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**D E C I S I O N**  
of 13 December 1994

**Case Number:** T 0831/92 - 3.4.1

**Application Number:** 81300965.1

**Publication Number:** 0035898

**IPC:** H05B 41/24

**Language of the proceedings:** EN

**Title of invention:**

Microwave generated plasma light source apparatus

**Patentee:**

MITSUBISHI DENKI KABUSHIKI KAISHA

**Opponent:**

FUSION SYSTEMS CORPORATION

**Headword:**

Plasma light source

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step (no)"

**Decisions cited:**

T 0153/85

**Catchword:**

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**Case Number:** T 0831/92 - 3.4.1

**D E C I S I O N**  
**of the Technical Board of Appeal 3.4.1**  
**of 13 December 1994**

**Appellant:** MITSUBISHI DENKI KABUSHIKI KAISHA  
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**Respondent:** FUSION SYSTEMS CORPORATION  
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**Representative:** Schwepfinger, Karl-Heinz, Dipl.-Ing.  
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**Decision under appeal:** Decision of the Opposition Division of the European Patent Office dated 6 July 1992 revoking European patent No. 0 035 898 pursuant to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** G. D. Paterson  
**Members:** Y. J. F. van Henden  
H. J. Reich

## Summary of Facts and Submissions

I. The Respondent filed an opposition to the European patent No. 0 035 898 requesting that it be revoked on the ground that, having regard to the state of the art which can be derived from, inter alia, documents:

B: US-A-4 001 632,  
C: US-A-3 872 349,  
F: JP-A-54-82876 (with translation in English),  
J: US-A-4 002 944 and  
O: US-A-3 234 421,

its subject-matter lacked an inventive step and, moreover, that the invention was not disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art - Article 100(a) and (b) EPC. In a further submission, the Respondent also referred to documents

OD1: US-A-3 521 111,  
OD2: US-A-3 942 068,  
OD3: US-A-4 015 164 and  
OD4: US-A-4 185 228.

II. During the proceedings before the Opposition Division, the Patentee (Appellant) filed with a letter dated 27 November 1990 a set of eighteen claims marked A and requested that the patent be maintained on this basis or, subsidiarily, on the basis of the same set with an amendment to Claim 1 which was proposed during oral proceedings held on 10 June 1992.

Claim 1 of said set A reads:

"A microwave generated plasma light source apparatus comprising, a microwave generator (1), a non-coaxial microwave cavity (49) having a light reflecting member (4) forming at least a portion of said cavity (49), said microwave generator (1) being coupled to said cavity (49) through a feeding opening (5) therein, a member (9) transparent to light and opaque to microwaves disposed across an opening of said cavity (49), a waveguide (3) for guiding microwaves generated by said microwave generator (1) to said feeding opening (5) of said cavity (49), and an electrodeless discharge bulb (6) shaped so as to function as a substantially point light source, said bulb (6) containing a light emissive substance and being located in said cavity (49) so that the cavity (49) operates resonantly when the bulb (6) is emitting light, characterized in that said bulb is supported only by dielectric support means (12 or 63, 66) extending from a wall of the cavity (49), and in that said light emissive substance comprises mercury of between  $7 \times 10^{-6}$  gram atom/cc and  $60 \times 10^{-6}$  gram atom/cc."

The remaining Claims 2 to 18 are appended to Claim 1.

According to the Patentee's auxiliary request, the upper limit of the concentration of mercury was changed to  $52.5 \times 10^{-6}$  gram atom/cc.

III. The Opposition Division revoked the European patent. It took the view that the teachings of documents F and C render the subject-matter claimed according to the Appellant's main and auxiliary request obvious.

- IV. The Patentee lodged an appeal against the decision of the Opposition Division, requesting that said decision be cancelled and that the European patent be maintained on the basis of the set A as filed with the letter of 27 November 1990; subsidiarily, on the basis of the auxiliary request submitted during the oral proceedings before the Opposition Division on 10 June 1992.
- V. The Respondent requested that the appeal be dismissed.
- VI. In a communication pursuant to Article 11(2) RPBA, the Board expressed the preliminary view that, bearing in mind his basic technical knowledge, a skilled person would not have to display inventiveness to combine the respective teachings of documents F and C in such a way as to arrive at the subject matter of Claim 1 according to any of the Appellant's requests.
- VII. During oral proceedings held on 13 December 1994 the Appellant maintained its former main and auxiliary requests and, as a basis for the maintenance of the patent in suit, proposed orally a second auxiliary request based upon the text of Claim 13 as granted which reads:

"An apparatus as claimed in any of Claims 1, 2, 5, 6 and 11 wherein said discharge light emissive substance encapsulated in said bulb (6) comprises mercury of  $7 \times 10^{-6}$  gram atom/cc to  $60 \times 10^{-6}$  gram atom/cc, gallium of at least  $1 \times 10^{-7}$  gram atom/cc and halogen of  $1.5 \times 10^{-7}$  to  $50 \times 10^{-7}$  gram atom/cc."

The Respondent objected to the admissibility of the second auxiliary request at such a late stage in the appeal proceedings.

VIII. In support of its requests, the Appellant submitted essentially the following arguments:

- (a) Document F makes clear that because the electric field is circular around the axis of the cylindrical cavity (7), the metal support rod (13) may be mounted parallel to the axis of the cavity. Thus, document F does not hint at possible problems concerning the use of metal rods, nor does it suggest that any other configuration of the electric field may be necessary or desirable. Accordingly, the skilled person is not led to consider the use of a dielectric support according to document C. Therefore, concluding that said person would combine teachings of documents F and C is based on an ex post facto analysis. Furthermore, document C exclusively deals with non-resonant coaxial sources and, contrary to the Opponent's allegations, Figures 9 and 10 thereof do not show a point source.
  
- (b) The present invention is concerned with a new type of electrodeless lamp operated in the non-coaxial resonant mode. However, the skilled person would be discouraged from developing such a device, since the prior art, as represented by document B, column 1, lines 43-53 and document J, column 1, lines 23-40, mentions the problems with resonant mode operation. As a matter of fact, document B states that, with resonant mode lamps, it is

necessary to provide both frequency tuning and impedance matching adjustment to obtain efficient operation over a wide range of discharge conditions. In the case of a lamp containing more than a certain concentration of mercury, therefore, said tuning and adjustment have to be performed since the discharge condition varies and mercury is vaporised. The Appellant was the first to realise that it is possible to design a resonant cavity requiring none of the adjustments referred to in B, and that a condition for its realization was to employ a concentration of mercury which exceeds the lower limit of  $7 \times 10^{-6}$  gram atom/cc. Furthermore, even if the skilled person would consider the use of a non-coaxial resonant device, he would not know how much mercury the light bulb should contain. In particular, document C only concerns coaxial non-resonant sources. Such a device works according to completely different principles than the present invention. Because of this difference, the mercury content of the lamp disclosed in document C offers no guidance to the mercury content of the kind of lamp claimed in the patent in suit. Furthermore, the skilled person would not be led to use a mercury content known in connection with other discharge lamps having electrodes or electrodeless elongate bulbs, since the type of light source of the present invention is extremely different from such known lamps, and since it is very hard to determine what mercury content is appropriate. Moreover, it would not be obvious to use a mercury content as known from document C, or from the other cited documents, for

the lamp disclosed in document F, because document F is exclusively concerned with fluorescent lamps in which a much smaller amount of mercury is used.

The auxiliary request defines a range of mercury which is particularly well suited for obtaining a stable discharge.

- (c) The claims do not offend against Article 123(2) EPC, because the range claimed in Claim 1 of the main request is clearly stated in the originally filed application, and, furthermore, it is also clear from the originally filed application that gallium and iodine are only optional. Moreover, the content " $52.5 \times 10^{-6}$ " stated in the independent claim of the auxiliary request can be derived from the Figure "150mg" disclosed on originally filed page 19, line 14.

IX. The Respondent argued essentially as follows in support of its request:

- (a) Document F corresponds to the preamble of Claim 1. This document discloses an embodiment with a cylindrical cavity and a cylindrical electric field. However, for a cavity which is not cylindrical, like the one disclosed in Figure 1 of document F, or the one according to the patent in suit, the electric field would not be cylindrical. In this case a metal support means would interfere with the electric field, and, consequently, the skilled person would be led by the teaching of document C to use a dielectric support means.



- (b) The embodiment according to Figures 9 and 10 of document C concerns a non-coaxial point light source (see column 6, lines 66-68). Such a lamp must operate in the resonant mode, since any other mode would lead to inefficient power transfer of microwaves to the bulb. Since document C discloses a non-coaxial point light source working in the resonant mode, it would be obvious to use a mercury content as disclosed in this document also for the lamp disclosed in document F, because this device also concerns a non-coaxial point source working in the resonant mode. The mercury content derivable from document C overlaps the range claimed in the patent in suit. Consequently the feature concerning the claimed range would be obvious to the skilled person. Further evidence for the obviousness of the claimed range is that the documents O, OD1, OD2, OD3, and OD4 all disclose mercury content ranges similar to the claimed range.

The auxiliary request lacks an inventive step for the same reasons as the main request.

- (c) The originally filed specification only discloses in general the use of mercury with no concentration range specified, or mercury in a specified range combined with gallium and a halogen of specified concentrations. There is therefore no basis in the originally filed application for specifying a certain range for mercury without also specifying the gallium and halogen contents. Since no such specifications of gallium and a halogen are mentioned in the

independent claims of the main and the auxiliary requests, the patent does not fulfil the requirement of Article 123(2) EPC.

- (d) The second auxiliary request should not be admitted into the proceedings, since it was submitted at such a late stage and since the Respondent has had no chance to consider this request before the oral proceedings.

X. At the conclusion of the oral proceedings, the decision was announced that the second auxiliary request is not admissible and that the appeal is dismissed.

## **Reasons for the Decision**

### 1. *Main request - Claim 1*

1.1 In the Board's view, the embodiment depicted in Figure 1 of document F constitutes the closest prior art and discloses all the features of the preamble of the claim.

Document F, however, does not disclose the features of the second part of the claim; i.e. the claimed subject matter differs from what is disclosed by document F in that:

- (a) the bulb is supported only by dielectric support means extending from a wall of the cavity; and in that

(b) said light emissive substance comprises mercury with a concentration between  $7 \times 10^{-6}$  gram atom/cc and  $60 \times 10^{-6}$  gram atom/cc.

1.2 Document F does not disclose by which means the bulb shown in Figure 1 is supported.

Document F discloses another embodiment, depicted in Figure 2, which has a particular construction including a cylindrical resonance cavity. In connection with this embodiment it is stated (page 3 fourth paragraph of the translation of the document) that, because of the direction of the only electric field component within the cylindrical resonant cavity (7), the bulb can be supported by metal rods mounted parallel to the central axis of the cylinder.

According to the Board's view it belongs to the general knowledge of the skilled person that a conducting metal support means can disturb an applied electromagnetic field because of the eddy current induced in the conducting means, whereby detrimental effects are likely to occur as a consequence of unwanted dissipation of the field's energy. The possible use of a metal rod in the embodiment of Figure 2 of document F will therefore be understood by a skilled reader as evidence that, **because of the particular field geometry created in the cylindrical cavity**, the field will not be disturbed by the presence of a metal support means mounted along the central axis of the cylinder. Furthermore, the skilled person will understand that, if another construction is used, the field may be disturbed by metal support means, in which case metal support means should be avoided. This is actually the

easily recognisable reason why document C discloses that it is known to use quartz, i.e. dielectric means, for supporting the bulb in a microwave generated plasma light source (see column 4, lines 51-52).

The device disclosed in Figure 1 of document F has a different configuration without a cylindrical cavity. The skilled person would thus realize that the field of the device of Figure 1 would be disturbed if a conducting support means were used. Therefore, in the Board's view, it would be obvious to use a dielectric support means for supporting the bulb disclosed in the embodiment of Figure 1 of document F. Therefore, in the Board's judgement, no inventive step can be seen in the feature (a) mentioned in paragraph 1.1 above.

- 1.3 Document F discloses that the lamp bulb of the embodiment of Figure 1 contains mercury (page 1, second paragraph of the translation), although the amount is not specified. Though document F concerns lamp bulbs which are covered with a fluorescent film (see page 1, first paragraph), as exemplified by document C, it is well known in the art of electrodeless light sources using plasma generated by microwaves to provide lamp bulbs containing mercury, but without a fluorescent film, as UV light sources. Therefore, in the Board's view, it is obvious to the skilled person to omit the fluorescent film disclosed in document F in order to make the lamp suitable for use as a light source based on the spectral wavelengths of mercury.

Since document F does not disclose the mercury content, the skilled person would have to decide this. The straight-forward way to determine this is by a routine

experiment in which the light emission of bulbs having different mercury contents is measured. The skilled person would by this obvious way find out that a suitable mercury content lies in the range specified in Claim 1. Furthermore, mercury content ranges derivable from the prior art, both for discharge lamp bulbs having electrodes (see documents O, OD1 and OD3), and for electrodeless bulbs (see documents C, OD2 and OD4) lie within, or overlap the range claimed in Claim 1. It is true, as the Appellant submits, that the claimed device constitutes a point light source working in the resonant mode, and it could be the case that the optimal mercury content for such a lamp bulb is somewhat different from the optimal content for the non-resonant type of device. However, without any other guidance, the contents disclosed in the mentioned documents at least suggest a suitable starting point for the above mentioned routine experiment. The similarity of the claimed range with the ranges known from the prior art thus provides further evidence as to the obviousness of the claimed range. Therefore, in the Board's judgement, the feature (b) mentioned above also lacks an inventive step.

- 1.4 In support of an inventive step, the Appellant argued that the teaching of the prior art documents would dissuade the skilled person from using a non-coaxial device working in the resonant mode.

The Board admits that documents B and J disclose alternatives to devices working in the resonant mode. However, there are several different constructions of discharge lamps known in the art and the resonant mode type is one obvious possibility. In particular the

prior art closest to the claimed invention, i.e. document F, which was published after documents B and J, suggests discharge lamps working in the resonant mode. Document F discloses no technical facts which would make a skilled person doubt the functioning of this conventional light source with its resonantly operated cavity. According to the Board's view, therefore, the skilled person would not be dissuaded from using such a device.

1.5 For the foregoing reasons, in the Board's judgement, the subject matter of Claim 1 of the main request does not involve any inventive step as required by Article 52(1) EPC.

2. *First auxiliary request - Claim 1*

This claim differs from Claim 1 of the main request only in that the upper limit for the mercury content is  $52.5 \times 10^{-6}$  instead of  $60 \times 10^{-6}$ . The upper limit defined in the auxiliary request is, according to the description, column 9, lines 44-56 of the patent in suit, the upper limit for the range in which a stable light emission is obtained.

The reasons explained in relation with the main request apply to Claim 1 according to the first auxiliary request. Additionally, in the Board's view, the skilled person would by normal routine experiments find out up to which mercury content the light emission is stable. Consequently, the skilled person would be led to avoid a mercury content above this limit. Therefore, the subject matter of Claim 1 of the first auxiliary

request does not involve any inventive step as required under Article 52(1) EPC.

3. *Second auxiliary request*

The second auxiliary request was proposed for the first time during oral proceedings before the Board. As a matter of principle, the filing of an auxiliary request in opposition proceedings during oral proceedings before a Board of Appeal is contrary to procedural fairness. As submitted by the Respondent, it is difficult for an Opponent to deal properly with a request not presented in good time before oral proceedings, and an adjournment, even to another day in order to allow further searches, might be appropriate if the request was to be admitted. Furthermore, the Board does not consider on the material before it that the subject-matter of such request would involve an inventive step. Therefore, following previous case law (see for example T 153/85, OJ EPO 1988, 1) the request is not admitted into the proceedings, because it is not clearly allowable.

4. Since none of the admissible requests fulfils the requirement of inventive step, the appeal is to be dismissed - Article 52(1) in conjunction with Article 56 EPC.

**Order**

**For these reasons it is decided that:**

The Appeal is dismissed.

The Registrar:

The Chairman:

M. Beer

G. D. Paterson