T 110/85

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Case Number: T 175 / 82

DECISION
of the Technical Board of Appeal 3.4.1
of 3 November 1983

Appellant: English Electric Valve Company Limited
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United Kingdom

Representative: Hoste, Colin Francis
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Decision under appeal: Decision of Examining Division 047 of the European Patent Office dated 9 July 1982 refusing European patent application No 79 302 757.4 pursuant to Article 97(1) EPC

Composition of the Board:
Chairman: R. Kaiser
Member: O. Huber
Member: P. Ford

Summary of Facts and Submissions

I. European patent application No. 79 302 757.4 entitled "Variable frequency magnetron" filed on 3 December 1979 and published on 11 June 1980 (publication No. 0 012 034) and claiming priorities of 5 December 1978 and 19 November 1979 from previous applications in Great Britain, was refused by decision of Examining Division 047 of the European Patent Office, dated 9 July 1982. The claims considered were claim 1 submitted on 19 August 1981, claim 1 submitted on 13 May 1980 and claims 5-12 as originally filed. The ground for refusal was that the replacement of the mechanical resonator formed by a reed of the magnetron described in US-A-3 440 565 by a tuning fork was obvious to a person skilled in the art. Therefore, the subject-matter of claim 1 did not involve an inventive step in the sense of Article 56 EPC, so that it did not represent a patentable invention within the meaning of Article 52 EPC.

II. On 6 September 1982, the appellant lodged an appeal against the decision by telex and paid the appeal fee. A document reproducing the contents of the telex was filed on 11 September 1982. A Statement of Grounds was submitted on 3 November 1982. By a communication dated 5 April 1983, the rapporteur, on behalf of the Board, additionally cited US-A-3 727 099, "Praktische Physik" by F. Kohlrausch, vol. 2, 1944, pages 236/237 and "A Textbook of Sound" by A.B. Wood, 1955, page 121.

III. During oral proceedings, held on 3 November 1983 at the request of the appellant, the appellant's professional representative requested

- that the decision under appeal be set aside,
- and that a patent be granted on the basis of the following points:

  Claim 1, received 19 August 1981 but with the amendment that the word "annular" should be deleted,

  Claims 5-12 as originally filed (to be renumbered as 2-9)

  Claims 13 and 14 received 20 September 1983 (to be renumbered as 10 and 11)

  Description as originally filed but with appropriate passages being amended

  Drawings as originally filed.

During oral proceedings pages 120-125 of the aforementioned "Textbook of Sound" were considered.

The independent claims 1, 10 and 11 read as follows:

1. A magnetron including movable conductive means which is movable relative to a resonant cavity for determining the frequency of oscillation of a microwave output signal, and characterised by a mechanical resonator in the form of a tuning-fork which is located within a vacuum enclosure containing the magnetron anode and said resonant cavity, and wherein one arm of said tuning

fork is rigidly connected to said movable conductive means so as to vibrate it and thereby to cyclically alter the resonant frequency of the cavity, and means coupled to said tuning fork for generating a signal representative of the instantaneous resonant frequency of the cavity.

10. A magnetron including movable conductive means which is movable relative to a resonant cavity for determining the frequency of oscillation of a microwave output signal, and characterised by a mechanical resonator in the form of a tuning fork (7), which is located within a vacuum enclosure containing the magnetron anode and said resonant cavity, and wherein an arm of said tuning fork (7) is connected to said movable conductive means which constitutes a wall (6) of the resonant cavity so as to vibrate the wall portion and thereby to cyclically alter the resonant frequency of the cavity (1), and means (14) coupled to said tuning fork for generating a signal representative of the instantaneous resonant frequency of the cavity.

11. A magnetron including movable conductive means which is movable relative to a resonant cavity for determining the frequency of oscillation of a microwave output signal, and characterised by a mechanical resonator in the form of a tuning fork (7) which is located within a vacuum enclosure containing the magnetron anode and said resonant cavity, and wherein the movable conductive means (6) is wholly supported by, and carried by, said tuning fork (7) which thereby vibrates the movable conductive means to cyclically alter the resonant frequency of the cavity (1), and means (14) coupled to said tuning fork for generating a signal representative of the instantaneous resonant frequency of the cavity.

The representative argues essentially as follows:

Frequency agile magnetrons utilizing motor and cam for generating a vibrating movement of a conductive means relative to the resonant cavity (US-A-3 876 903, cited by the Examining Division) cannot sweep across the available frequency band very rapidly because of the great mechanical inertia.

In other types of frequency agile magnetrons utilizing a vibrating flexible member, e.g. a reed, rod or bar (US-A-3 440 565 and 3 727 099), for vibrating the conductive means, the housing of the magnetron must provide complementary reaction forces introducing vibrations into the housing. The consequence is that the frequency cannot be predicted accurately and its instantaneous value cannot be determined very precisely, as the frequency sensor is itself subject to vibration. A further shortcoming is that a flexible vibrating member needs a considerable amount of energy to maintain the vibrations.

All these disadvantages of the prior art are overcome by replacing the mechanical drive system (US-A-3 876 903) or the vibrating member (US-A-3 440 565 and 3 727 099) by a tuning-fork.

This measure requires an inventive step for the following reasons:

(a) A tuning-fork providing frequency agility in a magnetron is not an obvious equivalent to a flexible member since the characteristics of both systems are different. A tuning-fork in electronic equipment,

e.g. in tuning-fork oscillators, has always been used as an invariable frequency standard. Not so in the case of the invention, where the actual value of the resonant frequency of the tuning-fork is of secondary importance.

(b) A tuning-fork occupies more space than a reed or rod. Therefore, it was considered to largely redesign the structure of a magnetron to accomodate the tuning-fork.

(c) Despite an intense technical development of frequency agile magnetrons and the fact that a tuning-fork is a well known mechanical resonator a large time period separates the discussed prior art and the priority date of the present patent application.

Taking into account all these facts, the subject matter of the application is based on an inventive step and the claims should be allowable.

Reasons for the Decision

1. The appeal complies with Articles 106-108 and Rule 64 EPC. It is therefore admissible.

2. The current claims are supported by the original documents.

3. The magnetron according to claim 1 or 10 or 11 is new.

4.1 The most relevant prior art is disclosed in US-A-3 727 099. The Figures of this document show a magnetron according to the preamble of claim 1 which comprises also essential features specified in the characterising portion of claim 1.

A mechanical resonator (60), i.e. an element vibrating in its natural frequency, see col. 4, lines 43-48, is located within the vacuum enclosure (12, 44, 52, 56) containing the magnetron anode (12, 14, 16) and the resonant cavity (20). One arm of the resonator (60) is rigidly connected to a movable conductive means (82) so as to vibrate it and thereby to cyclically alter the resonant frequency of the cavity (20). Means (75) are coupled to the resonator (60) for generating a signal representative of the instantaneous resonant frequency of the cavity (20). The claimed magnetron differs therefrom only in the sense that the resonator consists of a tuning-fork instead of a reed, see in US-A-3 727 099, col. 1, lines 42/43 and the Figures.

The magnetron described in US-A-3 727 099 also solves the problem cited in the description of the application, see page 1, lines 15-17, namely to provide a magnetron in which the restriction on the frequency sweep rate due to the effect of mechanical inertia (e.g. of the motor-camdrive for the conductive means according to US-A-3 876 903) is reduced. It is not contested that the use of a tuning-fork in the present case has remarkable advantages in comparison with a reed vibrating in its natural frequency. So mechanical losses and coupling to the supporting envelope are very small, see the description of the application, page 5, lines 10-14 and the statements of the appellant during oral proceedings.

When a magnetron according to US-A-3 727 099 does not meet any longer the requirements as to power consumption of the vibration drive, as to accuracy of the measurement and control of the instantaneous frequency, the

manufacturer of magnetrons will undoubtedly discover that there are certain shortcomings in the utilisation of a reed as mechanical resonator, especially as they are disclosed in the literature on the subject, see the aforementioned "Textbook of Sound", page 120, penultimate paragraph. There, it is pointed out that the base of a vibrating bar (in the present case the housing of the magnetron) is liable to vibrate with a comparatively large amplitude and, consequently, the frequency and damping are uncertain, so that such a vibrator is "not to be recommended in accurate work".

Therefore, a person in the art could be expected to look for a mechanical resonator which is able to perform better and more perfectly the same function as a vibrating reed or bar.

In the "Textbook of Sound" the chapter concerning vibrating bars is immediately followed by the chapter "Tuning-Forks", see page 121. This chapter gives full details of the properties of a tuning-fork and, especially on page 123, second paragraph, it is explained that the center of a tuning-fork is practically unmoved and that therefore a base connected with a tuning-fork is much less influenced by the vibrations than a base of a vibrating bar, see also the last paragraph on page 122. The great purity of tone and the constancy of frequency of a tuning-fork, cf. page 122, lines 2/3, are a consequence of the low damping value (high Q) as a person skilled in the art knows.

Under these circumstances the replacement of the resonating reed in the magnetron according to US-A-3 727 099 by a tuning-fork, in order to make use of the readily apparent technical advantanges of a tuning-fork is to be regarded as an obvious step for a person skilled in the art.

Certainly, the incorporation of a tuning-fork in a magnetron requires some structural modifications. However, there are no insurmountable difficulties or obstacles which would prevent a designer from doing so, if the need arises.

Finally, the time period of less than 6 years between the date of publication of US-A-3 727 099, i.e. 10 April 1973, and the priority of the present application, i.e. 5 December 1978, is not an indication of the presence of inventive step. One has to consider that the manufacture of a magnetron is a very delicate and complicated work and requires a lot of costly tools.

It is conceivable that the need for improving the accuracy and lowering the power consumption of the magnetron according to US-A-3 727 099 (which provided a sufficiently satisfactory frequency agility at the time of its publication) arose relatively shortly before the priority of the present application.

Thus, the magnetron according to claim 1 is the product of a normal development and does not involve an inventive step (Article 56 EPC). Claim 1 therefore cannot be allowed under Article 52(1) EPC.

4.2 The magnetron according to claim 10 differs from the subject-matter of claim 1 only in that the vibrating conductive means constitutes a wall of the resonant cavity. The question of whether the magnetron claimed in

claim 10 involves an inventive step is covered by the considerations set out in paragraph 4.1 by adding the following point:

From US-A-3 876 903, see Fig. 1, it is known to vibrate the upper end wall (28) of the cavity in order to cyclically alter the resonant frequency. Therefore, the specialisation of the conductive means as a wall of the cavity falls within the scope of the customary practice.

Thus, claim 10 is not allowable either.

4.3 The wording of claim 11 contains as the sole difference from that of claim 1 the features that the movable conductive means is wholly supported by, and carried by, the tuning-fork. This is also the case in the magnetron according to US-A-3 727 099, see the means (82) carried only by the reed (60). The arguments brought up in paragraph 4.1 also apply to claim 11. Claim 11 is, therefore, not allowable.

4.4 The other claims 2-9 are all dependent on claim 1. Since claim 1 of the set of claims, on the basis of which the appellant has requested the grant of a patent, is not allowable, the other claims 2-9 of the set are not allowable either.

Order

For these reasons,

it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

16/12/83