

**Internal distribution code:**

- (A) [ - ] Publication in OJ
- (B) [ - ] To Chairmen and Members
- (C) [ - ] To Chairmen
- (D) [ X ] No distribution

**Datasheet for the decision  
of 27 September 2011**

**Case Number:** T 0972/09 - 3.4.02  
**Application Number:** 01304114.0  
**Publication Number:** 1158326  
**IPC:** G02F1/313, G02F1/225, G02B6/293  
**Language of the proceedings:** EN

**Title of invention:**

Tunable all-pass optical filters with large free spectral ranges

**Applicant:**

LUCENT TECHNOLOGIES INC.

**Headword:**

**Relevant legal provisions:**

EPC 1973 Art. 56

**Keyword:**

Inventive step (no)

**Decisions cited:**

**Catchword:**



Case Number: T0972/09 - 3.4.02

**D E C I S I O N**  
**of the Technical Board of Appeal 3.4.02**  
**of 27 September 2011**

**Appellant:**  
(Applicant)

LUCENT TECHNOLOGIES INC.  
600 Mountain Avenue  
Murray Hill, NJ 07974-0636

US

**Representative:**

Sarup, David Alexander  
Alcatel-Lucent Telecom Limited  
Unit 18, Core 3, Workzone  
Innova Business Park  
Electric Avenue  
Enfield  
EN3 7XU

GB

**Decision under appeal:**

**Decision of the Examining Division of the  
European Patent Office posted 12 December 2008  
refusing European patent application No.  
01304114.0 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman:** A. G. Klein  
**Members:** F. J. Narganes-Quijano  
L. C. Bühler

## Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 01304114.0 (published with the publication No. 1158326).

II. In its decision, the examining division held that the subject-matter of claim 1 of the set of claims then on file did not involve an inventive step (Article 56 EPC 1973) in view of the disclosure of the following documents:

D1: EP-A-0997751

D2: "Design and modeling of waveguide-coupled single-mode microring resonators", M. K. Chin et al.; Journal of Lightwave Technology, Vol. 16 (1998); pages 1433 to 1446

D3: "Wavelength trimming of a microring resonator filter by means of a UV sensitive polymer overlay", S. T. Chu et al.; IEEE Photonics Technology Letters, Vol. 11 (1999); pages 688 to 690.

Claim 1 of the request upon which the decision was based reads as follows:

" A tunable optical all-pass filter comprising:  
a substrate (21);  
a first layer (22) on said substrate including a waveguide optical ring resonator (23);  
a second layer (24) located over the first layer;  
a third layer (25) including a curved waveguide (26) located over the second layer;  
characterized in that:

the curved waveguide is optically coupled to the optical ring resonator through the second layer by at least two optical couplers (27A and 27B), wherein the second layer has a first thickness outside of the regions of the couplers and a second lesser thickness proximate a region of the couplers, and further wherein the curved waveguide substantially overlays the optical ring resonator, the first thickness sufficiently thick to provide optical isolation between the curved waveguide and the optical ring resonator outside of the region of the couplers and the second lesser thickness providing optical coupling of the curved waveguide and the optical ring resonator proximate a region of the couplers;

a first phase shifter (29) located proximate the optical ring resonator for adjusting the optical pathlengths of the ring resonator; and

a second phase shifter (28) located proximate the curved waveguide for adjusting the path length of the waveguide between the two optical couplers."

III. With the statement setting out the grounds of appeal the appellant maintained the set of claims upon which the decision was based as a main request and submitted an amended set of claims as an auxiliary request.

Claim 1 of the auxiliary request differed from claim 1 of the main request in that the following sentence was introduced at the beginning of the characterizing portion of the claim: "the curved waveguide and the and the [sic] waveguide optical ring resonator parallel in a vertical plane".

The appellant requested that the decision under appeal be set aside and a patent be granted and, on an auxiliary basis, oral proceedings.

IV. Oral proceedings were appointed and in a communication annexed to the summons to attend the oral proceedings the Board referred to document

A1: JP-A-3168705 (1991) and the corresponding abstract published in "Patent Abstracts of Japan"

cited from the Board's own knowledge, and gave a preliminary assessment of the case. In particular, the Board expressed doubts as regards the issue of inventive step of the claimed subject-matter. More particularly, as far as the subject-matter of claim 1 of the main and the auxiliary requests then on file is concerned, the Board commented as follows:

"Document D1 discloses a tunable optical all-pass filter constituted by a curved waveguide and a waveguide optical ring resonator coupled to each other by two optical couplers, the curved waveguide and the ring resonator each having an optical-pathlength adjusting phase shifter (abstract and Figure 9A together with the corresponding description in paragraph [0048]).

It is undisputed that document D1 represents the closest state of the art and that the subject-matter of claim 1 of the main request differs from the optical filter disclosed in document D1 in the following layered structure on a substrate:

- the ring resonator and the curved waveguide are disposed in different layers so that the curved waveguide substantially overlays the ring resonator, and

- the ring resonator and the curved waveguide are optically isolated from each other by an intermediate layer having a lesser thickness at the regions of the optical couplers.

Thus, while in document D1 the curved waveguide and the ring resonator are coplanar and are optically coupled in the lateral or horizontal direction, in document D1 the curved waveguide and the ring resonator overlay each other and are optically coupled in the vertical direction by portions of the intermediate layer having a lesser thickness.

The reasons given by the examining division in support of the finding of lack of inventive step were essentially the following:

- in the context of integrated optical filters it is known to optically couple waveguides in the vertical direction, as illustrated by documents D2 (Figures 2 and 17) and D3 (Figures 1 and 2) which disclose the vertical optical coupling between a ring resonator and an optical waveguide through an intermediate layer,
- the vertical coupling configuration is considered as an alternative to the horizontal coupling and the skilled person would use one or the other depending on the circumstances with the corresponding advantages, like for instance a gain of space when using the vertical configuration or other advantages disclosed in document D2 (paragraph F on page 1444), and
- in order to achieve the optical coupling, the two waveguides must come close enough to each other, and if the waveguides are parallel to each other in the vertical direction, the only possibility of coupling is to reduce the distance between them in the coupling region, thereby having a lesser

thickness of the intermediate layer in the coupling region than outside the coupling region.

In the statement setting out the grounds of appeal the appellant has essentially submitted that

- the examining division concedes that documents D1 to D3 fail to disclose an intermediate layer having a lesser thickness in the coupling regions,
- in the arrangements of documents D2 and D3 the appropriate amount of optical coupling is achieved without an intermediate layer of varying thickness, and in these arrangements the distance between the waveguide and the ring resonator directly overlying one another could be reduced and, in the situation in which no coupling is desired, the waveguide and the ring resonator could be offset laterally in addition to the vertical offset created by the intermediate layer having a fixed thickness (Figure 17 of document D2),
- there is no motivation to change the vertical structures of documents D2 and D3 to have an intermediate layer of varying thickness as claimed, especially in view of the significant design and manufacturing issues involved in such an approach [...].

After consideration of the appellant's case, the Board notes the following:

Each of documents D2 (Figures 11 and 17 together with the corresponding description, in particular paragraph F on page 1444) and D3 (abstract and Figures 1 and 2) teach and analyse the vertical optical coupling between a waveguide and a ring resonator arranged in an overlaying configuration on a substrate. More

particularly, document D2 discloses the vertical coupling approach as an alternative to the conventional horizontal or lateral optical coupling between a waveguide and a ring resonator arranged in a coplanar relationship of the type disclosed for instance in document D1 and also acknowledged in the description of the application (Figure 1 together with the corresponding description on page 2, line 9 *et seq.*), and the document also discusses the technical advantages and disadvantages associated with the vertical coupling approach (paragraph F on page 1444). Thus, it would appear obvious, in view of the teaching of document D2 or D3, to apply in the filter disclosed in document D1 the vertical coupling approach between the waveguide and the ring resonator instead of the conventional horizontal or lateral coupling approach in accordance with the circumstances, and more particularly when smaller filter devices are to be designed (as specified in the application as one of the technical problems solved by the invention, see page 3, third paragraph) and/or when any of the technical advantages specified in document D2 (improved control of the accuracy of the gap between the waveguide and the ring resonator, improved coupling length, etc., see paragraph F on page 1444) are considered of interest.

The possible technical improvements in the thermal isolation of the waveguide and the ring resonator mentioned in the application (page 3, third paragraph) are of no relevance in the assessment of inventive step of the claimed invention because according to the application the problem of the thermal isolation occurs when phase shifters of the heater type are used (page 5, lines 16 and 17 of the application) and the problem is solved in terms of a predetermined relationship between the temperature dependence of the materials of



the layers (page 5, lines 17 to 28), and the claimed invention is restricted neither to thermal phase shifters nor to the use of such materials.

The further claimed feature relating to the thickness of the intermediate layer varying so that the thickness is smaller in the coupling regions between the curved waveguide and the ring resonator constitutes, in the Board's view, an obvious technical measure because the skilled person knows that the optical coupling and the optical isolation of the different segments of the waveguide and the resonator is determined by the respective distance between the segments (as it is already the case in the conventional horizontal or lateral coupling arrangement of the type disclosed in Figures 9A and 9B of document D1) and he would therefore consider the appropriate arrangement of the segments of the waveguide and of the resonator in order to achieve the appropriate optical coupling between the segments at the coupling regions and the appropriate optical isolation of the segments at the remaining regions. Whether the appropriate arrangement is then achieved by an offset of the segments in the horizontal, in the vertical or in an oblique direction is a matter of design, and in the particular case in which the waveguide and the resonator are arranged in a mutual overlaying relationship - as it is the case in Figure 17 of document D2 and in Figure 1 of document D3 - it would then be straightforward, as already pointed out by the examining division, to arrange the segments of the waveguide and the resonator closer to each other at the coupling regions than at the remaining regions requiring an optical isolation, thus resulting in the intermediate layer having a lower thickness at the coupling regions as required by the claimed subject-matter. The Board also notes in this respect that this

approach is known in the prior art as illustrated by Figures 7, 10 and 11 of document A1 disclosing the optical equivalence of a horizontal optical coupling between optical waveguides and a vertical optical coupling between overlaying optical waveguides at regions determined by the thinner portions of an intermediate layer arranged between the waveguides, the document also mentioning explicitly that the vertical optical coupling arrangement allows the design of space-saving coupling arrangements (see abstract).

Having regard to the above considerations and conclusions, the Board is inclined to follow the examining division's view that the subject-matter of claim 1 of the main request does not involve an inventive step.

Claim 1 amended according to the auxiliary request differs from claim 1 of the main request only in the additional feature according to which the curved waveguide and the ring resonator are "parallel in a vertical plane" (lines 7 and 8 of the claim). This feature, interpreted according to the disclosure of the invention in the sense that the curved waveguide is arranged so that it overlays the ring resonator in the vertical direction, appears to be superfluous (Article 84 EPC) in view of the fact that the claim already requires that the curved waveguide "substantially overlays the optical ring resonator" (lines 11 and 12 of the claim). In addition, in view of the fact that the amended feature repeats in different words one of the features already defined in claim 1 of the main request, the subject-matter of claim 1 amended according to the auxiliary request is the same as that of claim 1 of the main request and consequently the

same considerations [...] above also apply to claim 1 of the auxiliary request."

- V. In reply to the summons to attend oral proceedings, the appellant filed by letter dated 26 August 2011 three amended sets of claims as a main and a first and second auxiliary request, and informed the Board that it would not attend the oral proceedings.

Claim 1 of the main request is identical to claim 1 of the previous main request and identical to claim 1 of the request underlying the decision under appeal (*cf.* point II above).

Claim 1 of the first auxiliary request differs from claim 1 of the main request in that the word "proximate" in the expression "[...] a second lesser thickness proximate a region of the couplers" has been replaced by the word "in".

Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in that the following sentence has been introduced at the beginning of the characterizing portion of the claim: "the curved waveguide and the waveguide optical ring resonator parallel in a vertical plane".

- VI. Oral proceedings before the Board were held on 27 September 2011. As previously announced, the appellant was neither present nor represented at the oral proceedings.

At the end of the oral proceedings the Board announced the decision reported in the order below.

## **Reasons for the Decision**

1. The appeal is admissible.
2. *Inventive step*
  - 2.1 *Main request*

Claim 1 of the present main request is identical to claim 1 of the previous main request considered by the Board in the communication annexed to the summons to the oral proceedings. In this communication the Board addressed the arguments submitted by the appellant in the statement of grounds of appeal in support of its requests (see the fourth of the cited paragraphs in point IV above) and explained in detail why it was inclined to follow the examining division's view that the subject-matter of claim 1 of the main request does not involve an inventive step with regard to the disclosure of document D1 and the technical teaching of document D2 or document D3. In particular, the Board introduced document A1 into the proceedings in order to refute the arguments of the appellant and explained why the disclosure of this document lent further support for the examining division's assessment of inventive step (see point IV above).

In reply to the Board's preliminary assessment in the aforementioned communication, the appellant submitted with the letter dated 26 August 2011 arguments based on the disclosure of documents D2 and D3 and repeating in substance the arguments submitted with the statement of grounds of appeal and already considered by the Board in its preliminary assessment in the aforementioned communication. In addition, as regards the line of

argument developed by the Board on the basis of the disclosure of document A1, the appellant stated that it could not find the relevance of document A1, at least as it applies to the claims, without however submitting substantive arguments in support of its allegation.

After consideration of the issues addressed in the aforementioned communication, and in the absence of any new substantial argument contesting the Board's preliminary assessment of the case and in particular the line of argument developed with regard to document A1, the Board found no reason during the oral proceedings to depart from the preliminary opinion already expressed by the Board during the written proceedings and concluded that the subject-matter of claim 1 of the main request does not involve an inventive step (Article 56 EPC 1973).

## 2.2 *First auxiliary request*

Claim 1 of the first auxiliary request differs from claim 1 of the main request only in that the expression "the second layer has [...] a second lesser thickness *proximate* a region of the couplers" has been replaced by the expression "the second layer has [...] a second lesser thickness *in* a region of the couplers". However, according to the submissions of the appellant the previous and the amended expressions were both supported by the same embodiment disclosed in the application and, in addition, in the assessment in the Board's communication (*cf.* point IV above) the claimed feature according to which predetermined portions of the second layer are "proximate a region of the couplers" was construed as actually meaning "in the region of the couplers".

It follows from these considerations that the amendment made to claim 1 according to the first auxiliary request does not affect the Board's preliminary assessment already communicated to the appellant in the aforementioned communication. Consequently, the Board concluded during the oral proceedings that the subject-matter of claim 1 of the first auxiliary request does not involve an inventive step (Article 56 EPC 1973) for the same reasons given in point 2.1 above with respect to claim 1 of the main request.

### 2.3 *Second auxiliary request*

The subject-matter of claim 1 of the second auxiliary request consists of that of claim 1 of the first auxiliary request further specifying that "the curved waveguide and the waveguide optical ring resonator [are] parallel in a vertical plane". As already mentioned in the Board's communication with regard to claim 1 of the previous auxiliary request (cf. point IV above, last paragraph), this feature merely repeats in different words one of the features already defined in the claim, and the appellant has not contested this finding. It follows that the subject-matter of claim 1 amended according to the second auxiliary request is the same as that of claim 1 of the first auxiliary request. Consequently, the Board concluded during the oral proceedings that the subject-matter of claim 1 of the second auxiliary request does not involve an inventive step (Article 56 EPC 1973) for the same reasons given in points 2.1 and 2.2 above with respect to claims 1 of the main and first auxiliary requests.

3. In view of the above considerations and conclusions, the Board concluded during the oral proceedings that none of the requests of the appellant was allowable for

essentially the same reasons already communicated to the appellant and reproduced in point IV above, and that consequently the appeal was to be dismissed.

**Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:

M. Kiehl

A. G. Klein

Decision electronically authenticated