Oct. 9, 1962 L. L. CLAMPITT ET AL 3,058,029

MAGNETRON STRAPPINGS

Filed Nov. 24, 1958

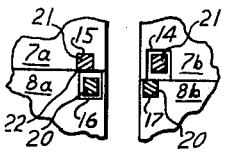


FIG. 2

FIG. 1

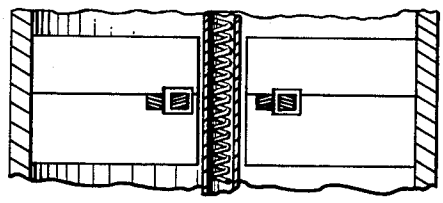


FIG. 3

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United States Patent Office 3,058,029 Patented Oct. 9, 1962

3,058,029

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Filed Nov. 24, 1958, Ser. No. 776,007
6 Claims. (Cl. 315—39.69)

This invention relates generally to magnetrons and, more particularly, to magnetrons having a center-strapped anode structure.

It is well known that magnetrons conventionally utilize strapping in order to separate undesired modes of operation from the desired mode (usually the π-mode) and to eliminate spurious oscillations. Most magnetrons make use of what is known as end strapping, wherein a pair of conducting straps is located either at the upper or lower edges of the anode elements or at both the upper and lower edges. To maintain sufficient space within the cavities formed by the anode-elements so that tuning elements or pins may be easily inserted into said cavities, it has sometimes been found desirable to utilize center-strapping, wherein a pair of conducting straps is located substantially midway between the upper and lower edges of the anode elements. Each of the straps is connected to alternate anode elements in a well-known manner. It has been found that the internally-located center straps are well shielded from the anode end spaces, and hence, may provide better R-F symmetry than do the end type straps. In such conventional center-strapping, the straps form rings having equal diameters, concentric with the anode cylinder, and are placed so that one is located substantially in a plane directly above the other. This construction assures that there is sufficient space within the cavities to allow tuning pins to be inserted easily.

This center-strapping arrangement is usually constructed according to one of two methods. According to one common method, the anode structure is fabricated in two halves, divided in a plane substantially perpendicular to the axis of the anode cylinder. Another construction method involves the making of sub-assemblies of vanes and straps which are then inserted into the anode cylinder. For relatively low power or high frequency anode structures, these methods for assembling conventional center-strapped magnetrons may have disadvantages because of the very small size of the components making up such structures. The fact that both straps are concentric and have equal diameters means that the upper strap requires some exterior means of support during the assembling process. The small size of these components makes them extremely fragile and easily distorted and prevents the assemblies from being easily constructed.

This invention utilizes a center-strapped anode structure that facilitates the assembly of these components so that they may be brazed together in one operation. The invention utilizes center straps positioned so that, during the assembling operation, the straps are entirely supported by the vanes themselves. Such support is achieved by using conducting rings having unequal diameters. Thus, the invention requires no additional support fixture such as are necessary for the assembling of conventional center-strapped magnetrons. In order to explain the construction of the invention and the advantages which are brought about in the assembly process by such a construction, it is helpful to examine the accompanying drawing in which:

FIG. 1 shows a partially cross-sectioned, exploded view of a magnetron utilizing a particular embodiment of the invention;

FIG. 2 shows portions of two opposing anode vanes used in the magnetron of FIG. 1, showing the positions of the assembled center straps; and

FIG. 3 shows a partial cross section of an anode structure utilizing another possible embodiment of the invention.

In FIG. 1, there is shown an exploded view of a magnetron comprising an anode structure **5** having an anode cylinder **6**, which, for the sake of clarity, is shown here broken into two portions, an upper cylindrical portion **6***a* and a lower cylindrical portion **6***b*. Extending inwardly from the innersurface of upper portion **6***a* are a plurality of upper vane segments **7**. Extending inwardly from the inner surface of lower anode cylinder **6***b* are a plurality of lower vane segments **8**. The upper end of anode cylinder **6***a* is sealed by upper cover plate **9**. The lower end of anode cylinder **6***b* is similarly sealed by a lower cover plate **10**. Extending through upper cover plate **9** and concentric with the axis of cylinder **6** is an upper magnetron pole piece **11**. Pole piece **11** has a hole **12** extending axially therein concentric with cylinder **6**. Extending through an opening (not shown) in lower cover plate **10** and concentric with the axis of cylinder **6** is a lower magnetron pole piece **13**.

Alternating ones of upper vane segments **7** are designated **7***a*. Between vane segments **7***a* are alternating vane segments **7***b*. The height of segments **7***b* along the direction of the axis of cylinder **6** is greater than the height of vane segments **7***a* along that same direction. Vane segments **7***b* each have an opening **14** located near the innermost end of each vane segment. Vane segments **7***a* each have an opening **15** smaller in dimension than that of openings **14** similarly located near the inner end of each vane segment. Alternating ones of lower vane segments **8** are designated **8***a*. Between segments **8***a* are alternating vane segments **8***b*. The height of segments **8***a* along the direction of the axis of cylinder **6** is greater than the height of segments **8***b* along the same direction. Vane segments **8***a* have openings **16** located near the innermost ends of each vane segment. Vane segments **8***b* have openings **17** which are smaller in dimension than openings **16** and are similarly located near the inner ends of each vane segment. When the two portions, **6***a* and **6***b*, of anode cylinder **6** are joined together, vane segments **7** join vane segments **8** to form a plurality of integral vane segments.

Located at the junction of lower surfaces **18** of vane segments **7** and upper surfaces **19** of vane segments **8** are a pair of ring-shaped conducting straps **20** and **21**. Conducting strap **20** has a smaller diameter than conducting strap **21** and is attached to vane segments **8***b* at openings **17**. The dimensions of openings **17** correspond substantially to the cross-sectional dimension of strap **20** so that strap **20** may be firmly seated therein. Because openings **16** of vane segments **8***a* are larger than openings **17** of vane segments **8***b*, strap **20** does not in any way contact segments **8***a*.

Conducting strap **21** is firmly seated in openings **15** of upper vane segments **7***a*, the sizes of said openings corresponding substantially to the cross-sectional dimensions of strap **21**. Because openings **14** of segments **7***b* are larger than openings **15** of segments **7***a*, strap **21** does not contact segments **7***b*.

In the assembled magnetron anode structure, the lower surfaces of vane segments **7***a* join the upper surfaces of vane segments **8***a*, and the lower surfaces of segments **7***b* join the upper surfaces of segments **8***b*. A view of the inner ends of joined vane segments **7** and **8** showing straps **20** and **21** in cross section is shown in FIG. 2. As shown in that figure, the straps are located substantially midway between upper edges **23** and lower edges **24** of the completely formed vanes.

To clarify the structure of the invention, FIGS. 1 and 2 do not show the cathode of the magnetron which, as is

well known, is located in the interaction space along the axis of anode cylinder 6. The cathode will normally extend upwardly into recessed opening 12 of upper pole piece 11 and downwardly into lower magnetron pole piece 13. It is to be understood also that usable energy is coupled out from the magnetron in any well known manner as, for instance, by a wire loop located in one of the cavities, one end of the wire loop extending outwardly through the wall of the anode cylinder. For simplicity, the wire loop has not been shown in FIG. 1.

It can be seen that the assembly of the anode structure shown in FIGS. 1 and 2 is simplified as compared to the assembly of prior magnetrons utilizing center straps having equal diameters. In the first step of the assembly process, center strap 20 having the smaller diameter is attached to lower segments 8*b* at openings 17. Upper strap 21 having the larger diameter is then placed so that its lower surface rests on edges 22 of lower vane segments 8*a*. Because the height of segments 8*a* is greater than the height of segments 8*b*, upper strap 21 does not touch segments 8*b* during this step of the assembly process. Because strap 21 is supported by lower vane segments 8*a*, there is no necessity for providing any external fixture for supporting upper strap 21 during the assembly operation, such as is necessary in the construction of center strapped anodes having equal diameters.

In the final step of the assembling process, upper half segments 7*a* and 7*b* are placed upon lower half segments 8*a*, 8*b*, and straps 20 and 21. Strap 21 is thus attached to segments 7*a* at openings 15 and passes through segments 7*b* by way of openings 14. The final construction, therefore, comprises a plurality of vane segments each having an upper and lower portion as shown in FIG. 2.

This invention, therefore, not only provides the well-known advantages of center strapping, such as balanced R-F fields for the π-mode of oscillation and a high-Q circuit, but also provides a simplified method of construction not previously available for center strapped configurations.

The embodiment shown in FIGS. 1 and 2 does not represent the only one possible for this invention. For instance, in applications wherein cavity space in a radial direction may not be at a premium, the straps may have unequal diameters and be placed concentrically in the same plane substantially perpendicular to the axis of the anode cylinder and cathode, as shown in FIG. 3. In this way, during the construction process, both straps are attached to the lower half segments of the anode vanes and no external support fixtures are required.

Other variations in the basic construction of this invention will be apparent to those skilled in the art within the scope of this invention. For instance, the strap need not be ring shaped, but may be in the shape of an appropriate polygon, for example, as long as the relative sizes of the straps are such that the upper one can easily rest on the edges of the lower vane segments during the assembling process. Therefore, this invention is not to be limited to the particular embodiment described in the drawings and discussed above, except as defined by the appended claims.

What is claimed is:

1. An electron discharge device including an anode structure, said anode structure comprising an anode cylinder; a plurality of vane members extending radially inward from said anode cylinder, the inner ends of said vane members thereby forming an interaction space, each of said vane members having an upper and a lower edge and being formed of a plurality of segments joined together in a region substantially midway between said upper and lower edges; a pair of conducting members connected to said vane members at said region, one of said conducting members interconnecting alternate vane members, the other of said conducting members interconnecting alternate vane members not connected to said first conducting member, said first and second conducting members being located at unequal distances from said interaction space.

2. An electron discharge device including a cathode and an anode, said anode comprising a plurality of upper vane segments and a plurality of lower vane segments joined to form a plurality of vane members radially spaced about said cathode, a first conducting ring having a first predetermined diameter connected to alterating ones of said vane members in the vicinity of the junction of said upper and lower vane segments, a second conducting ring having a second predetermined diameter connected to alternating vanes not connected to said first ring in the vicinity of said junction, said first and second predetermined diameters being unequal.

3. An electron discharge device including a cathode and an anode, said anode comprising a plurality of upper vane segments and a plurality of lower vane segments joined to form a plurality of vane members radially spaced about said cathode, a first conducting ring having a first predetermined diameter connected to alternating ones of said vane members in the vicinity of the junction of said upper and lower vane segments, a second conducting ring having a second predetermined diameter connected to alternating vanes not connected to said first ring in the vicinity of said junction, said first and second predetermined diameters being unequal and said first and second rings being located in different planes, each of which is substantially perpendicular to the axis of said cathode.

4. An electron discharge device including a cathode and an anode, said anode comprising a plurality of upper vane segments and a plurality of lower vane segments joined to form a plurality of vane members radially spaced about said cathode, a first conducting ring having a first predetermined diameter connected to alternating ones of said vane members in the vicinity of the junction of said upper and lower vane segments, a second conducting ring having a second predetermined diameter connected to alternating vanes not connected to said first ring in the vicinity of said junction, said first and second predetermined diameters being unequal and said first and second rings being located in substantially the same plane substantially perpendicular to the axis of said cathode.

5. A method of constructing a magnetron comprising the steps of fabricating an anode cylinder; fabricating a plurality of first lower-half anode segments each being substantially rectangular in shape and having an opening of a first predetermined size near one end; fabricating a plurality of second lower-half anode segments each being substantially rectangular in shape and having an opening of a second predetermined size near one end; fabricating a plurality of first upper-half anode segments each being substantially rectangular in shape and having an opening of said first predetermined size near one end; fabricating a plurality of second upper-half anode segments each being substantially of rectangular shape and having an opening of said second predetermined size near one end; placing said first and said second lower-half segments within said cylinder, said first and said second lower-half segments alternately extending inwardly from and in contact with said cylinder walls whereby said openings are located near the center of said cylinder; placing a first conducting ring in contact with said first lower-half segments at said first openings, whereby said first ring passes through the openings of said second lower-half segments; placing a second conducting ring having a larger diameter than said first ring on said second lower-half segments so as to rest on one edge of each of said openings of said second lower-half segments; placing said first upper-half segments within said cylinder in contact with said second lower-half segments and with said second conducting ring at said openings of said first upper-half segments; placing said second upper-half segments within said cylinder in contact with said first lower-half segments, said second upper-half segments being located between said first upper-half

segments in an alternating fashion, whereby said second conducting ring passes through said openings in said second upper-half segments, said upper-half segments being in contact with said cylinder walls; securing said upper-half and said lower-half segments to each other, to said conducting rings, and to said cylinder at said points of contact.

6. An electron discharge device including a cathode and an anode, said anode comprising a plurality of upper vane segments and a plurality of lower vane segments joined to form a plurality of members radially spaced about said cathode, a first conducting member having a first predetermined diameter connected to alternating ones of said vane members in the vicinity of the junction of

said upper and lower vane segments, a second conducting member having a second predetermined diameter connected to alternating vanes not connected to said first member in the vicinity of said junction, said first and second predetermined diameters being unequal.

References Cited in the file of this patent

UNITED STATES PATENTS

2,624,862	Everhart et al.	Jan. 6, 1953
2,645,843	Nordsieck	July 21, 1953
2,649,556	Litton	Aug. 18, 1953
2,678,486	Chick et al.	May 18, 1954
2,745,040	Dunsmuir	May 8, 1956
2,837,696	LaRue	June 3, 1958