipes 24 and 25, which may be hermetically sealed in openings 32 and 33. The rings 18 and 19 are soldered to the body 2 in the same way, and, if desired, in the same operation that the laminas 2 and 3 are soldered together. The end caps 20 and 21 may be punched from sheet copper, and since no deformation of the sheet to provide rims on the flat disk is required, the sheet may be relatively thick. The shoulder 34 may be coined on the flat disk to provide a portion projecting into and closely fitting with the interior surface of the ring to facilitate the sealing of the cap to the ring, which sealing may be effected by soldering in the manner previously described.

It will be seen that in the completed assembly the envelope 1 forms a unitary structure built up of simple parts, none of which requires difficult or expensive machine operations. The construction of the parts requires only punching or coining operations, and furthermore any stampings of a difficult type or requiring a relatively thin material are also eliminated. The assembly of the parts is also simplified since the laminas forming the body 2 and the end rings 18 and 19 may be stacked in the proper relation on a suitable jig with thin sheets of copper-silver solder therebetween, and the soldering effected

in a single operation. Preferably the solder is an eutectic alloy of copper and silver. The thin sheets of this between the laminas have the same general conformation as the laminas and the sheet or gasket of solder between the rings and the end laminas of the stack have the same conformation as the edge surface of the ring.

While there has been herein described but a single embodiment of the invention, other embodiments within the scope of the appended claims will suggest themselves to those skilled in the art from a consideration of the embodiment herein disclosed.

What is claimed is:

1. An electronic discharge device comprising a cathode, a metal envelope enclosing said cathode and constituting an anode for coacting with said cathode, said envelope comprising a plurality of laminas constituting a body portion, open-ended pipes one open end of each of which abuts and is hermetically joined to the respective ends of said body portion, and caps hermetically closing the remaining open ends of said pipes.

2. An electronic discharge device including a cathode, an envelope enclosing said cathode and constituting an anode structure, said envelope comprising a plurality of metallic sheets constituting a laminate body structure, a pair of open-ended pipes one open end of each of which abuts and is hermetically joined to the respective ends of said body structure, and caps hermetically closing the remaining open ends of said pipes remote from said body structure.

3. An electronic discharge device including a cathode, an envelope enclosing said cathode and constituting an anode structure, said envelope comprising a plurality of metallic sheets, said metallic sheets being soldered to each other along adjacent faces thereof providing hermetic seals therebetween and constituting a laminate body structure, a pair of open-ended pipes one open end of each of which abuts and is hermetically joined to the respective ends of said body structure, and caps hermetically closing the remaining open ends of said pipes remote from said body structure.

4. An electronic discharge device including a cathode, an envelope enclosing said cathode and constituting an anode structure having a plurality of radially extending arms for coacting with said cathode and defining a plurality of cavity resonators, said envelope comprising a plurality of metallic sheets, each of said metallic sheets defining a section through each of said cavities, said metallic sheets being hermetically joined to each other along adjacent faces thereof forming a laminate body structure, a pair of open-ended pipes one open end of each of which abuts and is hermetically joined to the respective ends of said body structure, and caps hermetically closing the remaining open ends of said pipes remote from said body structure.

5. A magnetron including a cathode, an envelope enclosing said cathode and constituting an anode structure having a plurality of radially extending arms for coacting with said cathode, and defining a plurality of cavity resonators, said envelope comprising a plurality of copper sheets, each of said copper sheets defining a section through each of said cavities, said copper sheets being soldered to each other along adjacent faces thereof providing hermetic seals therebetween and forming a laminate body structure, a pair of open-ended copper pipes one open end of each of which abuts and is hermetically soldered to

the respective ends of said body structure, and copper caps hermetically soldered to the remaining open ends of said pipes remote from said body structure.

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