

June 15, 1948.

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2,443,445

CAVITY RESONATOR MAGNETRON AND STRAPPING ARRANGEMENTS THEREFOR

Filed March 29, 1944

2 Sheets-Sheet 1

Fig. 1.

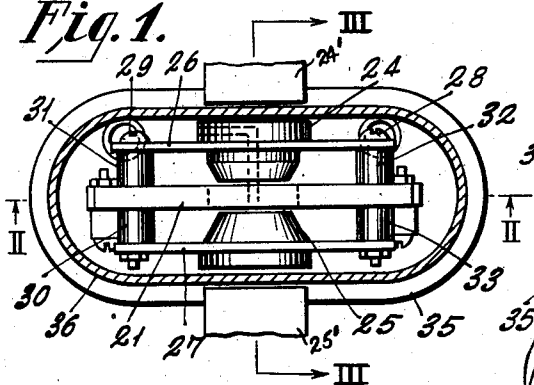


Fig. 2.

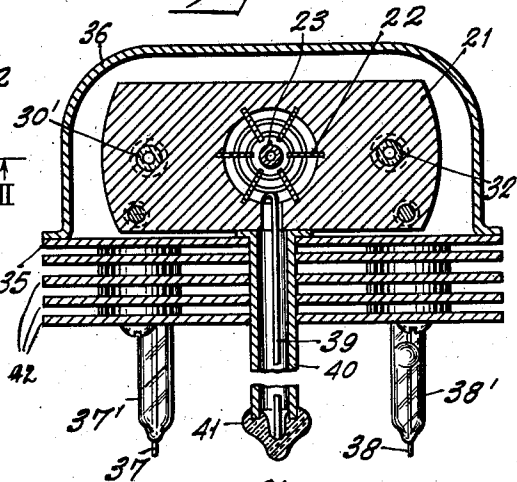


Fig. 4.

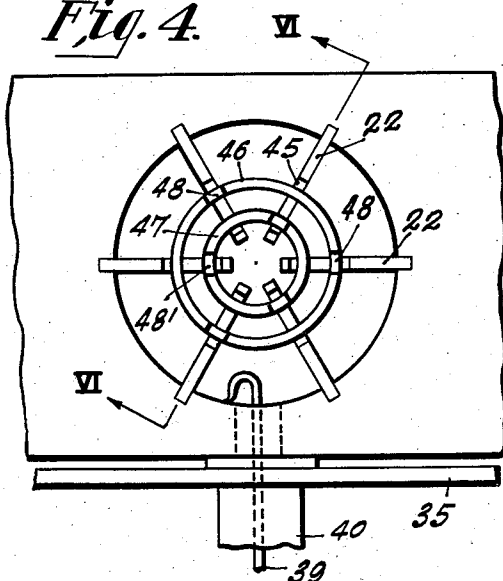


Fig. 3.

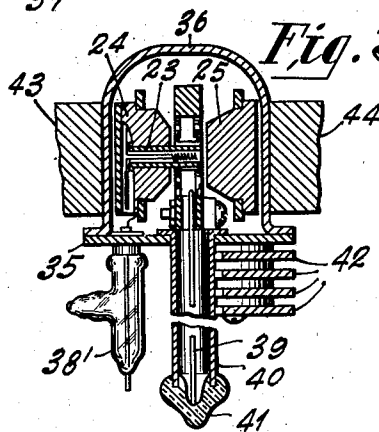


Fig. 5.

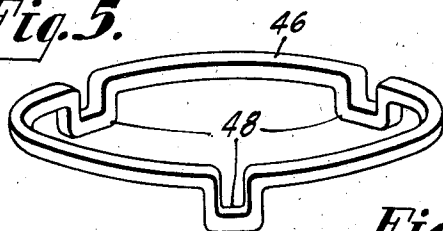


Fig. 6.

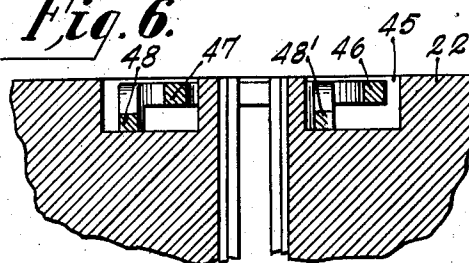
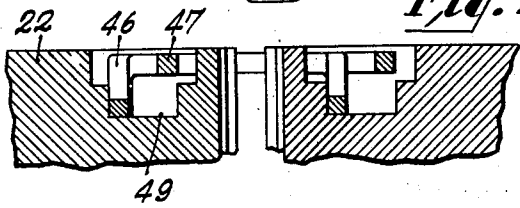


Fig. 7.



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2 Sheets-Sheet 2

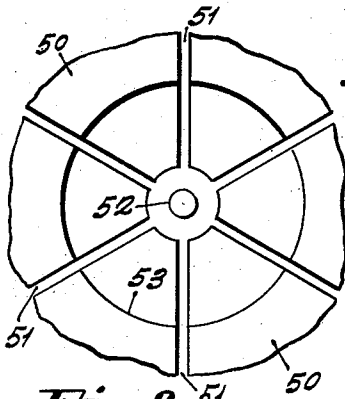


Fig. 8.

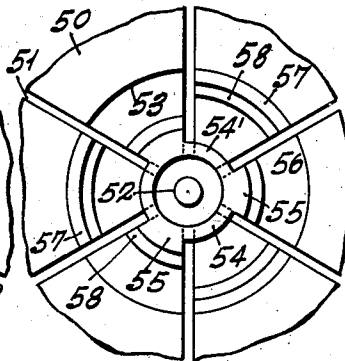


Fig. 10.

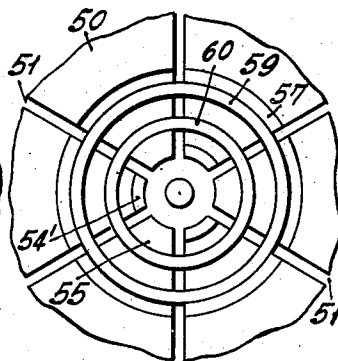


Fig. 12.

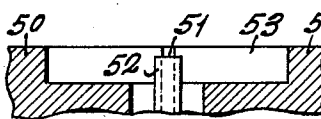


Fig. 9.

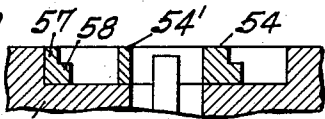


Fig. 11.

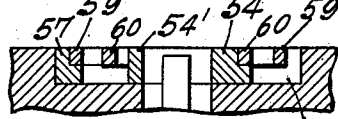


Fig. 13.

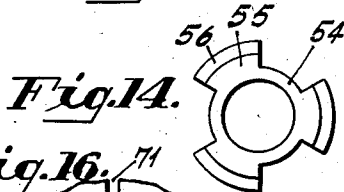


Fig. 14.

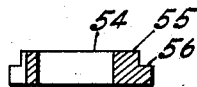


Fig. 15.

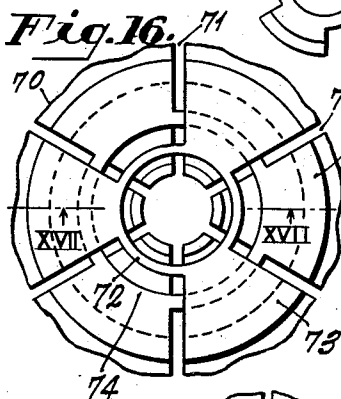


Fig. 16.

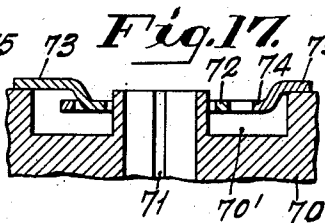


Fig. 17.

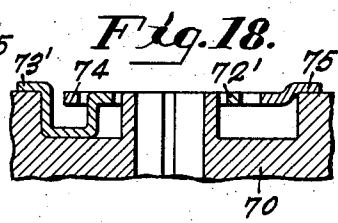


Fig. 18.

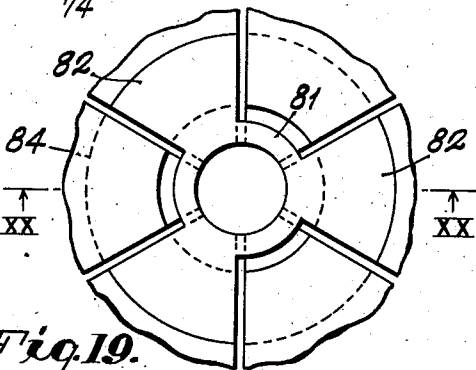


Fig. 19.



Fig. 20.

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UNITED STATES PATENT OFFICE

2,443,445

CAVITY RESONATOR MAGNETRON AND
STRAPPING ARRANGEMENT THERE-
FOR

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ors to Radio Corporation of America, a cor-
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Application March 29, 1944, Serial No. 528,538

1 Claim. (Cl. 315—40)

1

Our invention relates to electron discharge de-
vices useful at ultra high frequencies, more par-
ticularly to devices of the magnetron type em-
ploying cavity resonators.

Magnetrons utilized at ultra high frequencies
and employing cavity resonators may be of sev-
eral types. Those formed from a solid anode
block have slats radially directed from the central
cathode chamber, the slats providing the cavity
resonators between adjacent anode segments.
The slats may be enlarged at their inner ends to
provide resonators having a circular transverse
section. In another type a plurality of slats or
fins are supported within a central space and ex-
tend radially toward and define a cathode space,
the inner edges of the slats serving as the anode
segments and the slats and their supporting base
providing cavity resonators between the anode
resonators.

In magnetrons of this type, that is multi-seg-
ment type utilizing resonators, it is desirable to
have the magnetron operate in only one mode,
several modes being possible. In order to do this
alternate segments are connected together or
strapped together by means of conductors to in-
sure operation in the desired mode. Magnetrons
utilized at very high frequencies are of small size
and it is difficult to strap the anode segments
together. Thus, accurate and reproducible re-
sults in strapping are difficult to accomplish,
causing variations in dimensions in the spacing
which not only affects the wavelength at which
the magnetrons operate, but also the efficiency of
operation.

It is an object of our invention to provide mag-
netrons having improved methods of strapping,
promoting ease of construction, accuracy and re-
producibility as to dimensions and spacings, thus
insuring that magnetrons of the same size will
operate at the same frequencies and at high effi-
ciencies.

The novel features which we believe to be char-
acteristic of our invention are set forth with par-
ticularity in the appended claim, but the inven-
tion 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 parts removed to show details
of construction of an electron discharge device
made according to our invention, Figure 2 is a
longitudinal section taken along the line II—II
of Figure 1, Figure 3 is a longitudinal section
taken along the line III—III of Figure 1, Figure
4 is an enlarged view of the anode segments and
showing details of the strapping members em-
ployed in the device shown in Figures 1, 2 and 3,
Figure 5 is a perspective showing details of con-
struction of a strapping member made according
to our invention, Figure 6 is a section taken along

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the line VI—VI of Figure 4, Figure 7 is a sec-
tional view of a modification of the construction
shown in Figure 6, Figures 8 to 13, inclusive,
illustrate the steps in the construction of an-
other form of strapping arrangement according
to our invention, Figures 14 and 15 show details
of construction of an element utilized in Figures
8 to 13, inclusive, Figure 16 is a partial top view
of a modification of the strapping arrangement
shown in Figure 4, Figure 17 is a section taken
along the line XVII—XVII of Figure 16, Figure
18 is a partial section showing a modification of
the construction shown in Figure 17, Figure 19
is a further modification of a strapping arrange-
ment shown in Figure 16, and Figure 20 is a
section taken along the line XX—XX of Figure
19.

Referring to Figure 1, an electron discharge
device employing our invention is of the mag-
netron type and comprises an anode block 21 sup-
porting a plurality of radially directed slats or
fins 22 which extend toward and the inner ends
of which provide the anode segments and define
the cathode space in which the cathode 23 is
axially positioned, this cathode being supported
by the magnetic insert member 24 having oppo-
sately disposed thereto a second magnetic insert
member 25 which forms part of the magnetic
circuit completed by a magnet having poles 24'
and 25'. The cathode and inserts are supported
by means of conducting bridging members 26 and
27 which are in turn insulatingly supported from
the anode block by means of the bolts 28 and
29 insulated by means of insulating tubular mem-
bers 30, 31, 32 and 33, these bolts also being in-
sulated from the block by means of the inserts 30'
and 32'.

This electrode assembly is mounted on header
member 35 to which is sealed an envelope 36, the
header and envelope being made of non-magnetic
material, for example, stainless steel. The cath-
ode and heater leads 37 and 38 extend through
the header and are sealed therein by means of the
elongated insulating cup-shaped members 37' and
38'. One of the cavity resonators formed be-
tween the slats 22 has coupled thereto coupling
member 39 which forms the inner conductor of
coaxial line, the outer tubular conductor 40 of
which has hermetically sealed thereto member
41, the inner member 39 also serving as a radiator
which can be coupled into a waveguide. Cooling
fins 42 may be secured to the header.

In accordance with our invention and as shown
in Figures 4 and 6, each of the radially directed
slats or anode elements 22 is provided with a slot
45 for receiving a strapping ring made according
to our invention and shown in greater detail in
Figure 5. This strapping ring 46 is provided with
a plurality of deformations or extensions 48 nor-

mal to the plane of the ring and are positioned so that they contact alternate slats as shown in Figure 3. Two such rings are provided, one of which, 47, is of smaller diameter than the outer ring 46 and also being provided with extensions 43' normal to the plane of the strapping ring, these deformations engaging and being electrically connected to the other group of alternate anode slats. Thus during operation the voltage on adjacent anode segments are in phase opposition. As shown in Figure 6, the ring 46 is connected to the slat which is spaced from the ring 47 and likewise the ring 47 is electrically connected at 48' to one of the slats while the other ring 46 is positioned in space with respect thereto.

In the arrangement shown in Figure 7 the slot 49 in the slats is stepped so that the rings are positively positioned with respect to each other, the smaller strapping ring engaging the inner step and the outer ring engaging the outer step, lateral movement between the rings thereby being prevented.

In the case of magnetrons formed from a block by means of slots extending radially from a central chamber, a different approach to the problem is provided. Referring to Figures 8 to 15, the slots 51 result in the provision of a plurality of anode segments 50, the inner ends of which surround the cathode space, in which is axially mounted the cathode 52. In the first step in providing the strapping arrangement, the anode segments are recessed as indicated at 53. The element shown in Figure 14 is then positioned as indicated in Figure 10. This element or spider 54 is provided with three projections 55, the outer portions of which are formed to provide step 56. Likewise a ring 57 provided with a step 58 is positioned within the recess 53 in contact with the vertical wall of the recess. After being secured in position the spider 54 and the ring 57 are cut along the slots and alternate portions of the ring 57 are left as indicated in Figure 10. To provide alternate stepped portions at the inner ends of the anode segments 50, the spider is also slotted so that the step portions are left on different alternate legs. It is noted that the step portions are mounted at the ends of the segments in between those segments in which the step ring portions 57 are left. The portions of spider 54 in between the extensions 55 provide the inner wall 54' as shown in Figures 11 and 12. It is now possible to position two rings 59 and 60 within the recess 53, the outer ring being supported by the step ring 57 connecting alternate anode segments and the inner ring being supported by the step portions 56 of the spider, the relationship of the inner and outer rings being shown in Figure 13. Thus a most accurate positioning of the rings results.

Another way of providing the step portion 57 is to utilize the laminated construction shown in Figure 20, the first and second laminations adjacent the recess being extended one beyond the other to provide a step on which to place the outer ring.

A still further method would be to use a ring having a step portion with intermediate portions of less width and then cutting along the slots in the same manner as is done with the central spider.

A still further method would be to place sectors 57 of conducting material, such as shown in Figure 7, on alternate segments adjacent the periphery of the recess.

A further modification of the strapping ar-

angement is shown in Figure 16. Here a pair of spiders are utilized, one of the spiders 74 being provided with extensions or legs 75 so that every other anode segment between the slots 71 is connected by this spider. The second spider 72 is positioned over the first spider and the legs 73 engage the anode segments in between the first mentioned group of segments. The relationship of the two spiders is shown in Figure 17, the ring portions of the spider extending within the slots 70' in the anode segments 70.

In the modification shown in Figure 18 the outer spider 73' may have its inner portion deformed as indicated so that it passes under the ring portion of the top spider 74.

In Figures 19 and 20 a still further form of strapping arrangement is disclosed. The anode block may be made of a plurality of sheet elements 80 as shown in Figure 20. Some of the sheet elements may be formed to provide recesses for receiving the legs 82 of the strapping member 81 which is in the form of a spider and the legs 83 of the spider 84, other sheets being formed to provide a space for the ring part of the spiders as shown at 85. Figure 19 shows the anode block with the top plate of Figure 20 removed.

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 claim.

What we claim as new is:

An electron discharge device having a plurality of anode segments extending radially from a central space defined by said segments, a cathode adjacent said anode segments for supplying electrons within said central space, said segments comprising slat-like elements, said slat-like elements having slots in one end thereof, and concentric ring-shaped strapping elements having extensions normal to the plane of the element, the extensions of one of said ring-shaped strapping elements contacting alternate slat-like elements within the slots, and the extensions on another ring-shaped strapping element lying within the slots of and connecting the remaining slat-like elements together.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,063,342	Samuel	Dec. 8, 1936
2,111,263	Fritz	Mar. 15, 1938
2,242,888	Hollmann	May 20, 1941
2,408,234	Spencer	Sept. 24, 1946
2,408,235	Spencer	Sept. 24, 1946
2,408,903	Biggs et al.	Oct. 8, 1946

FOREIGN PATENTS

Number	Country	Date
445,084	Great Britain	Apr. 2, 1936

Disclaimer

2,443,445.—*John S. Donal, Jr., Barremore B. Brown, and Carmen Louis Cuccia,*
Princeton, N. J. CAVITY RESONATOR MAGNETRON AND STRAPPING AR-
RANGEMENT THEREFOR. Patent dated June 15, 1948. Disclaimer filed
June 20, 1950, by the assignee, *Radio Corporation of America.*

Hereby enters this disclaimer to the single claim of said patent.

[*Official Gazette July 25, 1950*]