March 22, 1949. J. S. DONAL, JR., ET AL 2,465,211

ELECTRON DISCHARGE DEVICE FOR HIGH-FREQUENCIES

Filed March 8, 1944 2 Sheets-Sheet 1

Fig. 1.

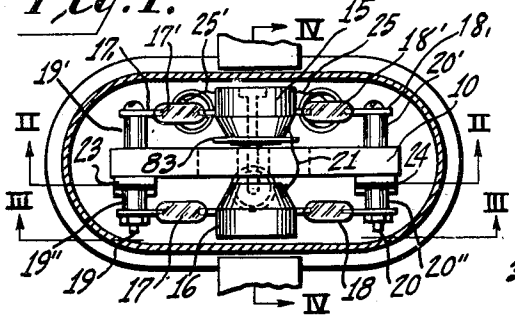


Fig. 2.

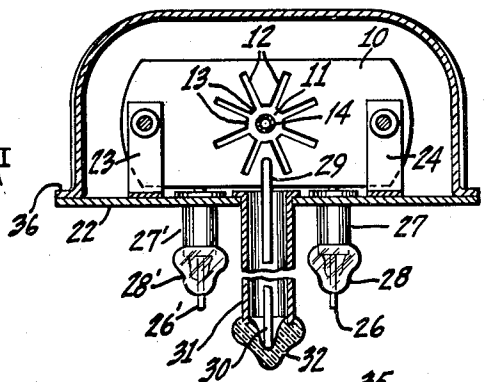


Fig. 3.

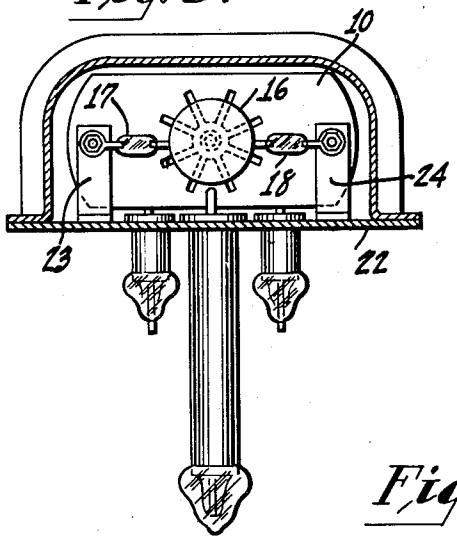


Fig. 4.

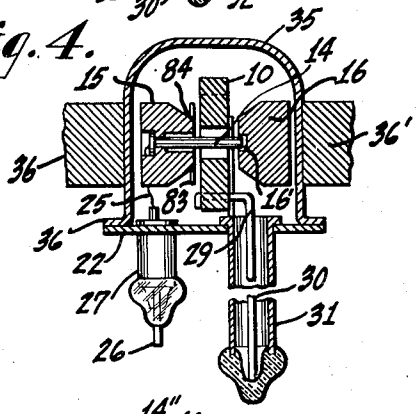


Fig. 5.

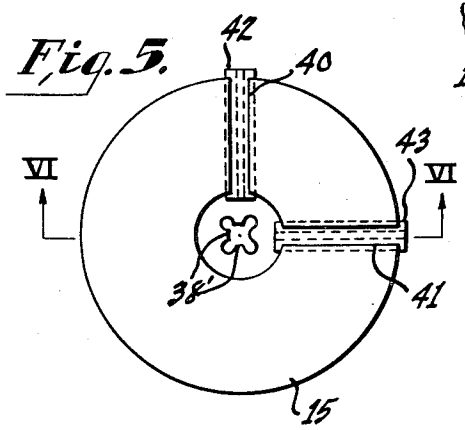
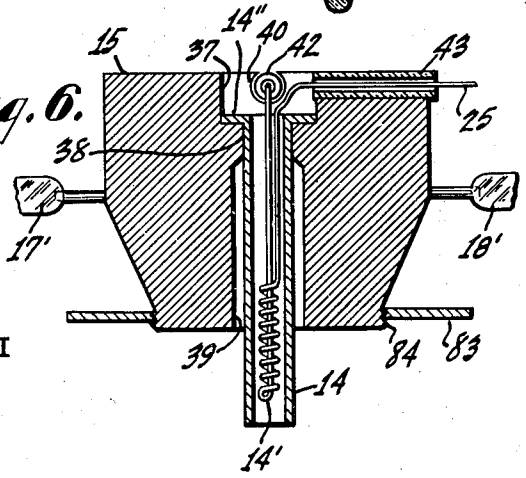


Fig. 6.



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ELECTRON DISCHARGE DEVICE FOR HIGH-FREQUENCIES

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Fig. 7.

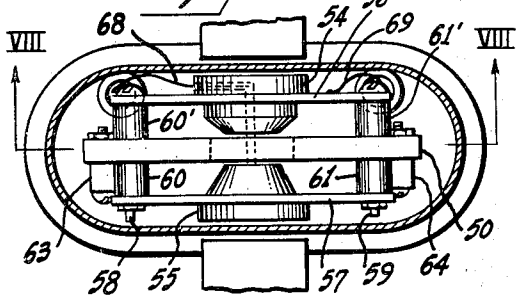


Fig. 8.

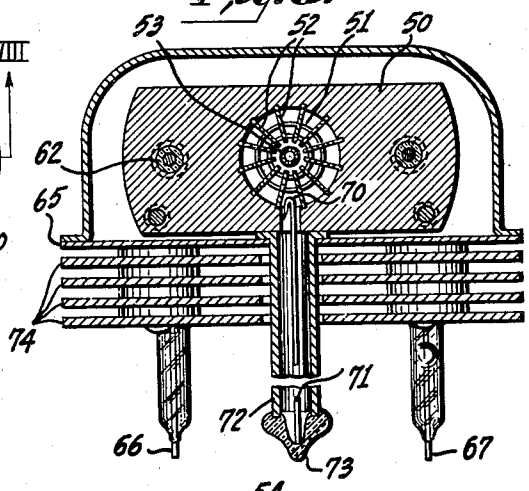


Fig. 9.

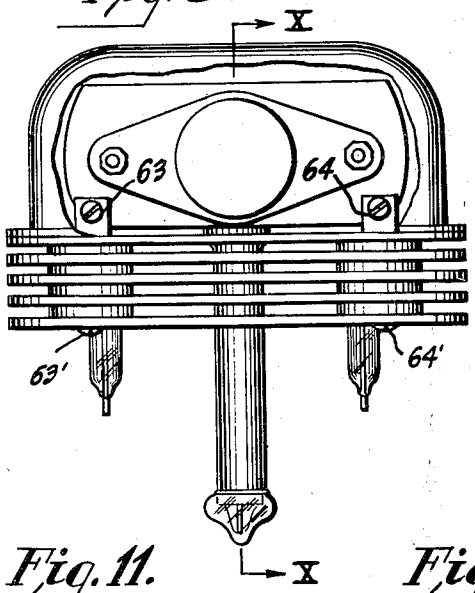


Fig. 10.

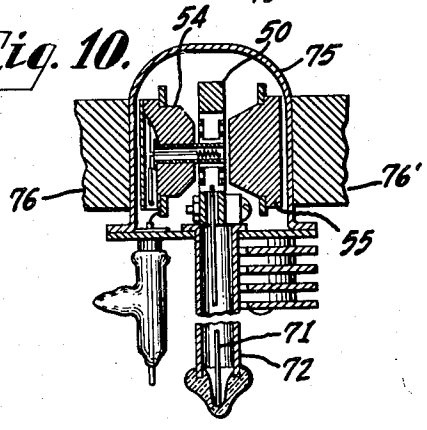


Fig. 11.

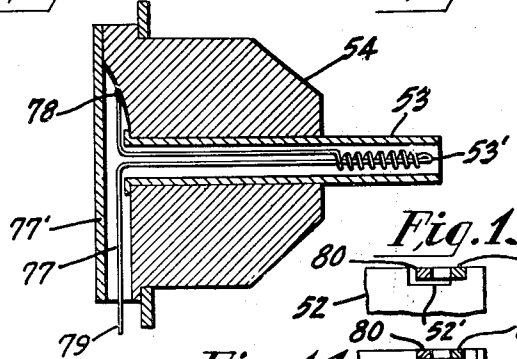


Fig. 12.

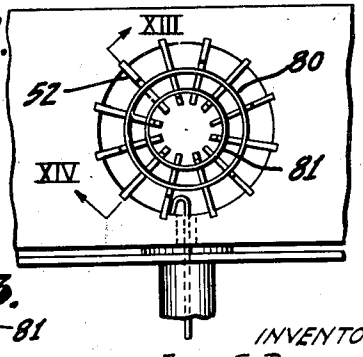
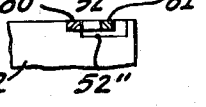


Fig. 13.

Fig. 14.



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Patented Mar. 22, 1949 2,465,211

UNITED STATES PATENT OFFICE

2,465,211

ELECTRON DISCHARGE DEVICE FOR HIGH FREQUENCIES

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Application March 8, 1944, Serial No. 525,514

20 Claims. (Cl. 315—40)

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Our invention relates to electron discharge devices for use at ultra high frequencies, and more particularly to magnetrons utilizing cavity resonator circuits.

In one form of a magnetron utilizing cavity resonators the electrode mount comprises an anode block having a central opening in which a cathode is axially positioned. Radially extending slots communicating with the central opening provide the cavity resonators, the portions of the block adjacent the central opening and between the slots providing the anode segments.

In another form the cavity resonators may be bores of cylindrically shaped chambers extending through the anode block and parallel to the central opening and communicating with the central opening through slots parallel to the axis of the central opening, the portions of the anode block adjacent the central opening and between the slots again providing the anode segments.

In this type of magnetron it has been the usual practice to machine the anode block with its resonant cavities from a solid block of conducting material such as copper, which may be in the form of a cylinder, spaces being machined at both ends of the cylinder to provide room for mounting the cathode and cathode leads, the ends of the cylinder being closed by cover plates soldered or otherwise sealed to the ends of the cylinder to provide an envelope. In a variation, a separate anode has been formed by machining or stamping, this anode being inserted into a machined envelope in the form of a hollow cylinder, end plates again being provided to complete the envelope.

The machining of the envelope is time-consuming and the construction described results in difficulty in mounting and centering of the cathode.

Usually fixed magnets or electromagnets are utilized with the magnetrons of the type described above. Because of the long air gaps made necessary between the electrode mount and the outside of the envelope larger magnets than desired are necessary to provide a field of desired intensity. In any magnetron, leads must be employed to support the cathode and make contact to the cathode and the cathode heater. These leads usually pass through the space at the ends of the anode and result in an air gap in the magnetic circuit which is inconveniently large. It is standard practice also to weld a metallic disc to the cathode leads in order to form electrostatic shields at cathode potential at the ends of the cathode for preventing drift of the electrons out

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the ends of the anode cavity. This contributes to the necessity for providing larger than desired air gaps.

In the usual form of magnetron of the type described, no way is provided to adjust the wavelength or to pre-tune the device in a simple and effective manner. It has also been found that due to temperature changes during operation, a variation in wavelength results.

No easy and effective way has been presented whereby a device of the kind described can be manufactured cheaply, easily and quickly on a production basis.

It is, therefore, an object of our invention to provide an improved electron discharge device of the magnetron type using cavity resonator circuits and particularly useful at ultra high frequencies.

Another object of our invention is to provide such a device of simplified design which will permit ready manufacture and eliminates the need of extensive machining operations.

A still further object of our invention is to provide such a device having a novel and effective means for supporting the cathode and its leads and which facilitates mounting and centering of the cathode.

More particularly it is an object of our invention to provide such a device in which the electrode mount assembly can be mounted on a header to facilitate assembly of the mount and incorporation within an envelope.

A further object of our invention is to provide such a device in which the gaps in the magnetic circuit are substantially reduced, thus decreasing the size and strength of the magnet, electromagnet or coils for providing a magnetic field of required intensity.

A further object of our invention is to provide a magnetron in which the conventional and electron shields are eliminated.

A further object of our invention is to provide a simple and convenient means for pre-tuning the device before sealing in the envelope.

A further object of our invention is to provide means for compensating for frequency shift due to temperature changes.

These and other objects will appear hereinafter.

The novel features which we believe to be characteristic of our invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figure

1 is a top view with part of the envelope removed to show details of construction of an electron discharge device made according to our invention; Figure 2 is a vertical section taken along the line II—II of Figure 1; Figure 3 is a vertical section taken along the line III—III of Figure 1; Figure 4 is a section taken along the line IV—IV of Figure 1; Figure 5 is a top view of the magnetic insert supporting the cathode of the electron discharge device shown in Figure 1; Figure 6 is a section taken along the line VI—VI of Figure 5; Figure 7 is a top view with part of the envelope removed to show a modification of the device shown in Figure 1; Figure 8 is a vertical section taken along the line VIII—VIII of Figure 7; Figure 9 is a side view with part of the envelope removed to show details of construction; Figure 10 is a section taken along the line X—X of Figure 9; Figure 11 is an enlarged sectional view of the cathode and its support and showing details of construction; Figure 12 is a view of the strapping arrangement for the anode elements; Figure 13 is a section taken along the line XIII in Figure 12 and Figure 14 is a section taken along the line XIV in Figure 12 to show details of strapping.

In accordance with our invention and referring to Figures 1 to 4 inclusive, we provide an electron discharge device of the magnetron type having an anode block **10** provided with a central opening or chamber **11** from which extend the radially directed slots **12** which form the cavity resonators. The end portions **13** of the block between the radial slots and defining the central opening provide the anode segments. An indirectly heated cathode **14** is positioned axially of the anode block. The anode block may be an assembly of stamped sheets of thin copper, the sheets being bonded together when they have been stacked to an appropriate thickness. This eliminates the necessity for the machining operations of the anode block. The block may be formed flat on the top and bottom to reduce the space necessary for the electrode assembly. This anode block may be supported from a header **22** and transversely to the header by means of the brackets **23** and **24**.

In the usual magnetron leads must be employed to support the cathode and make contact to the cathode and heater. In accordance with our invention however, the cathode is supported from the anode block in a novel manner. As best shown in Figures 1, 3 and 4, mounted on opposite sides of the anode block and coaxial with the chamber **11** is a pair of cylindrical inserts **15** and **16** having tapered ends and comprising magnetic material such as annealed cold rolled steel. A rod and bead construction, such as **17—18** and **17'—18'** supports the inserts from the anode block through which extend the screw members or bolts **19** and **20**, the inserts being spaced from the block by means of the spacer members, such as **19'**, **19''** and **20'**, **20.''** These inserts may be electrically connected together by means of the connecting strap **21**.

In manufacture the inserts may be fastened by short rods and glass beads to lugs 17_1, for example, and 18_1 through which the rods **19** and **20** extend. The making of the glass bead construction **17** and **18** is performed in a jig which holds the axis of the insert in a fixed position with respect to the centers of the lugs and holds the faces of the insert at a predetermined height with respect to faces of the lug. After the beads are made the cathode is slipped into one of the inserts **15** and welded. The cathode construction and support will be described in greater detail below.

The bolts **19** and **20** are then slipped through the lugs extending from the beads and the cylindrical spacers **19'** and **20'** slipped on the bolts, the bolts then being inserted through the holes in the anode block and through the brackets **23** and **24**, the spacers **19''** and **20''** being slipped on and the assembly held in place by means of the nuts associated with the bolts **19** and **20**. If the holes in the anode block are placed in the correct position, the cathode is automatically centered and the insert set at the right height above the anode. If it is desired to make a final centering of the cathode by hand or the use of a mandrel through the anode hole, the lugs may be made to have a loose fit on the bolts and the centering carried out before the nuts are tightened. The heater is then inserted in the cathode by a procedure to be described. The construction described above results in a very simple method of mounting. The cathode is held in rigid position with respect to the anode and the cathode-anode space is independent of the position of the assembly on the header or of deformation of the header.

If it is desired to hold the other end of the cathode rigidly in position, it may be inserted in a hole **16'** in the insert **16**. This might be done if, for example, it becomes desirable to increase the heat loss from the free end of the cathode.

This assembly is mounted on the header **22** which consists of an oval plate of metal of a thickness sufficient to give suitable rigidity. The shape need not be oval, but any form of adequate dimensions to fit the envelope decided upon. In one instance the header consisted of .025 inch stainless steel, the non-magnetic properties being of advantage in that no disturbance of the internal magnetic circuit of the tube is occasioned by its use. Holes are punched in the header to permit the entrance of the heater and heater-cathode leads and the load line. Eyelets such as **27** and **27'** are welded to the header to permit sealing-in of the heater and heater-cathode leads **26**, **26'** by means of the seals **28** and **28'**, these leads in turn being connected to the conductors **25** and **25'** extending from the cathode and the heater. A coupling loop **29** extends into the inner conductor **30** of the coaxial line including tubular member **31** sealed to the header and having its free end sealed vacuum-tight by an insulating cup-shaped cap **32**, this type of coupling line being described and claimed in a copending application of Donal and Hegbar, Serial No. 496,570 filed July 29, 1943, now U. S. Patent No. 2,442,118 granted May 25, 1948, and assigned to the same assignee as the present application. The junction of the tubular member **31** and the eyelets with the header may be made vacuum-tight by welding with silver-nickel solder at these junctions in an atmosphere of chemically-dried hydrogen.

The envelope **35** may be flattened as shown, resulting in an oval opening at the bottom. This provides the flat walls lying in a plane perpendicular to the magnetic field produced when the magnet is in position. This results in a minimum air gap in the magnetic circuit when the envelope is used in combination with an easily constructed external permanent magnet with flat pole faces, such as shown at **36** and **36'**, registering with the inserts **15** and **16** positioned within the envelope to further decrease the air gap in the magnetic circuit. For the envelope drawn cups of stainless steel may be utilized in order to avoid disturbances of the magnetic circuit. The envelope **35** is provided with a lip **36** which may be sealed to the

header 22 by means of atomic hydrogen welding, although electric welding could also be used.

In Figures 5 and 6 are shown details of the cathode support. The insert 15 is provided with a central bore of various diameters for receiving the cathode 14, the larger bore 37 permitting the cathode flange 14'' to be inserted with the cathode in contact with the insert only at the restricted portion 38 of the bore, the rest of the bore at 39 being of larger diameter to provide a space between the cathode sleeve 14 and the insert. Thus the heat loss from the cathode may be made very small, particularly if as shown in Figure 5 spacing fingers 38' only, contact the cathode sleeve. On the other hand under certain operating conditions it may be necessary to increase the heat loss in which event the length of the restricted portion 38 of the bore may be increased to increase the cathode area of contact.

A particularly novel feature of our invention resides in the method of forming an insert to receive the heater leads and the method of supporting the heater leads within the insert. Initially the insert 15 may be made slightly longer than its final dimensions and holes drilled radially from the outside surface so as to enter the bore at the portion 37 of larger diameter. The top face of the insert may then be turned down until the top surface intersects the bores to provide open slits 40 and 41. The leads from the heater are preformed and merely drop through the slits when the cathode heater 14' is placed in the cathode sleeve 14. Pieces of ceramic tubing 42 and 43 may then be slipped over the outer ends of the heater leads and pushed into the holes 40 and 41, locking the heater leads in place and insulating them from the insert. One of the heater leads 25 may be welded to the insert on its outer surface to form a heater-cathode connection. The two heater leads may then be welded in any convenient manner to leads 26, 26' extending through the glass seals 28 and 28'.

Since the insert 15 is electrically connected to the cathode and to the insert 16 by rods 19 and 20, the inserts are at cathode potential and act as shields and thus prevent loss of electrons from the anode space. The space between the ends of the inserts and the anode block and between the inserts and the walls of the envelope need be only sufficient to withstand the anode-cathode difference of potential and may be of the order .030 to .040 inch each. These spaces plus the thin walls of the envelope are the only gaps in the magnetic circuit, except for the anode thickness. Thus no space is lost due to the thickness of a non-magnetic cathode support. Furthermore the fact that the inserts can be varied in height means tubes of different anode length may be conveniently fitted into the same envelope merely by changing the height of the inserts.

As shown the inserts are tapered. The degree of taper employed may be used to concentrate the magnetic field in the anode space in any desired manner.

The spaces between the anode block and the inserts are not wasted as regards the magnetic circuit since it is known that they are necessary in order to provide magnetic coupling between the cavity resonators of the tube. Actually the surfaces of the inserts nearest the anode affect the operation of the tube in that the wavelength of the tube is a function of the size of these surfaces and of their distance from the anode. If the effect upon the magnetic circuit is desirable, the area and position of the inner faces of the

inserts may be used to adjust the wavelength of the tube before the envelope is welded on.

It may also be desirable to utilize plates of non-magnetic material affixed to the inserts and make them adjustable in order that the spacing from the surface of the anode block may be varied. This is illustrated in Figure 6 by means of the plate 83 supported in threaded engagement at 84 on the insert 15. The wavelength of the tube may be adjusted by advancing or retracting this plate, of which one may be positioned on each of the inserts. This arrangement is quite effective in that the movable plates cover a sufficient area of the outer ends of the cavity resonators to permit the desired tuning and yet not disturb the magnetic circuit. It is also obvious that this plate could be supported on the rods 19, 20, the plate being adjusted as to spacing by means of inserts.

It has been found that magnetrons change their wavelength with operating temperature due usually to thermal expansion of the cavity resonators. This upward change in wavelength can be automatically compensated for in our tubes by utilizing materials for inserts which have a lower coefficient of thermal expansion than the materials used for the rods 19 and 20 and spacers 19', 19'', 20', 20''. Thus the distance of the inserts from the anode and the capacitance of the cavities and, hence, the wavelength would be reduced as the tube warms up. This is practical since the wavelength is very sensitive to the distance of the inserts from the anode block. The use of threaded plates, such as 83, would increase the compensating wavelength change as long as they affected the capacitance only, of the cavities. If desired, these plates might be positioned over the outer portion, only, of the cavities, and hence affect cavity inductance rather than capacitance. If their effect then be made greater, due to larger area or closer spacing, than the effect of the inserts upon the capacitance, compensation for wavelength increase due to temperature increase would be obtained by mounting the plates on supports of such thermal expansion characteristics that the plates are moved closer to the ends of the cavities as the temperature of the assembly increases, since it is known that closer spacing results in a reduction of cavity inductance and hence of wavelength.

In Figures 7 to 14, inclusive, is shown a modification of the device shown in Figure 1. The anode block is provided with a central chamber 51 into which extend a plurality of radially positioned flat fin-like elements 52, the inner edges of which provide anode segments and the spaces between which provide the cavity resonators. The cathode 53 is positioned axially of the space defined by the anode segments.

As before, a pair of magnetic inserts 54 and 55 are positioned on either side of the anode block. Bridging members 56 and 57, which may be of conducting material, support the inserts. These in turn can be insulatingly supported from the anode block by means of the bolts 58 and 59 having thereon insulating spacer collar members 60, 60' and 61, 61', for example, and the insulating collar 62 surrounding the bolts within the anode block. The electrode assembly is positioned vertically within the envelope and secured to the header 65 by means of bolts extending through the blocks 63 and 64 secured to the header or extending through the header. The header is provided with the eyelets through which the cathode and heater leads 66 and 67 extend and to

which they are sealed. The inner ends of these leads are connected by means of conductor 68 to one side of the cathode heater and by 69 to the bridging member 56. The coupling loop extends through a passageway in the anode block into one of the cavity resonators as shown in Figure 8 and is connected to the inner conductor 71 of the coaxial line, the outer tubular member 72 of which is sealed to the header, the end being sealed off vacuum-tight by means of the insulating cup-shaped member 73. In order to increase the heat dissipation from the device there are provided a plurality of radiating fins 74 which are secured to the header as shown or to the blocks 63 and 64 if these extend through the header. If the blocks 63 and 64 are not extended through the header, screws or bolts 63' and 64' may be threaded into the blocks 63 or 64 through the header so that there is direct heat conduction from the anode block to the radiating fins 74.

An external magnet having pole pieces 76 and 76' is mounted externally of the envelope 75 and provides the magnetic circuit with the inserts 54 and 55.

In the present arrangement the cathode 53 is supported by means of the insert 54 having at its outer end a groove 77, one end 78 of the heater being welded to the insert and the other extending externally of the insert at 79. The heater is coated with insulating material. A cover 77' is positioned over the groove. While insert 54 is shown as in contact with the cathode sleeve through the length of the bore to increase heat dissipation from the cathode, the bore could be enlarged a shown at 39 in Figure 6.

In Figures 12 to 14, inclusive, is shown the method of strapping alternate anode segments together. As shown in Figure 13, which is a section taken along the line XIII of Figure 12, the anode slat or fin 52 is provided with a slot 52' into which fit the ring-like conducting straps 81 and 80, the ring 81 being electrically connected to the radial slat 52. Alternate slats are provided with slots 52'' through which the strap members 80 and 81 pass. In this case the strap 81 has no contact with the anode slat whereas the larger diameter strap 80 contacts the anode slat.

The purpose of the strapping is to increase the efficiency of the tube and could as well be used in the form shown in Figures 1 to 6, inclusive. In various mechanical forms, straps are electrical connections between anode segments, the choice of segments connected or left unconnected being either a matter of experience in the art or a matter decided from theoretical consideration.

While we have indicated the preferred embodiments of our invention of which we are now aware and have also indicated only one specific application for which our invention may be employed, it will be apparent that our invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of our invention as set forth in the appended claims.

What we claim as new is:

1. An electron discharge device having a support member and an electrode assembly, said electrode assembly including an anode means mounted on said member and having a plurality of anode elements defining a space, a cathode for supplying electrons within said space and means insulatingly supporting said cathode with respect to said anode means and including an element of magnetic material insulatingly mounted on said anode means adjacent said anode elements, and a magnet having a pole piece registering with the element of magnetic material.

2. An electron discharge device having a support member and an electrode assembly including an anode means mounted on said member and having a plurality of anode segments defining a space, a cathode for supplying electrons within said space and means insulatingly supporting said cathode with respect to said anode means and including a first element of magnetic material insulatingly mounted on one side of said anode means adjacent said anode segments, a second element of magnetic material insulatingly mounted on the opposite side of the anode means adjacent said anode segments and registering with said first element, and a magnet having its pole pieces registering with the elements of magnetic material.

3. An electron discharge device having a support member and an electrode assembly including an anode block mounted on said member and having a plurality of anode elements defining a space, a cathode for supplying electrons within said space and means supporting said cathode and comprising a member of magnetic material insulatingly mounted on said anode block and having a bore, a portion of said cathode being positioned within said bore.

4. An electron discharge device including a header member, an electrode assembly including an anode mounted on said header member, said anode having a plurality of anode elements defining a space, a cathode for supplying electrons within said space and means supporting said cathode and including a member of magnetic material insulatingly mounted on said anode adjacent said anode elements, and an envelope sealed to said header member and positioned close to said member of magnetic material, and external means providing a magnetic circuit through said member of magnetic material.

5. An electron discharge device including a flat header member, an electrode assembly mounted on said header member and including a flat anode block mounted normal to said header member, said block having a plurality of anode elements defining a space, a cathode for supplying electrons within said space and means supporting said cathode and including a first member of magnetic material positioned on one side of said anode block adjacent said anode elements, and a second member of magnetic material positioned on the other side of said anode block adjacent said anode elements and registering with the first member of magnetic material, and an envelope sealed to said header member and positioned closely adjacent said members of magnetic material, and external means providing a magnetic circuit through said members of magnetic material.

6. An electron discharge device having an electrode assembly including an anode block having a plurality of anode elements defining a space, a cathode for supplying electrons within said space and means supporting the cathode from said anode block and comprising a first member of magnetic material having a bore extending therethrough, said cathode being positioned within said bore and means insulatingly supporting said member of magnetic material from one side of said block, and a second member of magnetic material insulatingly supported on the opposite

side of said anode block and registering with said first member, and means adjacent said members of magnetic material for producing a magnetic field within said central space surrounded by said anode elements.

7. An electron discharge device having an electrode assembly including a flat anode block having a plurality of anode segments and cavity resonators connected between said segments, a cathode positioned axially of said anode segments and means supporting the cathode from said anode block and comprising a first member of magnetic material having a bore extending therethrough, said cathode being positioned within said bore and means insulatingly supporting said member of magnetic material from said block, and a second member of magnetic material on the other side of said anode block and registering with said first member, and means adjacent said members of magnetic material for producing a magnetic field between said cathode and said anode elements.

8. An electron discharge device having an electrode assembly including an anode block, said block having a plurality of anode elements defining a space, and a cathode for supplying electrons within said space, members of magnetic material positioned on opposite sides of said anode block and registering with the central space in said block, and means insulatingly supporting said members of magnetic material from said block, one of said members of magnetic material supporting said cathode, an envelope including a header, said header comprising a flat conducting member, said electrode assembly being supported from said header, said header having a plurality of apertures, tubular members extending outwardly from said apertures and leads extending through said apertures and insulatingly sealed through said tubular members, said leads being connected to said cathode.

9. An electron discharge device having an electrode mount assembly including an anode block, said block having a plurality of anode elements defining a space, and a cathode for supplying electrons within said space, members of magnetic material positioned on opposite sides of said anode block and registering with the central space in said block, and means insulatingly supporting said members of magnetic material from said block, one of said members of magnetic material having a bore extending therethrough and into which said cathode extends and is supported thereby, an envelope including a header, said header comprising a flat conducting member, said electrode mount assembly being supported from said header, said header having an aperture, a tubular member extending outwardly from said aperture, and a coupling loop terminating at said anode block adjacent said anode elements and extending through said tubular member, and providing with said tubular member a coaxial line.

10. An electron discharge device having an electrode assembly including an anode block of flat elongated construction, said block having a plurality of anode elements defining a space, and a cathode for supplying electrons within said space, members of magnetic material positioned on opposite sides of said anode block and registering with the central space in said block, and means insulatingly supporting said members of magnetic material from said block, one of said members of magnetic material supporting said cathode, a header comprising a flat conducting member, said electrode mount assembly being supported from said header, and a flattened envelope sealed to said header member and having flat walls closely adjacent said members of magnetic material, and an external magnetic means closely adjacent the walls of said envelope and registering with the members of magnetic material for providing a magnetic circuit.

11. An electron discharge device having an electrode assembly including an anode block of flat elongated construction, said block having a plurality of anode segments defining a space, and cavity resonators connected between said anode segments, and a cathode positioned coaxially of said space, a plurality of members of magnetic material positioned on opposite sides of said anode block and registering with the central space in said block, and means insulatingly supporting said members of magnetic material from said block, one of said members of magnetic material having a bore extending therethrough and into which said cathode extends and is supported thereby, a header comprising a flat conducting member, said electrode assembly being supported from said header, said header being provided with a plurality of apertures, tubular members extending outwardly from said apertures and leads extending through some of said apertures and insulatingly sealed through said tubular members, and connected to said cathode, and a coupling loop terminating at said anode block and extending through another of the tubular members extending from said header member and providing therewith a coaxial line, and a flattened envelope sealed to said header member and having flat walls closely adjacent said members of magnetic material, and an external means closely adjacent the wall of said envelope and registering with the members of magnetic material for providing with said members of magnetic material a magnetic circuit.

12. An electron discharge device including an anode, a cathode, and a member of magnetic material supported adjacent said anode and having a central bore extending therethrough, the bore being enlarged at one end for a comparatively short distance for providing a recess, the bore being enlarged at its other end for a comparatively longer distance, and a cathode sleeve having a flange fitting within the recess at said one end and extending through the bore and in contact with the bore between said recesses, said member of magnetic material having radially directed passageways extending therethrough and communicating with said recess at said one end of said bore, and a cathode heater within said cathode sleeve and having heater leads extending from said heater through said passageways, and insulating tubular members surrounding said heater leads within said passageways, the portion of said bore in contact with said cathode sleeve being in contact with said sleeve at spaced points around the circumference of said cathode sleeve to reduce heat conduction from said cathode.

13. An electron discharge device including an anode, a cathode and a member of magnetic material supported adjacent said anode and having a central bore extending therethrough, said bore being enlarged at one end for a comparatively short distance and providing a recess, and a cathode sleeve having a flange fitting within the recess and extending through said bore, said member of magnetic material having radially directed passageways extending therethrough and communicating with the recess, and a cathode heater within said cathode sleeve and having

heater leads extending from said cathode heater through said passageways.

14. An electron discharge device including an anode, a cathode and a member of magnetic material supported adjacent said anode and having a central bore extending therethrough, the bore being enlarged at one end for a comparatively short distance and providing a recess, and a cathode sleeve having a flange fitting within the recess and extending through said bore and in contact with said bore for only a part of the length of said bore, said member of magnetic material having radially directed passageways extending therethrough and communicating with the recess, and a cathode heater within said cathode sleeve and having heater leads extending from said cathode through said passageways, and insulating tubular members surrounding said heater leads within said passageways.

15. An electron discharge device having an electrode assembly including an anode having a plurality of cavity resonators and having a plurality of anode segments defining a central space, said cavity resonators being between said segments, a cathode for supplying electrons within said space, a conducting member mounted on said anode adjacent said resonators and supporting said cathode, and a conducting plate mounted on said member adjacent said cavity resonators and adjustable toward and from said cavity resonators for pre-tuning said electron discharge device.

16. An electron discharge device having an electrode assembly including an anode having a plurality of cavity resonators and having a plurality of anode segments defining a space, said cavity resonators being between said segments, a cathode for supplying electrons within said space and means supporting the cathode adjacent said anode and including a conducting member mounted on said anode, and a conducting plate threaded on said member adjacent said cavity resonators, whereby said plate is adjustable toward and from said cavity resonators for pre-tuning said electron discharge device.

17. An electron discharge device having an electrode assembly including an anode having a plurality of cavity resonators and having a plurality of anode segments defining a space, said cavity resonators being between said segments, a cathode for supplying electrons within said space and means supporting the cathode adjacent said anode block and comprising a member of magnetic material adjacent and registering with said central space, and a non-magnetic conducting plate mounted adjacent said cavity resonators and supported on said member of magnetic material and adjustable toward and from said cavity resonators for pre-tuning said electron discharge device.

18. An electron discharge device including an envelope having an envelope including a header member of conducting material, an electrode assembly mounted on said header member and including an anode block, said block having a plurality of anode elements defining a space and a cathode for supplying electrons within said space,

said anode being supported from said header member by conducting members fixed to said anode and to said header member and extending through said header member, and a plurality of heat radiating fins mounted externally of said header member on said conducting members supporting said anode.

19. An electron discharge device including an envelope having an envelope including a flat header member of conducting material, an electrode assecmbly mounted on said header member and including an elongated anode block, said block having a plurality of anode elements defining a space and a cathode for supplying electrons within said space, said anode being supported from said header member by conducting members fixed to said anode at opposite ends thereof and to said header member, a plurality of heat radiating fins mounted externally of said header member, and heat conducting means extending through said header member and supporting said fins in heat conducting relationship on said conducting members supporting said anode.

20. An electron discharge device having an electrode assembly including an anode having a plurality of cavity resonators and having a plurality of anode segments defining a space, said cavity resonators being between said segments, a cathode for supplying electrons within said space, and means supporting the cathode adjacent said anode and including a member of magnetic material, said member of magnetic material being insulatingly supported on said anode and positioned adjacent said anode segments, whereby changes in the distance of said member from said segments vary the capacitance of the resonant cavities, said member of magnetic material and said means insulatingly supporting said member of magnetic material on said anode having different coefficients of thermal expansion to compensate for changes in resonant wavelength due to thermal expansion of said resonators.

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