**Aug. 21, 1951** E. C. OKRESS **2,564,716**

MAGNETRON AND METHOD OF MANUFACTURE

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Fig. 3.

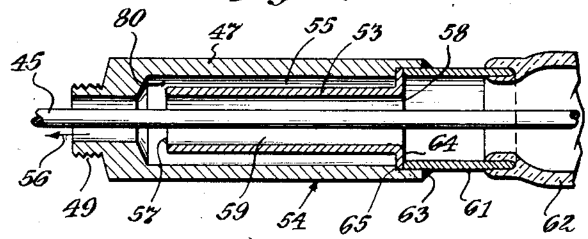



Fig. 4.

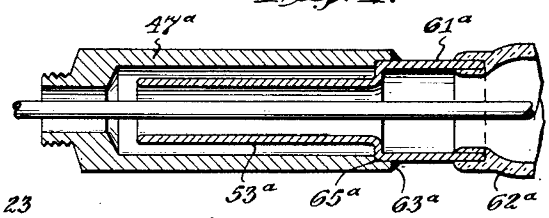



Fig. 1.

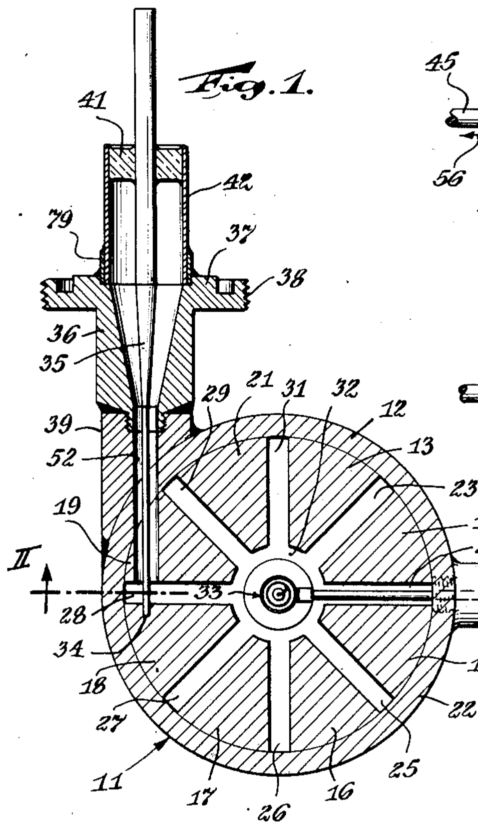



Fig. 5.

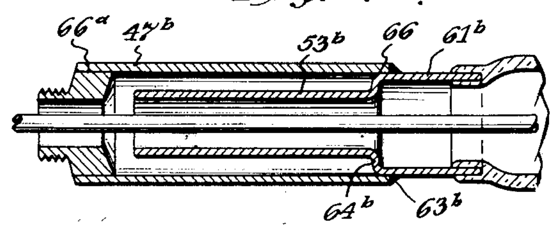
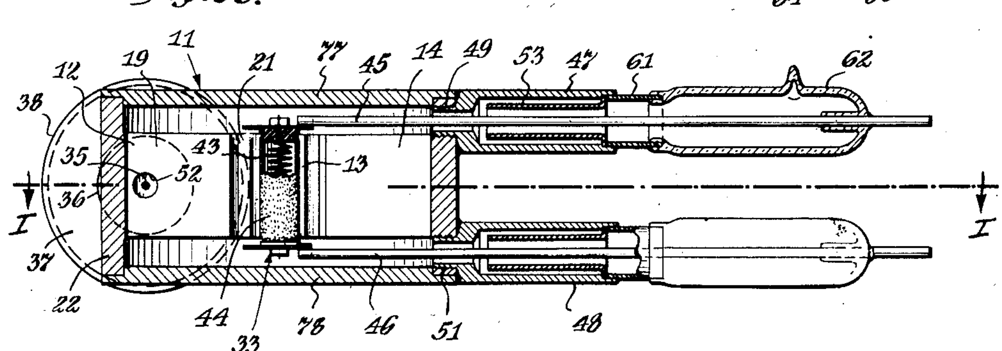



Fig. 2.

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MAGNETRON AND METHOD OF MANUFACTURE

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Fig. 6.

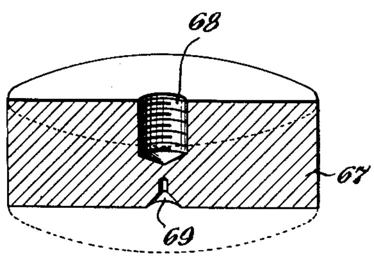


Fig. 7.

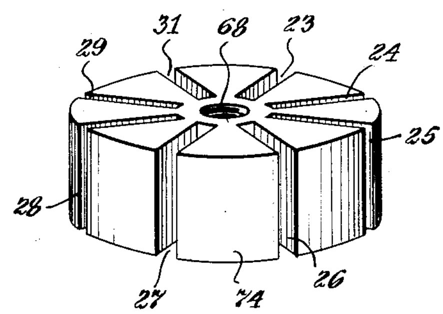


Fig. 8.

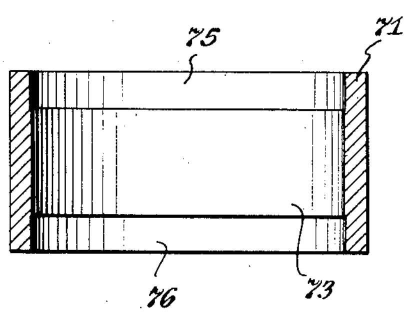


Fig. 9.

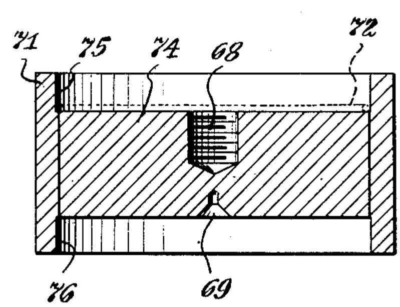


Fig. 10.

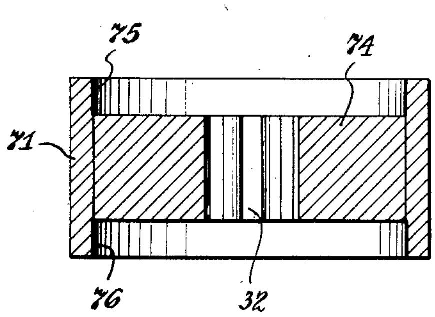


Fig. 17.

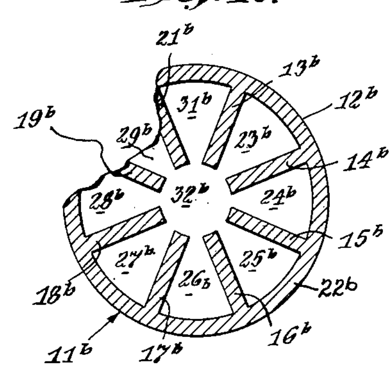


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Fig. 11.

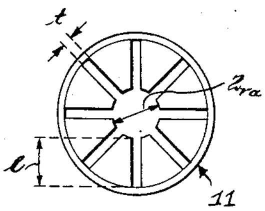



Fig. 12.

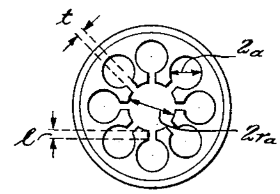



Fig. 13.

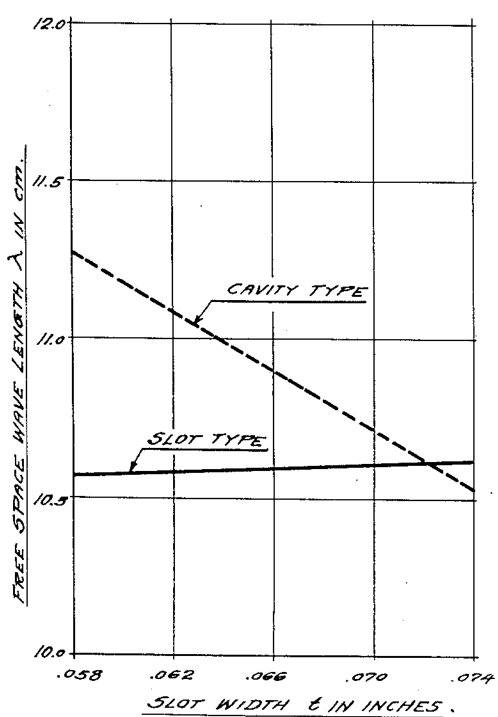



Fig. 14.

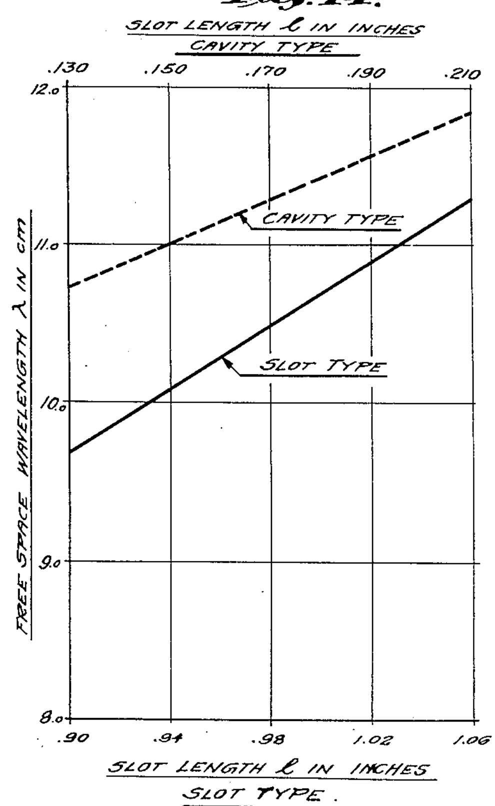



Fig. 15.

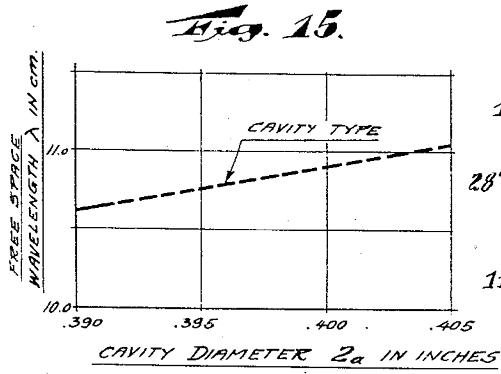
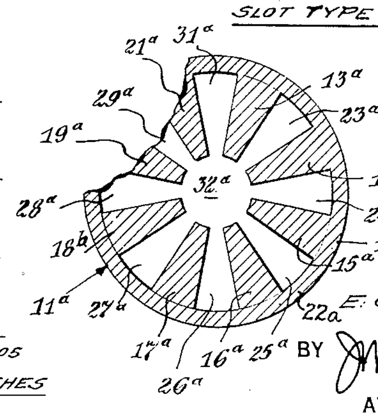



Fig. 16.

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Patented Aug. 21, 1951

2,564,716

# UNITED STATES PATENT OFFICE

2,564,716

## MAGNETRON AND METHOD OF MANUFACTURE

Ernest Carl Okress, Montclair, N. J., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 1, 1942, Serial No. 460,376

18 Claims. (Cl. 315—39)

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This invention relates to generators of high frequency electricity, and particularly those of the type called magnetrons.

The principal object of my invention, generally considered, is an improved magnetron for energy in the region of ten centimeter wavelengths and a method of manufacture, as well as an improved portion thereof such as the cathode lead assembly.

Another object of my invention is the manufacture of magnetrons by a method which avoids the necessity of very accurate machining.

A further object of my invention is to simplify and cheapen the construction of magnetrons.

A still further object of my invention is to increase the permissive tolerances in the manufacture of magnetrons.

An additional object of my invention is to provide an improved coupling arrangement for magnetrons.

Another object of my invention is to provide an improved filtered cathode lead assembly for magnetrons.

A further object of my invention is to provide an improved method of manufacturing magnetrons.

Other objects and advantages of the invention, relating to the particular arrangement and construction of the various parts, will become apparent as the description proceeds.

Referring to the drawings:

Fig. 1 is a sectional view on the line I—I of Fig. 2, in the direction of the arrows, with parts in elevation, of a magnetron embodying my invention.

Fig. 2 is a sectional view on the line II—II of Fig. 1, in the direction of the arrows.

Fig. 3 is an enlarged sectional view of a portion of the magnetron shown in Fig. 2.

Fig. 4 is a view corresponding to Fig. 3, but showing a modification.

Fig. 5 is a view corresponding to Fig. 3, but showing another modification.

Fig. 6 is a sectional perspective view of a blank from which the body member of the magnetron may be manufactured.

Fig. 7 is a perspective view of said blank after a preliminary operation has been performed thereon.

Fig. 8 is a transverse sectional view of a hollow generally cylindrical body portion in which the processed blank of Fig. 7 it to be fitted.

Fig. 9 is a view corresponding to Fig. 8, but showing the blank of Fig. 7 in place in the hollow body portion, with soldering material positioned for connecting the parts.

Fig. 10 is a view corresponding to Fig. 9, but showing the parts after connection and after removing the central core to provide the cathode-receiving chamber, completing the resonant cavity.

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Fig. 11 is a diagrammatic representation of a multiple slot magnetron embodying my invention, in order to indicate what the dimensions of the following graphs refer to.

Fig. 12 is a diagrammatic representation of a conventional or multiple cavity magnetron, over which the present magnetron is an improvement, in order to indicate what the dimensions of the following graphs refer to.

Fig. 13 is a graph showing the relationship between the free space wavelength of the generated energy and the width of the slot for the eight slot type and the eight cavity type magnetrons.

Fig. 14 is a graph showing the relationship between the free space wavelength of the generated energy and the slot length for the eight slot type and the eight cavity type magnetrons.

Fig. 15 is a graph showing the relationship between the free space wavelength of the generated energy and the diameter of one of the cavities in the eight cavity type magnetrons.

Figs. 16 and 17 are fragmentary, diagrammatic views corresponding to Fig. 1, but showing other modifications.

Resonant cavity magnetrons, such as those in the 10 centimeter range, have previously been constructed exclusively in accordance with that designated 10 in Fig. 1 of the Okress et al. application, Serial No. 457,024, filed September 2, 1942 which issued on Jan. 13, 1948 as Patent No. 2,434,508, that designated 11 in Fig. 1 of the Mouromtseff et al. application, Serial No. 433,146, filed March 3, 1942 now abandoned, or as diagrammatically illustrated in Fig. 12 of the present case. Such structures require very accurate machining with tolerances of the order of one-half a thousandth of an inch for dimensions such as the diameter ($2a$) of the cylindrical cavities, the width ($t$) of the slots leading from the anode chamber to said cavities, the radial length ($l$) of said slots and the diameter ($2r_a$) of the cathode receiving chamber due to the high wavelength sensitivity, as shown by the following table.

*Table I.—Multiple cavity magnetrons*

| $\frac{\Delta\lambda}{\Delta t}$ | $\frac{\Delta\lambda}{\Delta l}$ | $\frac{\Delta\lambda}{\Delta(2a)}$ | Wavelength shift per mil change in slot width | Wavelength shift per mil change in slot length | Wavelength shift per mil change in cavity diameter |
|---|---|---|---|---|---|
| −18.5 | 14.4 | 10.6 | *Cm.* −0.047 | *Cm.* 0.037 | *Cm.* 0.027 |

As a consequence of the close tolerances, as well as the difficult configuration, the time and cost of manufacture involved is relatively high and I, therefore, propose an improved construction which will now be disclosed. The corresponding wavelength sensitivity is indicated in the following table.

*Table II.—Multiple slot magnetrons*

| $\frac{\Delta\lambda}{\Delta t}$ | $\frac{\Delta\lambda}{\Delta l}$ | $\frac{\Delta\lambda}{\Delta(2a)}$ | Wavelength shift per mil change in slot width | Wavelength shift per mil change in slot length | Wavelength shift per mil change in cavity diameter |
|---|---|---|---|---|---|
| 1.29 | [1] 4.0 | -------- | *Cm.* 0.003 | *Cm.* 0.010 | -------- |

[1] Ratio independent of number of slots.

Referring to the drawings in detail, and first considering the embodiment of my invention illustrated in Figs. 1 and 2 thereof, there is illustrated a magnetron **11** consisting of a body or anode portion **12** of oxygen-free, high-conductivity copper having generally triangular, trapezoidal or sector shaped selenium copper alloy (described by Smith in A. I. M. & M. E. Tech. Pub. No. 870) portions **13**, **14**, **15**, **16**, **17**, **18**, **19** and **21** projecting inwardly from the peripheral portion **22** and separated by slots **23**, **24**, **25**, **26**, **27**, **28**, **29** and **31**. All of these slots communicate with the central chamber **32** where the oxide coated nickel base cathode **33** is positioned.

One of the segments, such as **18**, has a recess **34** to which the inner end of the composite coaxial terminal **35** is affixed, said terminal in the present instance having its large and tapering portions formed of tungsten and its small or inner portion formed of electrolytic copper and being enclosed in tubular copper casing **36** having an annular flange **37** threaded as indicated at **38** for a coaxial capacitive cable coupling, which may correspond with the threaded portion 24 of the Rigrod et al. application, Serial No. 454,615, filed August 12, 1942, which issued on September 24, 1946, as Patent No. 2,408,271. This casing **36** is desirably threadably connected to a boss **39** outstanding from the peripheral portion **22** of the device and desirably formed of similar material. The terminal **35** is desirably centered with respect to the casing **36**, as by means of a Corning #704 or soft borosilicate glass bead **41** between the same and a cylindrical conductor member of "Kovar" (which is an alloy containing 28.7 to 29.2% nickel, 17.3 to 17.8% cobalt, 52.9 to 53.4% iron, not more than .06% carbon, not more than .5% manganese, and not more than .2% silicon) or other suitable material **42**, the inner end of which is desirably soldered with eutectic gold-copper solder to a steel ring **79** and the combination soldered to the flange portion **37** with "BT" solder, as shown most clearly in Fig. 1. "BT" solder melts at about 779° C. and is 72% silver and 28% copper.

The cathode **33** in the present embodiment is shown as consisting of a helical tungsten filament **43** enclosed in an electron-emitting housing **44** composed of a mixture of oxides of strontium, barium and calcium on a nickel sleeve and supplied with power from a suitable source by tungsten leads **45** and **46**. The leads project through copper casings **47** and **48** held in place as by threadably connecting reduced terminal portions **49** and **51** to said body portion, and soldering with "RT" solder after assembly of all parts, as shown most clearly in Fig. 2. "RT" solder melts at about 682° C. and is 60% silver, 25% copper, and 15% zinc.

The slotted arrangement illustrated rather than the conventional cylindrical cavity system previously referred to, permits the use of a more liberal tolerance of the order of one or two thousandths of an inch, as compared with the extremely small tolerance necessary in the conventional construction evident from tables already referred to.

From the theory of multiple slot magnetrons, and considering one with eight slots as illustrated in Figs. 1 and 11, it is known that $\Delta\lambda \cong \delta t$ and $\Delta\lambda \cong 4\delta l$, in which $\delta t$ represents the increment change in slot width and $\delta l$ the increment change in slot length measured radially. $\lambda$ of course represents the wavelength in free space. This shows that $\Delta\lambda$, or the increment change in wavelength, is only about four times $\delta l$, the increment change in slot length, as compared with relatively high variations in wavelengths for changes in slot length and width in conventional cylindrical cavity resonant magnetrons. Furthermore, a comparison of the Tables I and II and a consideration of the graphs of Figs. 13, 14 and 15 indicate definitely that the multiple slotted type magnetron for about 10 centimeter waves, in accordance with my invention, permits more tolerance for the critical dimensions, controlling the wavelength than the conventional type referred to.

A consideration of the graphs of Figs. 13, 14 and 15 will show clearly why the tolerances may be much greater for a slot type magnetron than for one of the cavity type. Furthermore, a study of the graphs, which are comparable as relating to magnetrons of the same size, although the calculations on which they are based neglect end effects, in connection with Tables I and II, the following conclusions may be drawn. The eight cavity magnetron has a wavelength sensitivity, with regard to slot width, approximately 29% greater than that for slot length variations and approximately 75% greater than that for cavity diameter variations. In contrast the eight slot magnetron has a wavelength sensitivity, with reguard to slot length, approximately three times as great as that for slot width.

Finally, the eight cavity magnetron is approximately 14.5 times as sensitive to slot width variations and approximately 3½ times as sensitive to slot length variations as the equivalent eight slot magnetron.

The method of coupling shown in Fig. 1 represents and permits accurate control of the coupling coefficient, since it is dependent upon the position of the recess **34** and the coaxial tube or terminal receiving cavity **52**. This arrangement is superior mechanically and electrically as compared with either the end cavity or loop terminal generally used and illustrated in the Okress et al. application previously referred to.

A cathode lead assembly is illustrated more in detail in Fig. 3. Previously, a filter for such an assembly included a cup opening toward the magnetron or other generator and with its closed end portion secured to the lead, as by silver soldering on a previously nickel-plated tungsten conductor over an effective area. That arrangement had several disadvantages, such as: nickel-plating tungsten; soldering a cup on a tungsten lead which requires special fixtures and the joints sometimes turn out to be weak mechanically; careful orientation, as a special fixture is required to hold the cup in proper position in the cathode tube or casing and during the process of sealing the lead-in conductor to the glass envelope, so that the gap is not too small; and a movement of the tungsten lead in the cathode tube may bend the cup and therefore throw it out of line so that it is much closer to one portion of the cathode tube than another, thereby further increasing voltage breakdown troubles.

The improved construction illustrated in Fig. 3 overcomes all of the above disadvantages by connecting the filter sleeve **53** to the cathode-lead casing **47** rather than the lead **45**.

Some of the microwave energy in the generator to which the lead assembly is connected tends to pass out along the inside of the cathode-lead assembly to the exterior because of some coupling of the lead in the electromagnetic fields in the end cavity of said generator. For reasons out of place here, this radio-frequency leakage is undesirable and means are provided whereby it is prevented from escaping from the generator along the cathode leads to the exterior.

The radio-frequency energy tending to enter the cathode-lead assembly **54** from the magnetron body encounters the filter section **53** which may be formed as a tube of electrolytic copper or similar material. At the annular gap **80** of the quarter wavelength depth section **55** there appears a very high impedance,

$$\frac{4}{\pi}QZ_0$$

where $Z_0$ represents the characteristic impedance of the annular chamber **55** and Q is expressed by

$$\frac{2\pi}{\lambda R}Z_0$$

(where λ is the wavelength and R the resistance per unit length) which can be made relatively large by suitable choice of radial parameters and material composing the walls of the annular chamber **55**.

Assuming that the impedance looking in the direction of the arrow **56** is negligible, which is generally correct, we find that while the impedance at the gap **57** is very high, almost equal to Z'' or

$$\frac{4}{\pi}QZ_0$$

the resulting low impedance at the gap **58** is equal to

$$\frac{Z_0'}{Z''}$$

where $Z_0'$ is the characteristic impedance of chamber **59**. Hence at the boundary **57** we have the radio-frequency power reflected back into the tube due to the mirror-like action of this boundary because of large impedance discontinuity.

In assembling the cathode-lead casing **47**, which may be of copper, the sleeve **61**, which may be of "Kovar" or other material which seals readily to the glass **62**, and the preferably electrolytic copper tube filter section **53**, it is to be noted that only one gold-copper eutectic soldering operation is necessary, as indicated at **63**, as the inner end of the "Kovar" sleeve **61** holds the filter section **53** in place by pressing the outstanding annular flange portion **64** against the shoulder **65**. This simple, though effective, cathode-lead assembly requires no special fixtures except for aligning the desirably tungsten lead **45** which is free of all encumbrances.

Referring now to the embodiment illustrated in Fig. 4, the filter section **53**$^a$ may be a spinning and have a hollow cylindrical extension **61**$^a$. It may be formed of "Kovar" or some other material suitable for sealing to the glass member **62**$^a$. The section **53**$^a$ may then be plated with suitable high conducting metal, such as copper or silver, before soldering in place as indicated at **63**$^a$.

When the spinning **53**$^a$—**61**$^a$ is used, the casing **47**$^a$ may be shouldered as indicated at **65**$^a$ in Fig. 4, or formed as designated at **47**$^b$ in Fig. 5 without a shoulder and made of suitable material so that an annular weld may be formed at **66** between the spinning **53**$^b$—**61**$^b$ and the casing **47**$^b$ when a proper adjustment therebetween is made. Instead of the weld, soldering may be effected as indicated at **63**$^b$. For welding, seamless steel tubing may replace copper for making the cylindrical portion of the casing **47**$^b$, as indicated at **66** and **66**$^a$. It is evident that with high axial magnetic field strengths required for high power, such a structure cannot be used although it is feasible for low power.

As a further embodiment, the portions **47**$^b$ and **61**$^b$ may be formed as a continuous cylinder with an annular flange **64**$^b$ of the section **53**$^b$ welded or otherwise secured to the inner surface of said cylinder.

Figs. 6 to 10, inclusive, show the parts of the magnetron body during the process of manufacture. After the design, I desirably start with a cylindrical disk **67** of selenium copper alloy or other similar metal and provide a threaded centering pocket **68** in one side opposite a centering cavity **69** in the other. A steel stud is then secured into the threaded portion **68**. This blank may then be mounted in a lathe and turned to truly cylindrical form about the centering cavity **69**, or otherwise formed so that the peripheral surface is truly cylindrical about the axis of said cavity.

The slots **23** to **29**, inclusive, and **31** are then cut or milled, as illustrated in Fig. 7, just far enough so that they reach, but do not substantially encroach on what will be the cavity **32** in the magnetron, as shown in Figs. 1 and 2. The slotted blank of Fig. 7 and the segment to form the boss **39** of Fig. 1 are then fitted to the cylindrical shell **71**, as shown in Fig. 8, to form the assembly illustrated in Fig. 9 supported by a fixture, not shown, and secured in place as by means of "BT" solder ring or other connecting means **72** running into the space between the outer surface of the blank **67** and the inner surface of the annular member **71** when the whole body is brought to the melting temperature of the solder. The boss segment **39** is back of shell **71**.

The surfaces of the member **71**, above and below the surface **73** which is to be connected to the outer surface **74**, is desirably slightly cut away or relieved, as indicated at **75** and **76**, to facilitate entry of the solder or other connecting medium into the clearance space between the parts. It will be understood that this clearance space need only be very small and that the connection is effected in a hydrogen furnace or other heating means where the parts are prevented from undesired oxidation.

After the parts are joined as one, as represented in Fig. 9, the center core is removed as by proper drilling to provide the cavity **32** as shown in Figs. 1, 2 and 10, after which the other parts may be assembled, and "RT" solder applied in the form of wire wound about the desired region for soldering, including the upper and lower copper cover members or plates **77** and **78** as shown in Fig. 2, with "RT" solder rings applied at the joints and the whole assembly exposed in a hydrogen furnace and brought to the melting temperature of the solder.

Referring now to the embodiment of my invention illustrated in Fig. 16, there is shown a magnetron 11a consisting of a body or anode portion 12a which, like the magnetron 11, is desirably formed of copper and has selenium copper alloy portions 13a, 14a, 15a, 16a, 17a, 18a, 19a, and 21a projecting inwardly from a peripheral portion 22a and separated by anode cavities or slots 23a, 24a, 25a, 26a, 27a, 28a, 29a and 31a. All of these slots communicate with the central chamber 32a where a cathode may be positioned, as in the first embodiment.

Instead of forming the slots generally rectangular in section or with a pair of opposite walls parallel, in the present embodiment I have made these anode cavities, slots or pockets generally triangular, trapezoidal or sector shaped in section, that is, diverging outwardly or from the cathode cavity 32a, and separated by correspondingly shaped portions projecting inwardly from the peripheral portion 22. The particular divergence of the anode cavities is here obtained by making each anode projection, 13a, 14a, 15a, 16a, 17a, 18a, 19a and 21a, with straight side walls which, between their inner and outer ends, converge for an appreciable distance. The circumferential length of each slot may be greater or less than that of the separating partitions 13a to 19a, inclusive, and 21a, depending on the characteristics desired. The magnetron of this embodiment may be formed as described in connection with the first embodiment except that in forming the slots, as shown in Fig. 7, they are made to flare or expand outwardly, rather than of uniform width. This may be effected by using a correspondingly modified milling cutter or by taking two cuts at the desired angle with respect to one another for each slot. Except as specifically described in connection with the present embodiment the same may correspond with that of the first embodiment, except that the output device used on cylindrical cavity type magnetrons would be more appropriate.

Referring now to the embodiment of my invention illustrated in Fig. 17, a form of magnetron 11b is there illustrated consisting of a body or anode portion 12b of copper having selenium copper alloy portions 13b, 14b, 15b, 16b, 17b, 18b, 19b and 21b projecting inwardly from the peripheral portion 22b and separated by slots or pockets 23b, 24b, 25b, 26b, 27b, 28b, 29b and 31b. All of these slots communicate with the central chamber 32b where a cathode may be positioned as in the first embodiment, with which this embodiment may correspond except as otherwise specifically described.

In the present embodiment the portions projecting inwardly from the peripheral portion 22b are all generally thin and of uniform width, like the slots 23 to 29, inclusive, and 31 of the first embodiment, so that the slots or pockets therebetween are generally triangular, trapezoidal or sector shaped in section, like the portions 13 to 19, inclusive, and 21 between the slots of the first embodiment. In all of the embodiments, however, the inner circumferential width of each slot is uniform and may correspond with the uniform inner circumferential width of the separating partitions, notwithstanding the variation in outer circumferential width of these parts, although this correspondence is not essential.

One advantage of the embodiments of Figs. 16 and 17, as compared with that of the first embodiment, and especially of the embodiment of Fig. 17, is that magnetrons of lighter weight and greater efficiency and power capacity are thereby produced. This is because the impedance of the generally triangular, trapezoidal or sector shaped slot or pocket at the slot aperture is much higher than that of the slot of uniform width of the magnetron of the first embodiment, and hence this slot shape results in a much better match for the electronic field impedance than in the case of the magnetron of the first embodiment. An additional advantage of the trapezoidal slot structure is that the wavelength sensitivity with regard to the structural parameters of the cavity is between that of the rectangular slot and the cylindrical cavity structure.

From the foregoing it will be seen that I have provided an improved magnetron and method of manufacturing which avoids the necessity of accurate machining, simplifies and cheapens the construction, increases the permissive tolerances, involves an improved method of coupling, and makes use of improved filters on the cathode leads.

Although preferred embodiments of my invention have been disclosed, it will be understood that modifications may be made within the spirit and scope of the appended claims.

I claim:

1. The method of manufacturing magnetrons comprising forming a generally cylindrical body member, cutting therein radial slots from the periphery only partly to the center, to leave outstanding projections, fitting said body member into a hollow cylindrical member, securing said body member projections to said cylindrical member, and removing the center portion of said body member to provide a generally cylindrical center cavity for reception of a cathode assembly, which cavity communicates with radial pockets extending to the hollow cylindrical member.

2. The method of manufacturing magnetrons comprising forming a generally cylindrical body member with outstanding circumferentially-spaced generally triangular projections, fitting said body member into a hollow cylindrical member, soldering the engaging peripheral surfaces of said body and cylindrical members, and removing the center portion of said body member to provide a generally cylindrical center cavity for reception of a cathode assembly, which cavity communicates with radial pockets extending to the hollow cylindrical member.

3. A filtered lead assembly comprising a lead, a casing through which a portion of said lead extends, a tube coaxial with said casing, coaxially surrounding said lead but spaced therefrom and with a portion spaced from said casing, and having an outstanding annular portion directly secured to said casing, and a vitreous closure member united to said annular portion and through which said lead is sealed.

4. A filtered lead assembly comprising a lead, a casing through which a portion of said lead extends, a tube surrounding but spaced from said lead and formed with an outstanding annular flange engaging a shoulder on said casing, a sleeve secured to the outer edge of said casing and holding said flange against said shoulder, and a glass closure member extending from a portion of said lead beyond said sleeve and sealed thereto.

5. A filtered lead assembly comprising a lead, a casing through which a portion of said lead extends, a metal member surrounding but spaced from said lead and comprising hollow cylindrical portions of different diameters united by an intermediate annular portion, means securing

said member adjacent said annular portion to said casing, and means closing the outer portion of said metal member comprising a glass sleeve through which the outer portion of said lead projects, the inner portion of said sleeve being sealed to the cylindrical portion of said member of larger diameter.

6. A filtered lead assembly comprising a lead, a casing through which a portion of said lead extends, and a metal member surrounding but spaced from said lead and comprising hollow cylindrical portions of different diameters united by an intermediate annular portion, means securing the portion of larger diameter inside said casing in adjusted position and coaxially therewith, and a glass closure member sealed to the outer edge of said portion of larger diameter and the lead which passes therethrough.

7. A magnetron comprising a housing formed as an outer generally hollow cylindrical portion from which inwardly tapering portions project defining a central cathode cavity from which generally rectangular chambers extend radially, a cathode assembly disposed in said cavity, leads from the cathode assembly projecting through said hollow cylindrical portion to outside of said housing, and a sleeve surrounding but spaced from each lead, providing filters for minimizing loss of power from the housing.

8. A magnetron comprising a housing formed as an outer generally hollow cylindrical portion from which generally triangular portions project inwardly defining a central cathode cavity from which generally rectangular chambers extend radially, a cathode assembly disposed in said cavity, leads from the cathode assembly projecting through said hollow cylindrical portion to outside of said housing, casings surrounding portions of said leads outside of said housing, and a sleeve surrounding but spaced from each lead and with an outstanding portion secured to the corresponding casing, providing filters for minimizing loss of power from the housing.

9. A magnetron comprising a housing formed as an outer generally hollow cylindrical portion from which inwardly tapered portions project defining a central cathode cavity communicating with generally rectangular chambers disposed thereabout, a cathode assembly disposed in said cavity, leads from the cathode assembly projecting through said hollow cylindrical portion to outside of said housing, a terminal lead extending into said housing in a direction generally normal to one of said chambers and with its inner end fixed in a cavity in a wall of said chamber, and a conductive casing projecting from said housing and disposed coaxial with respect to said lead.

10. A magnetron comprising a housing formed as an outer generally hollow cylindrical portion from which inwardly tapered portions project defining a central cathode cavity communicating with generally rectangular chambers disposed thereabout, a cathode assembly disposed in said cavity, leads from the cathode assembly projecting through said hollow cylindrical portion to outside of said housing, a sleeve surrounding but spaced from each lead providing a filter for minimizing loss of power from the housing, a terminal lead extending into said housing in a direction generally normal to one of said chambers and with its inner end fixed in a cavity in a wall of said chamber, and a conductive casing projecting from said housing and disposed coaxial with respect to said lead.



11. A magnetron housing formed as an outer generally cylindrical hollow portion to which inwardly tapering flat-sided portions project defining a central cathode cavity communicating with pockets sector shaped in cross section and disposed therearound, said cylindrical portion extending axially beyond said flat-sided portions for connection with cover plates.

12. A magnetron housing formed as an outer generally cylindrical hollow portion of copper to which are attached separately formed flat-sided selenium copper alloy portions of uniform width which project inward defining a central cathode cavity communicating with pockets sector shaped in cross section and disposed therearound, said cylindrical portion extending axially beyond said flat-sided portions for connection with cover plates.

13. The method of manufacturing magnetrons comprising forming a generally cylindrical body portion with outstanding circumferentially spaced projections, fitting said body member into a hollow cylindrical member, securing said body member projections to said cylindrical member, and removing the center portion of said body member to provide a generally cylindrical center cavity for reception of a cathode assembly, which cavity communicates with outwardly flaring pockets extending to said hollow cylindrical member.

14. A magnetron comprising a housing formed as an outer generally hollow cylindrical portion from which portions project inwardly defining a central cathode cavity communicating with chambers disposed thereabout, a cathode assembly disposed in said cavity, leads from said cathode assembly projecting through said hollow cylindrical portion to outside of said housing, a terminal lead extending into said housing in a direction normal to the central radial plane of one of said chambers and with its inner end fixed in a cavity in a wall of said chamber, and a conductor casing projecting from said housing and disposed coaxial with respect to said lead.

15. A magnetron comprising a housing formed as an outer generally hollow cylindrical portion, from which flat sided portions project inwardly defining a central cathode cavity communicating with chambers sector-shaped in cross-section and disposed thereabout, a cathode assembly disposed in said cavity, leads from said cathode assembly projecting through said hollow cylindrical portion to outside of said housing, a terminal lead extending into said housing in a direction normal to the central radial plane of one of said chambers and with its inner end fixed in a cavity in a wall of said chamber, and a conductor casing projecting from said housing and disposed coaxial with respect to said lead.

16. A magnetron housing comprising a hollow cylindrical portion of oxygen-free high-conductivity copper from which flat-sided walls of selenium copper alloy project inward in generally radial directions defining a central cathode cavity communicating with pockets disposed therearound.

17. A magnetron housing comprising a hollow cylindrical copper portion, a plurality of flat-sided walls of selenium copper alloy encircled thereby axially, shorter than said cylindrical portion, and projecting from the inner surface thereof in generally radial directions defining a central cathode cavity communicating with pockets disposed therearound, and cover mem-

bers secured to the axially projecting edge portions of said cylindrical portion.

18. A filtered lead assembly comprising a lead, a shouldered casing through which a portion of said lead extends, and a tube coaxial with said casing, surrounding but spaced from said lead, with an annular portion outstanding from the outer end portion of said tube, in a plane transverse to its axis, and engaging and secured to the shouldered portion of said casing.

ERNEST CARL OKRESS.

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