(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 791 947 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.08.1997 Bulletin 1997/35

(51) Int Cl.[6]: **H01J 23/46**, H01J 25/587

(21) Application number: **97300926.9**

(22) Date of filing: **13.02.1997**

(84) Designated Contracting States:
FR NL

(30) Priority: **21.02.1996 GB 9603649**

(71) Applicant: **EEV LIMITED**
Chelmsford, Essex CM1 2QX (GB)

(72) Inventor: **Brady, Michael Barry Clive**
Maldon, Essex, CM9 6LB (GB)

(74) Representative: **Cockayne, Gillian**
GEC Patent Department
Waterhouse Lane
Chelmsford, Essex CM1 2QX (GB)

(54) A magnetron

(57) The magnetron 1 of the invention comprises a cathode, a coaxial cylindrical anode 2, anode vanes 3, 4 which are spaced around the inner circumference of the cylindrical anode so as to form resonant cavities and an output probe 5 which is located within a recess 11 in an anode vane 3 such that the probe is spaced from the vane. The probe comprises an electrically conductive rod 6, a coaxial electrically conductive sleeve 7 which contacts the cylindrical anode and, preferably, two conductors 8 which contact the rod and contact the sleeve at diametrically opposed points. The invention permits extraction of microwave energy from the magnetron whilst eliminating the need for a large recess within the anode vane. Thus, this anode vane dissipates heat better than hitherto, and so the invention reduces the possibility of arc discharge within the magnetron.

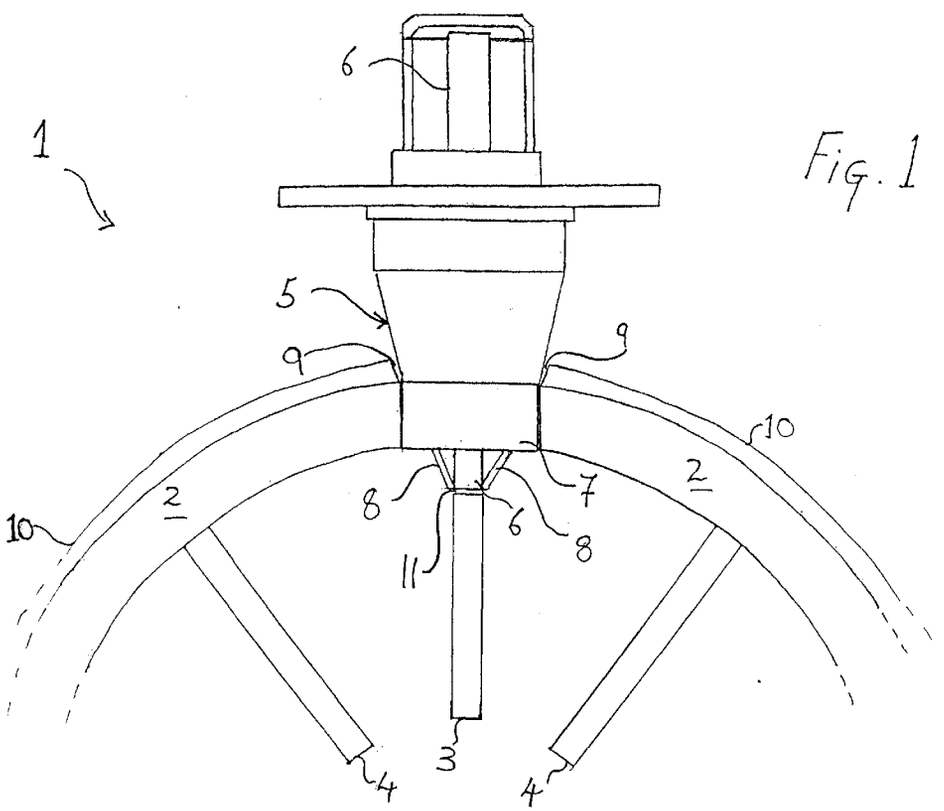


Fig. 1

EP 0 791 947 A1

Description

This invention relates to magnetrons.

An essential feature of a magnetron is an output probe which is a device which is used to extract microwave energy from resonant cavities inside the magnetron. A typical output probe comprises a metal rod within a coaxial metal sleeve, the rod protruding from the sleeve. Such a probe is suitable for insertion into a vane of the magnetron's anode via an aperture in the magnetron. On insertion, the sleeve of the probe contacts the main cylindrical body of the anode whilst the protruding end of the rod lies in a recess which has been cut into an anode vane, and the rod is connected to the vane in order that it may receive RF energy produced in the magnetron.

A problem which may be encountered with such probes is that the recess in the anode vane into which the probe is inserted may comprise a significant proportion of the vane. This may be undesirable as the anode tends to get hot when the magnetron is in use and the vane into which the probe is inserted has less cross sectional area available to dissipate heat than the other vanes. Hence, there is greater possibility of evaporation of surface atoms from this vane. Such evaporation of metallic atoms may cause arc discharge within the magnetron, thereby damaging it. The main cylindrical body of the anode may be cooled e.g. by a water-cooling system, but cooling of the vanes is not straightforward.

The invention provides a magnetron comprising a cathode, a coaxial cylindrical anode, anode vanes which are spaced around the inner circumference of the cylindrical anode so as to define resonant cavities therebetween and an output probe which is located within a recess in an anode vane, the probe comprising an electrically conductive rod and a coaxial electrically conductive sleeve which contacts the cylindrical anode characterised in that the probe is spaced from the vane and further comprises a conductor which connects the rod to the sleeve so as to form a loop for extracting energy from within a resonant cavity.

The probe advantageously has a second conductor, connecting the rod to the sleeve to form a second loop. Preferably, these conductors contact the sleeve at diametrically opposed points.

The invention permits extraction of microwave energy from the magnetron whilst eliminating the need for a large recess within the anode vane and hence the invention reduces the possibility of the occurrence of arc discharge in the magnetron.

The invention will now be described by way of example, with reference to the accompanying drawings in which:

Figure 1 is a plan view of the magnetron, all parts except the output probe being shown in section; and

Figure 2 is a side view of the output probe of Figure 1 when inserted in the vane shown in Figure 1.

Referring to the drawings, the magnetron, indicated generally by the reference numeral 1, comprises a cathode (not shown), an anode comprising of a cylindrical body 2 and vanes 3, 4 spaced around the inner circumference of the cylindrical body 2 and an output probe, indicated generally by the reference numeral 5, which comprises an electrically conductive rod 6 which is coaxially mounted inside electrically conductive sleeve 7; and conductors 8. One end of rod 6 protrudes slightly from sleeve 7 and one end of each conductor 8 is attached to the protruding end of the rod, the other ends being connected to diametrically opposed points on the sleeve such that there is an electrically conductive path across the inserted end of the probe.

The probe is inserted through an aperture 9 which has been cut out of the magnetron casing 10 and the cylindrical body 2 of the anode. Aperture 9 leads into a recess 11 which has been cut out of anode vane 3. As can be seen in Figure 2, the recess 11 is small, it is in fact smaller than that required for prior art probe arrangements. When inserted, the sleeve 7 of the probe contacts the cylindrical body 2 of the anode whilst the arrangement comprising the protruding end of the rod and the conductors 8 lies inside the recess 11 and is spaced from vane 3 so that the probe does not make physical contact with this vane.

When the magnetron 1 is in use, RF energy is transferred to the anode structure in the usual manner. The end of the probe which is not inserted into the magnetron is fitted into a waveguide (not shown) such that the length of the probe is substantially perpendicular to the length of the waveguide. The probe 5 acts as an aerial which receives the microwave energy produced in the magnetron and re-emits the energy to the waveguide for useful extraction e.g. in industrial heating systems.

Whilst the magnetron is in use, the anode tends to heat up. The cylindrical body 2 of the anode is cooled by a water-cooling system (not shown) whilst the vanes 3, 4 dissipate heat by conduction to the anode. The invention permits a smaller recess to be cut into vane 3 than was necessary hitherto for efficient extraction of microwave energy from the anode. Hence, vane 3 has better heat-dissipation ability than was previously attainable and this lowers the possibility of arc discharge within the magnetron which reduces the lifetime of the magnetron.

Variations may be made without departing from the scope of the invention. For instance, the conductors may be replaced by one conductor which lies across the protruding end of the rod and which also contacts the sleeve at diametrically opposed points as before. Further variations will be apparent to those skilled in the art.

Claims

1. A magnetron (1) comprising a cathode, a coaxial cylindrical anode (2), anode vanes (3,4) which are spaced around the inner circumference of the cylindrical anode so as to define resonant cavities therebetween and an output probe (5) which is located within a recess (11) in an anode vane (3), the probe comprising an electrically conductive rod (6) and a coaxial electrically conductive sleeve (7) which contacts the cylindrical anode characterised in that the probe is spaced from the vane and further comprises a conductor (8) which connects the rod to the sleeve so as to form a loop for extracting energy from within a resonant cavity.

2. A magnetron as claimed in claim 1, characterised in that a second conductor (8) is provided which connects the rod (6) to the sleeve (7) so as to form a second loop for extracting energy from within a resonant cavity.

3. A magnetron as claimed in claim 2, characterised in that the conductors (8) contact the sleeve (7) at diametrically opposed points.

4. A magnetron as claimed in claim 1, characterised in that the conductor (8) connects the rod (6) to the sleeve (7) at a second point on the sleeve which is diametrically opposite the first so as to form a second loop for extracting energy from within a resonant cavity.

Fig. 1

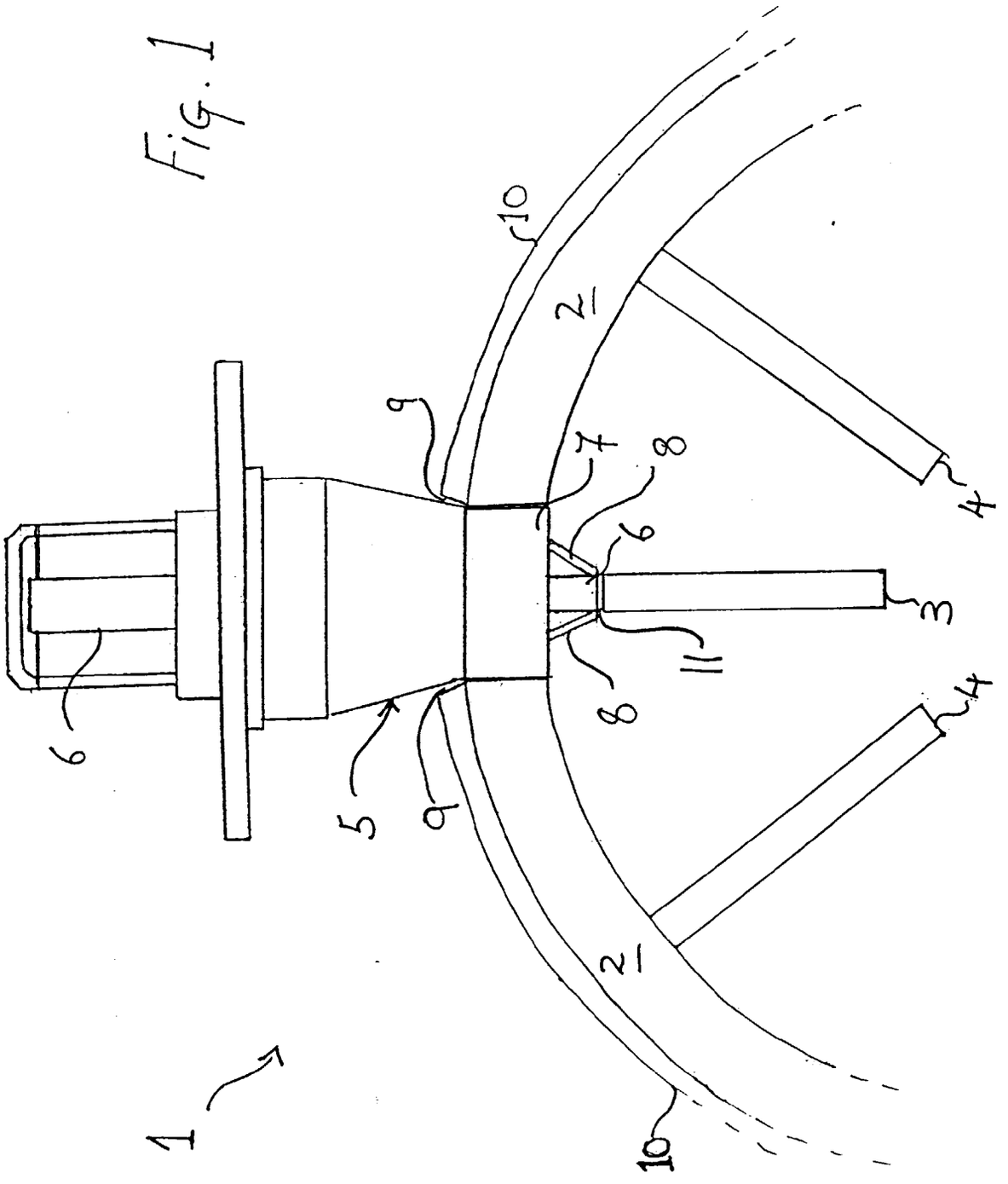
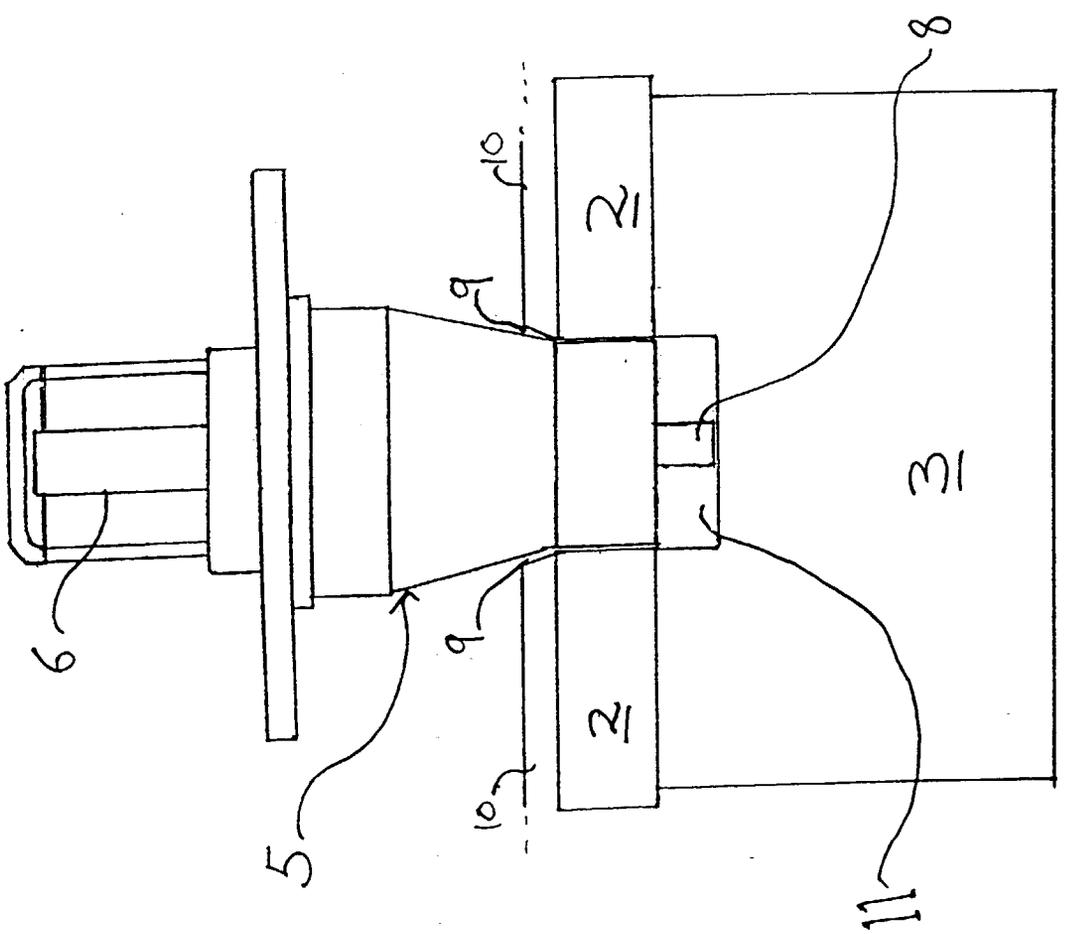


FIG. 2



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 0926

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 2 473 828 A (SPENCER) * column 2, line 20 - line 41; figure 3 * * column 3, line 31 - line 60 *	1	H01J23/46 H01J25/587
X	US 2 977 503 A (SCHMIDT) * column 1, line 15 - line 19; claim 1; figures *	1-4	
X	DE 14 91 389 A (PHILIPS' PATENTVERWALTUNG GMBH) 26 August 1971 * column 4, line 53 - column 5, line 27; figure 2 *	1-4	
X	DE 15 41 021 A (PHILIPS PATENTVERWALTUNG GMBH) 19 February 1970 * figures *	1-4	
X	DE 19 20 073 A (HUSQVARNA MIKROWELLEN GMBH) 19 November 1970 * page 3, line 16 - line 21; figure 2 *	1-4	
X	ELECTRONIC APPLICATIONS, vol. 20, no. 1, 1959, EINDHOVEN, NL, pages 13-23, XP002031248 "Continuous-wave Magnetrons Types 7091 and 7292" * page 14, left-hand column, line 1 - line 12; figure 3A * * page 14, right-hand column, line 6 - line 10 *	1-4	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01J
X	PHILIPS TECHNISCH TIJDSCHRIFT, vol. 22, no. 3, 1960, EINDHOVEN NL, pages 99-112, XP002031249 W. SCHMIDT: "Verwarming van spijzen in een magnetronfornuis" * figure 3 *	1-4	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 May 1997	Martín Vicente, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 0926

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	VORTRÄGE DER INTERNATIONALEN TAGUNG "MIKROWELLENRÖHREN", MÜNCHEN, 7-11/6/1960; HESG. J. WOSNIK. BRAUNSCHWEIG. 1961, NACHRICHTENTECHNISCHE FACHBERICHTE, vol. 22, pages 213-218, XP000672819 W. SCHMIDT: "Zur Konstruktion von Magnetrons, insbesondere Dauerstrichmagnetrons für industrielle Anwendung" * figure 7 *	1-4	
X	POLYTECHNISCH TIJDSCHRIFT, ELECTROTECHNIEK, ELEKTRONICA, vol. 17E, no. 20, 5 October 1962, RIJSWIJK NL, pages 677e-685e, XP000674094 G. SLINGERLAND: "Het continuummagnetron als energiebron voor verhittingsprocessen" * figure 12 *	1-4	
X	ELEKTRONISCHE RUNDSCHAU, no. 9, 1958, BERLIN DE, pages 309-314, XP002031252 W. SCHMIDT: "Das Dauerstrichmagnetron Valvo 7091" * figure 5 *	1-4	TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 May 1997	Martín Vicente, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)