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File No.: T 0134/91 - 3.4.1  
Application No.: 84 112 780.6  
Publication No.: 0 140 330  
Classification: H01K 1/14  
Title of invention: Miniature incandescent lamp

**D E C I S I O N**  
of 8 July 1993

Applicant: KABUSHIKI KAISHA TOSHIBA  
Proprietor of the patent:  
Opponent: Osram GmbH FI/Patentwesen

Headword:

**EPC:** Art. 56, 83

Keyword: "Inventive step (no)" - "Sufficient disclosure (no)"

**Headnote**  
**Catchwords**



Case Number: T 0134/91 - 3.4.1

**DECISION**  
of the Technical Board of Appeal 3.4.1  
of 8 July 1993

**Appellant:**  
(Opponent)

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**Representative:**

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Osram GmbH

**Respondent:**  
(Proprietor of the patent)

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**Representative:**

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**Decision under appeal:**

Decision of the Opposition Division of the  
European Patent Office dated 28 December  
1990 rejecting the opposition filed against  
European patent No. 0 140 330 pursuant to  
Article 102(2) EPC.

**Composition of the Board:**

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

### Summary of Facts and Submissions

- I. The Respondent is proprietor of European patent No. 0 140 330.

Claim 1 of this patent reads:

"a miniature incandescent lamp comprising a glass bulb (1) containing an inert gas therein and a coiled filament (2) arranged in said bulb (1), the inert gas containing xenon and nitrogen, the content of xenon in the inert gas being not less than 80% by volume, characterised in that the pitch ratio  $p/d$  of the spacing  $p$  between two adjacent turns of the coiled filament (2) to the wire diameter  $d$  is not less than 1.4".

Claims 2 to 7 are appended to Claim 1.

The provision of a "pitch ratio" at least equal to 1.4 should prevent arcing between turns of the coiled filament, thereby increasing both the luminous efficacy of the lamp and its life duration - see page 2 of the patent, lines 45 to 48.

- II. The patent was opposed by the Appellant on the grounds mentioned in Article 100(a) and (b) EPC, referring to the prior art which can be derived from, *inter alia*, documents

D1: US-A-2 891 189

D2: CH-A-212 051.

- III. Oral proceedings were held on 15 November 1990, at the end of which the Opposition Division rejected the opposition.

- IV. The Opponent lodged an appeal against the decision of the Opposition Division.
- V. The Respondent commented on the Grounds of Appeal in a letter dated 12 November 1991.
- VI. In a communication pursuant to Article 11(2) RPBA, the Board took the provisional view that the grounds mentioned in Article 100(b) EPC were a bar to the maintenance of the patent in suit and that, furthermore, Claim 1 of the latter did not seem to involve an inventive step, having regard to the state of the art which can be derived from document (D1).
- VII. Oral proceedings were held on 8 July 1993.
- VIII. The Appellant requested that the decision under appeal be set aside and that the European patent be revoked. Its argumentation may be summarised as follows:

Document (D1) pertains to a miniature incandescent lamp comprising a coiled filament and a bulb filled with nitrogen and at least 80% by volume of xenon. In this lamp, the nearest points of maximum potential difference are separated by a distance depending on the rated voltage, which distance is not inferior to a certain limit. The result to be achieved being a reduced risk of arcing in a lamp containing as much xenon as possible, the skilled person thus readily understands that said risk depends on field intensity rather than on voltage. From (D2), said skilled person furthermore learns that the risk of arcing can be influenced through modifications of the mandrel ratio and pitch ratio, and that, in the case of a coiled coil filament, the pitch ratio of the secondary helix should preferably be high. Nevertheless, just as with the Reynold's number and the mandrel ratio, the pitch ratio of a coiled filament is

dimensionless, so that its influence is not dependent on the type of lamp. Therefore, no display of inventiveness is needed to combine the teachings of (D1) and (D2), which leads to the claimed invention.

Besides, the disclosure of the invention is not sufficient. A skilled person designing a miniature incandescent lamp starts indeed from given values of the lamp's rated voltage, power and colour temperature. Both the filament's resistance and the current's intensity in the filament are thus implicitly given. Therefore, once the diameter of the wire forming the filament has been determined, the length of said wire may no longer be varied. This in turn entails that, if the mandrel ratio of the coiled filament is increased, the number of windings has to be reduced accordingly, whereby the voltage drop along one winding is increased in the same proportion as the mandrel ratio. In a lamp according to Claim 1 of the European patent, i.e. in which the pitch ratio is chosen independently of the mandrel ratio, this further entails that the electric field's intensity between neighbouring windings too is increased in the same proportion as the mandrel ratio. The latter, however, may not be chosen too small, for the bulb of a miniature lamp has limited dimensions and, moreover, the heat losses would be higher. Therefore, the risk of arcing is not necessarily reduced and, in the absence of any indication concerning the mandrel ratio, the patent does not meet the requirements of Article 83 EPC.

IX. The Respondent requested that the appeal be dismissed and that the patent be maintained as granted. In support of its requests, it substantially argued as follows:

In practice, the mandrel ratio is set within a certain range whose limits are determined by the strength of the filament's material. There is no reason to believe that

a skilled person would make the mandrel ratio extremely great or extremely small. Being thus comprised within a restricted range, the actual value of the mandrel ratio is of less importance. Therefore, the invention is sufficiently disclosed.

Specifically, the arcing dealt with in (D1) takes place between both ends of a coil and it is even stated that the highest potential difference is substantially equal to the rated voltage of the lamp. By contrast, the invention deals with arcing between adjacent turns of a coil. The skilled person would therefore not learn from (D1) anything useful for preventing such arcing. Now, (D2) is related to a double helical coil filament and it is doubtful that a skilled person would rely upon its teachings when seeking an optimum single coil filament. The secondary pitch ratio indicated there is indeed much smaller than the pitch ratio according to the invention, whereas the voltage drop through a turn of the secondary winding is much greater than that of the present invention. The probability of arcing is thus greater than in a lamp embodying said invention.

- X. At the end of the hearing, the decision was announced that the decision under appeal is set aside and that the patent in suit is revoked.

### **Reasons for the Decision**

1. *Interpretation of Claim 1*

The patent in suit defines the pitch of the coiled filament (2) as the spacing (p) between "adjacent" - i.e. neighbouring - turns of the coil - see page 2, lines 51 and 52. The pitch of a helically coiled wire,

however, is usually understood as the distance between an intersection of the wire's neutral fibre by a plane containing the axis of the helix and the next such intersection(s) of the neutral fibre by the plane. This interpretation being adopted in the cited documents, all values of the pitch ratio mentioned in the patent in suit have to be augmented by one unit when being compared to the values disclosed in said cited documents.

2. *Sufficiency of the Disclosure.*

2.1 Any person of ordinary skill in the field of electricity knows that, if a voltage (V) is applied at the extremities of a lamp's filament and if the electrical power dissipated in said filament is (W), then the current's intensity through the filament is ( $I = W/V$ ) and the latter's resistance is ( $R = V/I = V^2/W$ ). Likewise, any such person also knows that, if a wire has a cross section (S), a length (l) and is made of a material having a resistivity ( $\rho$ ), the electrical resistance of this wire is given by the formula ( $R = \rho l/S$ ). With regard thereto, the Board concurs with the Appellant that, once the diameter of the wire forming the filament of an incandescent lamp has been determined - whereby the desired colour temperature shall be achieved at the filament's surface - , the length of said wire may no longer be varied as far as the lamp's rated voltage, power and colour temperature must remain the same.

Therefore, the Board also concurs with the Appellant that, under the latter condition, the number of turns of a coiled filament is inversely proportional to the filament's mandrel ratio, and that the voltage drop along one turn of the filament is consequently proportional to the mandrel ratio.

2.2 During the oral proceedings of 8 July 1993, the Respondent contended that the mandrel ratio of coiled filaments for miniature incandescent lamps would lie within a narrow range of values, so that it would be nearly the same for all such lamps. Nevertheless, though knowing that the Appellant did not share this view and, therefore, that the question of the mandrel ratio would be at issue, the Respondent did not bring any evidence in support of its assertions concerning that point. On the other hand, it is beyond doubt that the Appellant is right when putting forward that a filament coil having a small mandrel ratio would be too long for the heat losses to remain acceptable, and that the dimensions, in particular the length, of a miniature incandescent lamp's bulb should be limited.

In the Board's judgment, therefore, the patent in suit does not set to the mandrel ratio of the filament any other limitation than those a skilled person would expect to result from the size and/or form of the claimed lamps's bulb.

2.3. Hence, owing to the lack of explicit values of the mandrel ratio in the description and the lack of any statement as to which rated voltage the claimed pitch ratio applies, a skilled person has no guidance to infer from the claimed minimum pitch ratio as to what constitutes the maximum voltage drop along one turn. The Respondent did not contest that, if the diameter of the coiled wire forming the lamp's filament and the latter's pitch ratio remain constant, any increase of the voltage drop along one turn of the coil results in an increase of the maximum electric field's intensity at the surface of the coiled wire. When realising a lamp according to Claim 1 of the patent in suit, therefore, one does not necessarily exclude that, despite the inclusion of nitrogen in the lamp's gas filling, the electric field's



intensity between facing portions of neighbouring filament turns might become high enough for arcing to take place between such facing portions.

- 2.4. In the Board's judgment, therefore, the patent in suit fails to disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art - Article 83 EPC. The grounds mentioned in Article 100(b) EPC thus form a bar to the maintenance of the patent in suit as granted.
  
3. Furthermore, in the Board's judgment, Claim 1 lacks an inventive step having regard to the disclosure in Document (D1) and to the basic technical knowledge of the skilled person for the reasons which follow.
  
- 3.1. Document (D1) pertains to lamps provided with a coiled metal filament and constructed for use at voltages of at most 40 volts, especially "above about 10 volts" - see column 1, lines 15 to 20 and column 2, lines 9 to 12. Furthermore, it reveals that the use of a xenon filling enhances the risk of flash-over along the filament, except in lamps constructed for operation below the ionisation voltage of xenon, i.e. lower than 10 volts in practice - see column 1, lines 34 to 39. Such teachings are consistent with those of the patent in suit, where it is stated that, in a lamp of the 12V, 5W type filled with pure xenon, arcing takes place at a voltage of 14.5 volts - see page 3, lines 42 to 46.

It might be objected that the highest wattage mentioned in the European patent is 8 watts, whereas the only value to be found in (D1) is 20 watts. Nevertheless, the latter value is only given by way of example while applying formulae disclosed in (D1). There is consequently no reason to question the relevance of (D1) in the field of miniature incandescent lamps.

3.2 To preclude the occurrence of flash-over in a low voltage incandescent lamp with a gas filling consisting of at least 80% by volume of xenon, the rest being krypton and or argon, document (D1) proposes to admix the filling with "a small percentage of nitrogen substantially below that which has been found to be necessary up to now" - see: column 2, lines 18 to 29 and 54 to 60. From another passage of (D1), it appears that the percentage of nitrogen which previously had been held to be necessary was at least 5% - see column 1, lines 42 to 46. Furthermore, for a pressure of 600 Torr and a voltage of 12.5 volts, i.e. those mentioned in the patent in suit, the formulae disclosed in (D1) give a percentage by volume of nitrogen which is 2.1% when interpolating the coefficient (K) figuring there linearly in the range of 450 to 750 Torr - see column 3 of (D1), lines 12 to 29. Since such a percentage of nitrogen falls within the range covered by Claim 3 of the European patent, in the Board's judgment, no inventive step can be perceived in the composition of the gas mixture filling the bulb of the claimed lamp.

3.3 Document (D1) mentions the risk of electric discharge "between the nearest points of highest potential difference of the filament and one of its supports" - see column 3, lines 30 to 35 -, but the Respondent contended that a person skilled in the art of making miniature incandescent lamps would not consider it relevant. However, it is explicitly stated in (D1) that the technical problem addressed there is that of preventing flash-over **along the filament** of an incandescent lamp, and thereby to increase the lamp's rated life - see column 1, lines 32 to 34 and column 2, lines 9 to 17. The Board furthermore concurs with the Appellant that the risk of electric discharge in a gas filled lamp is the highest where the electric field intensity is maximum, and that the field intensity

between the nearest points of highest potential difference is not necessarily the highest field intensity. In the case of a coiled filament, the field intensity between neighbouring turns depends on the voltage drop along one turn and, in so far as the other parameters defining the form and dimensions of the filament remain unchanged, it obviously decreases when the pitch ratio is increased. Therefore, if flash-over was still observed in lamps according to the prior art from which the invention started, no inventive step either was required to select a particular minimum pitch ratio. As a matter of fact, this is actually the less so as increasing the pitch ratio furthermore reduces the shadowing effect, i.e. the interception of light by neighbouring filament's turns.

3.4 Claims 2 to 7 are dependent from Claim 1 and therefore fall with it.

3.5 Therefore, the grounds mentioned in Article 100(a) EPC also represent a bar to the maintenance of the patent in suit.

**Order**

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

1. The Decision under appeal is set aside.
2. European patent No. 0 140 330 is revoked.

The Registrar:

The Chairman:

M. Beer

G.D. Paterson