

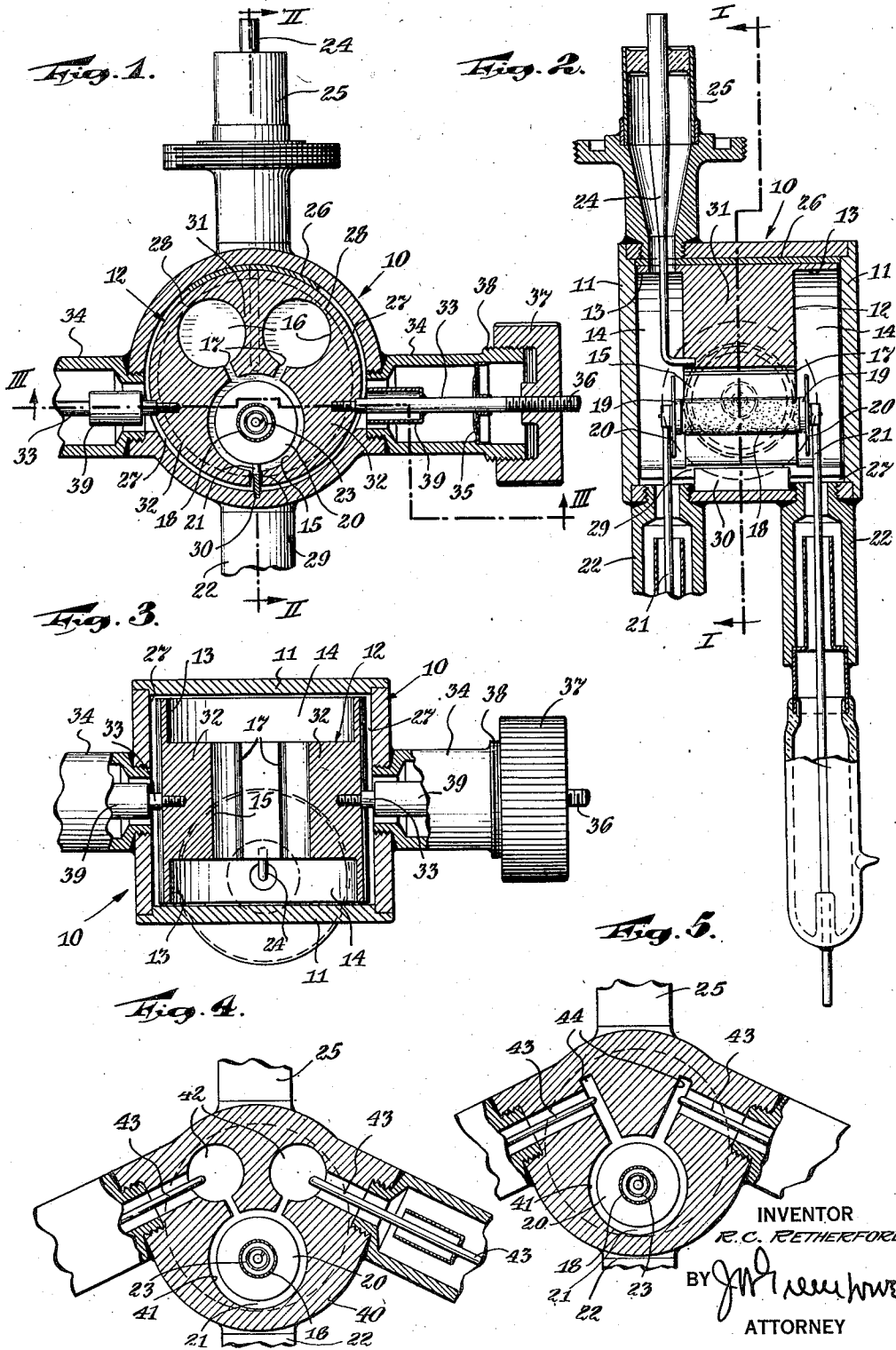
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MAGNETRON

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MAGNETRON

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This invention relates to magnetrons and is more particularly directed to provision of means for tuning a magnetron to desired wave-length.

One of the serious deficiencies of magnetrons has been the inability to tune the same to a definite wave-length after assembly. Even with exercise of greatest possible precision of fabrication, the output wave-length has been found to vary in different magnetrons intended to be identical. This necessitates accurate testing and calibration of each magnetron and selection from those tested of ones having the desired wave-length for a particular use or installation. Production of magnetrons for a definite wave-length is therefore prolonged by the unavoidable inclusion of many which do not satisfy the specified condition.

Accordingly, in its broadest aspect, the invention contemplates provision of a magnetron which may be tuned to desired wave-length output.

Of similar character, an object of the invention is to enable a magnetron to be tuned after assembly to produce the desired wave-length output.

Another object of the invention is to provide a structure enabling the magnetron to be tuned in use by the operator.

A further object of the invention is to obtain a structure wherein wave-length tuning may be effected over a considerable range.

Yet another object of the invention is to promote more rapid manufacture by requiring less accuracy of cathode mounting with respect to concentricity with the anode.

More specifically, an object of the invention is to obtain tuning with respect to the resonant frequency of a radial cavity or cavities.

Still further objects of the invention will appear as the description progresses, both by direct recitation thereof and by implication from the context.

Referring to the accompanying drawing in which like numerals of reference indicate similar parts throughout the several views;

Fig. 1 is a cross-sectional view, transverse to the cathode, of a magnetron embodying the present invention, taken on line I—I of Fig. 2;

Fig. 2 is a section longitudinal of the input and output leads and on the plane including the cathode axis, as on line II—II of Fig. 1;

Fig. 3 is a sectional view at right angles to both Figs. 1 and 2 as on line III—III of Fig. 1;

Fig. 4 is a sectional view similar to Fig. 1 and showing a modified construction of tuning means; and

Fig. 5 is a similar sectional view showing the

magnetron having differently formed cavities from those of preceding figures.

In the specific embodiment of the invention illustrated in said drawing, reference numeral 10 designates a cylindrical magnetron casing having end plates or covers 11 sealed thereto whereby the interior may be evacuated. Within the casing is a body portion or anode 12 of generally cylindrical shape, shorter than the said casing and provided with end flanges 13 for spacing the major parts of the ends of the anode or body portion from the end plates or covers 11 and thereby afford the usual and necessary end spaces 14 within the magnetron. It is necessary for these flanges 13 to come quite close to the cover plates 11 and for spacing or gap 27, sequentially referred to between the casing and body portion or anode, to be small to prevent the magnetic flux from passing between the shell or casing and the flanges and body portion. Such passage of flux, if permitted, would be likely to cause the magnetron to operate in spurious modes of operation.

The present showing of magnetron preferably provides a cathode cavity 15 parallel to but offset from or eccentric with respect to the axis of the anode body and casing, said cavity extending through the body so as to open into both end spaces 14. Likewise eccentric to the anode body and extending therethrough to the end spaces 30 are a plurality (here shown as two in number) of cavity resonators 16 which are otherwise separate from each other but open longitudinally at the side of the cathode cavity 15, as by constriction 17.

Extending through the cathode cavity 15 is a cathode 18 preferably coaxial to the cavity and projecting into the end spaces 14. The cathode is supported at its ends by ceramic or other insulating collars 19 on the outer ends of which are mounted conductive discs 20 to which lead-in wires 21 are radially attached. These lead-in wires are sealed through appropriate sealing means 22 for the purpose at the side of the magnetron. A heater filament 23 extends through the cathode and is attached at its ends to said discs 20. An output lead 24 is likewise shown sealed through appropriate sealing means 25 at the opposite side of the magnetron from the lead-in wires. This output lead extends in a radial direction for the greater part of its length within said end space, but has its inner end bent toward and inserted in a hole for the purpose in the end face of the anode body. Preferably the said output lead overlies the portion of the anode body forming the wall between the eccentrically dis-

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posed cavity resonators 16. Longitudinally of the anode body also in the region of said wall between the cavities is provided a spacer support 26 by which the anode body is there rigidly mounted on the inner cylindrical face of the casing. Elsewhere between the anode and casing a spacing 27 is provided for permitting relative movement of the anode with respect to the casing.

It may now be observed that the eccentric cavity resonators 16 are relatively close to the outer wall of the anode at the part thereof next the side edges of spacer support 26, thereby constituting those parts of the anode resiliently movable regions 28. At the opposite side of the cathode cavity from said cavity resonators, the anode wall is longitudinally split, as at 29, with a gap between the faces forming the split sufficient to receive a stop strip 30 projecting from the casing into said gap.

By virtue of the construction described, the anode body provides one fixed segment 31 projecting inwardly between the cavity resonators from the spacer support, and provides two other segments 32 at the other sides of said cavity resonators and which also extend around the cathode cavity as far as gap 29. These two segments 32 are symmetric with respect to each other and a plane centrally of the fixed wall between the axes of the cavity resonators, said plane including the axis of the cathode cavity. Said two segments, while substantially rigid in themselves are movable toward and away from stop strip 30 by virtue of the resiliency of the thinned wall regions 28. Moving said segments alters the cavity resonator shape and capacity and changes the size of the constriction 17 between the cavity resonators and the anode cavity. This obtains the desired tuning for wavelength. Stop strip 30 limits movement of the segment in the direction tending to close constrictions 17 so that they cannot be closed entirely but are always open to passage of energy. Outward swing of the segments is limited by engagement thereof with the inner face of the casing.

In order to control and manipulate the said anode segments, a separate control means is provided for each. Description of one will apply to both. At a mid-part of the cylindrical wall portion of the segment, a rod 33 projects outwardly through the casing. The inner end of said rod is shown threaded and permanently fixed thereby in said segment. Around said rod coaxial therewith and sealed to the segment is a cylindrical housing 34. Within said housing is a flexible diaphragm 35 sealed to both the inside wall of the housing and to the rod. Said rod projects beyond the diaphragm and housing and is threaded thereat, as indicated by numeral 36, to receive a knob-like cap 37 which has an outer flange overlapping the end margin of the housing where threads 38 are provided of differential relation to threads on the rod whereby rotation of the cap effects a longitudinal displacement of the rod without the rod rotating. The construction accordingly enables either or both anode segments to be adjusted, making it possible to match the frequency of one cavity resonator to that of the other, and also to shift the frequency of the magnetron as a whole. A radio frequency quarter wave choke 39 is shown mounted on rod 33 within the evacuated portion of housing 34.

In accordance with showing of Figure 4, the invention is illustrated in conjunction with a magnetron wherein the casing and body or anode are unified and accordingly present no spacing for adjustment or tuning. The construction shown

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comprises a magnetron body 40 having an eccentrically disposed cathode cavity 41 and eccentrically disposed cavity resonators 42 radiating from the cathode cavity. Radially from each of these cavity resonators extends a probe or rod 43, the outer structure and mounting of which conforms to the previously described structure and mounting for rod 33 with duplication of the longitudinal adjustment and flexible diaphragm sealing for said rod. Manipulation of the adjusting knob to move probe or rod so as to protrude more or less into the cavity resonator varies the capacity and thereby effects desired tuning over a considerable range. As in the previously described structure, independent adjustment is available to the two cavity resonators which again makes it possible to match the frequency of the one cavity resonator to that of the other and also to shift the frequency of the magnetron as a whole.

Figure 5 shows the invention applied to a magnetron having slot-like cavity resonators 44 in place of the conventional cylindrical ones. The same structure of adjustable probe or rod 43 as described above is utilized, as will be readily appreciated from the drawing.

The invention, irrespective of choice of embodiment, provides a means for varying the output wave-length over a considerable range of adjustment. Also, the cavity resonators may be separately tuned so that asymmetries in the resonators may be compensated by the matching. By virtue of this adaptability to matching the resonators, less accuracy in manufacture is required and greater tolerance for cathode mounting and eccentricity is acceptable. Both the matching feature and the fact the magnetron can be tuned as a whole not only makes it easier to manufacture within prescribed frequency limits, but enables the user to adjust and vary the frequency as found desirable or necessary. The eccentricity of the cathode cavity and consequent asymmetry of the cavity resonators, with utilization of a restricted number thereof, lends itself to fulfillment of the desired matching and tuning as shown and described herein. Furthermore, the eccentricity of the cathode cavity and of the cavity resonators in the anode body is conducive to the construction of a magnetron of small size and for production of an output of short wave length.

I claim:

1. A magnetron having an anode body with a cathode cavity of fixed length therein and with a pair of other cavities each of which constitutes a cavity resonator of fixed length and laterally radiating from the cathode cavity, all of said cavities being longitudinally parallel and said pair of cavities having a common fixed wall therebetween extending longitudinally of the cavity resonators, said pair of cavities having adjustable walls movable toward and away from said common fixed wall by which the hollow volume of said cavity resonators is varied with the length thereof remaining constant for matching the frequencies of said cavity resonators, and a cathode in said cathode cavity.

2. A magnetron having an anode body with a cathode cavity of fixed length therein and with a pair of other cavities each of which constitutes a cavity resonator of fixed length and laterally radiating from the cathode cavity, all of said cavities being longitudinally parallel and said pair of cavities having a common wall therebetween extending longitudinally of the cavity resonators, a cathode in said cathode cavity, adjustable means for said resonant cavity reso-

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nators comprising adjustable walls movable toward and away from said common fixed wall by which the hollow volume of said cavity resonators is varied with the length thereof remaining constant for matching the frequencies of said cavity resonators, and means at the exterior of said anode body connected to said adjustable walls for moving said adjustable walls and effecting frequency matching of said cavity resonators.

3. A magnetron having an anode body with a cathode cavity eccentrically disposed therein and with cavity resonators eccentric to the anode body and radiating from the cathode cavity, the diameter of the anode body being confined to a size commensurate to the sum of the diameters of the cathode cavity and a single cavity resonator and the cathode cavity and cavity resonators being maximum in a direction radial to the cathode cavity commensurate to the diameter of the anode body thereby obtaining a magnetron of minimum diameter and cavities of maximum dimension in the available diametric size of the magnetron for production of an output of short wave length, a cathode in said cathode cavity, and adjustable tuning control means comprising adjustable walls movable toward and away from said common fixed wall by which the hollow volume of said cavity resonators is varied with the length thereof remaining constant for matching the frequency of said cavity resonators, and means at the exterior of said anode body connected to said movable walls for adjusting the same and tuning the cavity resonators to desired wave-length output.

4. A magnetron having an anode body with a cathode cavity eccentrically disposed therein and with two resonant cavities constituting cavity resonators eccentric to the anode body and on opposite sides of the axis of the anode body from the eccentrically disposed cathode cavity providing adjustable wall portions for the cavity resonators at the sides most remote from each other which said wall portions are also at the exterior of the anode body and each accessible to application from the exterior of tuning control means thereto, and tuning control means connected to each of said wall portions for adjusting the resonant frequency of each of said cavity resonators.

5. A magnetron having an anode body with a cathode cavity eccentrically disposed therein and with two cavity resonators eccentric to the anode body and on opposite sides of the axis of the anode body from the eccentrically disposed cathode cavity thereby providing wall portions for the cavity resonators at the sides most remote from each other which said wall portions are also at the exterior of the anode body and each accessible to application from the exterior of tuning control means thereto, and tuning control means connected to each of said wall portions for adjusting the resonant frequency of each of said cavity resonators, said tuning control means protruding at opposite sides of the magnetron and flexibly sealed for movement toward and away from the anode.

6. A magnetron having an anode body with a cathode cavity and cathode therein and two cavity resonators radiating from the cathode cavity, tuning means for each of said cavity resonators, said tuning means comprising a rod projecting outwardly from said anode to the exterior of the magnetron and movable longitudinally of itself with respect to said magnetron, a radio frequency choke on each rod, and flexible means

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sealed to said rod; said choke being located between said flexible means and the anode.

7. A magnetron having an anode body with a cathode cavity and cathode therein and said body having a split from one part of said cavity to the outside of said body, said anode having cavity resonators radiating from said cathode cavity on the opposite side thereof from said split, and adjustable tuning means connected to said body for compressing the anode body and thereby varying the size and tuning of the cavity resonators.

8. A magnetron having an anode body with a cathode cavity one region whereof being close to the exterior of said body and said body having a split thereat, a cathode in said cathode cavity, said anode having two cavity resonators radiating from said cathode cavity on the opposite side thereof from said split, said cavity resonators each having a region close to the exterior of said body and remote from the split in the anode, and adjustable tuning control means connected to said body for flexing the anode body at said regions of the cavity resonators and thereby varying the size and tuning of the cavity resonators.

9. A magnetron having an anode body with a cathode cavity and cathode therein, with a split at one side of the cathode cavity and with two cavity resonators radiating from the cathode cavity at an opposite part thereof from said split, thereby forming the anode body in three segments, means rigidly mounting one segment, and adjustable tuning control means connected to said body for adjustably moving an adjacent segment and thereby varying the size of and tuning a cavity resonator.

10. A magnetron having an anode body with a cathode cavity and cathode therein, with a split at one side of the cathode cavity and with two cavity resonators radiating from the cathode cavity at an opposite part thereof from said split, thereby forming the anode body in three segments, means rigidly mounting the middle one of said segments, the two other of said segments being at opposite sides of the rigidly mounted segment, and adjustable tuning control means connected to each of said two other segments for adjustably moving the same and thereby varying the size of and tuning the cavity resonators.

11. A magnetron having an anode body with a cathode cavity, with a split at one side of the cathode cavity and with two cavity resonators radiating from the cathode cavity at an opposite part thereof from said split, thereby forming the anode body in three segments, means rigidly mounting one segment, another one of said segments being adjacent the rigidly mounted one, a rod carried by and protruding from said adjacent segment, adjustable tuning control means connected to said rod for adjustably moving said rod for adjusting said adjacent segment and tuning the magnetron, and a cathode in said cathode cavity.

12. A magnetron having a sealed casing, an anode body in said casing, said anode body having a segment fixed at its periphery to said casing, said anode body having two flexible segments on opposite sides of said fixed segment and spaced from said casing, a cathode sealed within said casing, and adjustable tuning control means connected to said segments for flexing the said two segments for tuning the magnetron.

13. A magnetron having a sealed casing, an anode body in said casing, said anode body hav-

ing a segment fixed at its periphery to said casing, said anode body having two flexible segments on opposite sides of said fixed segment and spaced from said casing, a cathode in said casing, means for flexing the said two segments for tuning the magnetron, said means comprising a rod of which one end is fixed to one of said two segments and the other end whereof projects from said casing, a housing projecting from said casing around said rod, and a knob-like cap threaded on said housing and rod for moving the rod longitudinally with respect to the housing.

14. A magnetron having a sealed casing and cathode within the casing, an anode body in said casing, said anode body having a segment fixed at its periphery to said casing, and said anode body having two flexible segments on opposite sides of said fixed segment and spaced from said casing, and means for flexing the said two segments for tuning the magnetron, said means comprising a rod of which one end is fixed to one of said two segments and the other end whereof projects from said casing, a housing projecting from said casing around said rod, and a knob-like cap threaded on said housing and rod for moving the rod longitudinally with respect to the housing, and a flexible diaphragm within the housing

sealed thereto and to said rod effecting a vacuum-tight seal for the housing.

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