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**Datasheet for the decision  
of 1 August 2008**

**Case Number:** T 1508/05 - 3.5.02

**Application Number:** 96301213.3

**Publication Number:** 0731473

**IPC:** H01B 11/12

**Language of the proceedings:** EN

**Title of invention:**

Composite conductor having improved high frequency signal transmission characteristics

**Applicant:**

W.L. GORE & ASSOCIATES, INC.

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 54, 56

**Relevant legal provisions (EPC 1973):**

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**Keyword:**

"Main request, auxiliary requests A, C, C1, D, D1, E, E1 - novelty (no)"

"Auxiliary requests B, F, F1, - inventive step (no)"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 1508/05 - 3.5.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.02  
of 1 August 2008

**Appellant:**

W.L. GORE & ASSOCIATES, INC.  
551 Paper Mill Road  
P.O. Box 9329  
Newark  
Delaware 19714 (US)

**Representative:**

Shanks, Andrew  
Marks & Clerk Scotland  
19 Royal Exchange Square  
Glasgow G1 3AE  
Scotland (GB)

**Decision under appeal:**

Decision of the Examining Division of the  
European Patent Office posted 15 July 2005  
refusing European application No. 96301213.3  
pursuant to Article 97(1) EPC 1973.

**Composition of the Board:**

**Chairman:** M. Ruggiu  
**Members:** J.-M. Cannard  
P. Mühlens

## Summary of Facts and Submissions

I. The appellant contests the decision of the examining division to refuse European patent application No. 96 301 213.3. During the oral proceedings held on 5 September 2003, claim 1 of the main request then on file and the first and second auxiliary requests filed during the oral proceedings were considered unclear and lacking novelty (Articles 84 and 54 EPC) by the examining division. On 4 February 2004, the division issued a communication under Rule 51(4) EPC 1973 informing the applicant that it intended to grant a patent on the basis of the third auxiliary request filed during the oral proceedings. In a letter dated 11 June 2004, the applicant expressed disapproval of the text proposed in said communication and requested a decision under Rule 68(2) EPC 1973. The decision refusing the application was issued on 15 July 2005.

II. The document:

D1: EP-A-0 465 113,

considered in the first instance, remains relevant to the present appeal.

III. With the statement of grounds of appeal, the applicant filed sets of claims according to a main request and auxiliary requests A and B. The applicant was then summoned to oral proceedings scheduled to take place on 1 August 2008. With a faxed letter dated 11 July 2008, the applicant filed sets of claims according to auxiliary requests C, C1, D and D1 based on the existing main request; E and E1 based on existing auxiliary

request A; and F and F1 based on existing auxiliary request B.

IV. With faxed letters dated 18 July 2008 and 22 July 2008, the appellant asked the Board "whether it believes oral proceedings is still required to conclude this appeal" and "if any of the recently filed Requests are considered allowable". The Board replied that the oral proceedings were maintained and that it tended to the view that none of the requests on file was allowable (communications of 21 and 22 July 2008).

V. The appellant faxed two letters dated 25 July 2008, which contained the respective following statements:

"The Applicant hereby withdraws its request for oral proceedings. Accordingly, it is requested that the Board reach a decision based on the papers currently on file."  
and,

"we will not be attending the proceedings scheduled for 1 August 2008".

VI. As announced, the applicant did not attend the oral proceedings held on 1 August 2008. The appellant had requested in writing that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 22 of the main request filed with a letter dated 25 November 2005, subsidiarily on the basis of claims 1 to 14 of auxiliary request A, claims 1 to 4 of auxiliary request B, claims 1 to 20 of auxiliary request C, claims 1 to 16 of auxiliary request C1, claims 1 to 10 of auxiliary request D, claims 1 to 8 of auxiliary request D1, claims 1 to 14 of auxiliary request E,

claims 1 to 11 of auxiliary request E1, claims 1 to 4 of auxiliary request F or claims 1 to 3 of auxiliary request F1, the auxiliary requests A and B having been filed with the letter dated 25 November 2005 and auxiliary requests C, C1, D, D1, E, E1, F and F1 with a letter dated 11 July 2008.

VII. Independent claim 12 of the main request reads as follows:

"A method of forming a composite conductor (10) comprising a conductive coating (14) disposed upon a conductive base (12), said method comprising:

- (a) pre-determining a frequency range in which a composite conductor (10) is intended to transmit a signal;
- (b) selecting a material for the conductive base (12) and a material for the conductive coating (14), the conductive coating (14) having a permeability  $\mu_1$  and a conductivity  $\sigma_1$  and the conductive base (12) having a permeability  $\mu_2$  and a conductivity  $\sigma_2$ , such that the conductive base (12) has a higher surface resistance than the conductive coating (14) and

$$\frac{\mu_2}{\sigma_2} > \frac{\mu_1}{\sigma_1}$$

- (b) determining a thickness of the conductive coating (14) to be disposed on the conductive base (12) by selecting the thickness of the conductive coating (14) to be within a range of one-half to five times a skin depth of said conductive

coating (14) in the pre-determined frequency range,

(c) depositing said predetermined thickness of conductive coating (14) on said conductive base (12),

wherein said signal within the pre-determined frequency range has an attenuation which is substantially independent of said frequency of said signal."

VIII. Claim 1 of the auxiliary request A reads as follows:

"A composite conductor (10) having improved high frequency signal transmission characteristics comprising:

a conductive base (12) having a permeability  $\mu_2$  and a conductivity  $\sigma_2$ ; and

a conductive coating (14) disposed upon the conductive base (12), the conductive coating (14) having a permeability  $\mu_1$  and a conductivity  $\sigma_1$ , such that

$$\frac{\mu_2}{\sigma_2} \gg \frac{\mu_1}{\sigma_1}$$

wherein the conductive coating (14) has a thickness selected to be in the range from about one-half to about five times a skin depth of said coating (14) in a predetermined frequency range,

wherein a current distribution of the composite conductor (10) is redistributed from the conductive base (12) to the conductive coating (14) by employing a

conductive base (12) having a higher surface resistance than the conductive coating (14),

wherein a signal propagated through said composite conductor (10) lengthwise of said composite conductor (10), has a frequency and an amount of attenuation; and

wherein said amount of attenuation is substantially independent of said frequency of said signal within said predetermined frequency range."

IX. Claim 1 of the auxiliary request B reads as follows:

"A coaxial cable (18) having improved high frequency signal transmission characteristics comprising:

a conductor (20) comprising:

a conductive base (25) having a permeability  $\mu_2$  and a conductivity  $\sigma_2$ ; and

a conductive coating (26) disposed upon the conductive base (25), the conductive coating having a permeability  $\mu_1$  and a conductivity  $\sigma_1$ , such that

$$\frac{\mu_2}{\sigma_2} \gg \frac{\mu_1}{\sigma_1}$$

wherein the conductive coating (26) has a thickness selected to be in the range from about one-half to about five times a skin depth of said coating (26); and

wherein a current distribution of the conductor (20) is redistributed from the conductive base (25) to the

conductive coating (26) by employing a conductive base (25) having a higher surface resistance than the conductive coating (26);

a dielectric material (27) disposed about the conductor (20),

an outer conductor (21) disposed about the dielectric material (27); and

an insulating jacket (24) disposed about the outer conductor (21)

wherein a signal propagated through said coaxial cable (18), lengthwise of said coaxial cable (18), has a frequency and an amount of attenuation; and

wherein said amount of attenuation is substantially independent of said frequency of said signal, and

wherein the outer conductor (21) is defined by,

a) a conductive base (23) having a permeability  $\mu_2$  and a conductivity  $\sigma_2$ ; and

b) a conductive coating (22) disposed upon a conductive base (23), the conductive coating (22) having a permeability  $\mu_1$  and a conductivity  $\sigma_1$ , such that

$$\frac{\mu_2}{\sigma_2} \gg \frac{\mu_1}{\sigma_1} \quad "$$

X. Independent claim 11 of the auxiliary request C and claim 1 of the auxiliary request D only differ from



independent claim 12 of the main request in that the feature "selecting the thickness of the conductive coating (14) to be within a range of one-half to five times a skin depth of said conductive coating (14) in the pre-determined frequency range" is replaced by "selecting the thickness of the conductive coating (14) to be substantially equal to or less than a skin depth of said conductive coating (14) in the pre-determined frequency range".

XI. Independent claim 9 of the auxiliary request C1 and claim 1 of the auxiliary request D1 only differ from independent claim 12 of the main request in that the feature "selecting the thickness of the conductive coating (14) to be within a range of one-half to five times a skin depth of said conductive coating (14) in the pre-determined frequency range" is replaced by "selecting the thickness of the conductive coating (14) to be substantially equal to a skin depth of said conductive coating (14) in the pre-determined frequency range".

XII. Claim 1 of the auxiliary request E only differs from claim 1 of the auxiliary request A in that the feature "a thickness selected to be in the range from about one-half to about five times a skin depth of said coating (14) in a pre-determined frequency range" is replaced by "a thickness selected to be substantially equal to or less than a skin depth of said coating (14) in a predetermined frequency range".

XIII. Claim 1 of the auxiliary request E1 only differs from claim 1 of the auxiliary request A in that the feature "a thickness selected to be in the range from about one-

half to about five times a skin depth of said coating (14) in a pre-determined frequency range" is replaced by "a thickness selected to be substantially equal to a skin depth of said coating (14) in a predetermined frequency range".

XIV. Claim 1 of the auxiliary request F only differs from claim 1 of the auxiliary request B in that the feature "a thickness selected to be in the range from about one-half to about five times a skin depth of said coating (26)" is replaced by "a thickness selected to be substantially equal to or less than a skin depth of said coating (26)".

XV. Claim 1 of the auxiliary request F1 only differs from claim 1 of the auxiliary request B in that the feature "a thickness selected to be in the range from about one-half to about five times a skin depth of said coating (26)" is replaced by "a thickness selected to be substantially equal to a skin depth of said coating (26)".

XVI. The appellant's arguments can be summarized as follows:

The present invention related to a plated conductor where the thickness of the plating layer was controlled for improving high speed digital transmission lines by equalising attenuation losses in the conductor across a specific frequency range. Novel features of the invention were the choice of the materials and the thicknesses of the conductor and plating layer which needed to be properly selected to match the frequency range of the conductor.

Document D1 taught the use of noble metals as plating materials. However, the use of different thicknesses of the plating material was neither disclosed nor suggested in D1. D1 neither recognised nor solved the problem of the invention of correctly choosing materials and thicknesses of a conductor and plating materials to improve the transmission of a signal in a predetermined frequency range. In this regard, D1 taught away from the invention.

The cable claimed in the auxiliary requests B, F and F1 differed from the cable disclosed in D1 by an outer conductor which was made of a composite conductor. Replacing the outer conductor of D1, which was a layer of copper or silver, by a composite outer conductor similar to the inner conductor was not obvious to the skilled person. The inner conductor of D1 included a plated nickel layer that was strained by plastic working solely to improve the adhesion of a plated silver layer. There was no suggestion of such plastic working of the outer conductor of D1. Thus, the skilled person would have no reason to replace the single plated layer of the outer conductor of D1 by a composite conductor.

### **Reasons for the Decision**

1. The appeal is admissible.
  
2. Although the Board doubts that the present requests satisfy the requirements of Article 123(2) EPC, it has examined whether the subject-matter of the claims of the present requests is novel (Article 54 EPC) or involves an inventive step (Article 56 EPC).

*Independent claim 12 of the main request - Novelty*

3. According to claims 13 and 14 appended to claim 12 of the main request, the material forming the conductive base 12 may consist of nickel and the material forming the conductive coating 14 may be silver. According to the description of the application (application as published, page 5, lines 43 to 50), silver has a high conductivity and a low permeability relative to nickel. Thus, a conductive base made of nickel has a higher surface resistance than a conductive coating made of silver and the relationship between the permeability and the conductivity of said base and said coating is given by the expression:

$$\frac{\mu_2}{\sigma_2} \gg \frac{\mu_1}{\sigma_1} .$$

The thickness of the conductive coating specified in claim 12 may be substantially equal to a skin depth of said coating in the pre-determined frequency range of the transmitted signal. Furthermore, claim 12 does not specify any value of said pre-determined frequency range, so that it covers any frequency range so narrow that the attenuation is necessarily substantially independent of the frequency within said range.

Accordingly, the scope of independent claim 12 of the main request is so broad as to cover selecting a thickness of a silver conductive coating disposed upon a conductive base made of nickel that is substantially equal to a skin depth of said coating in a pre-determined frequency range.

4. Document D1 discloses a coaxial cable comprising *inter alia* a central conductor having a plated nickel layer 10 coated with a plated silver layer 11 which has a thickness on the order of 1 micrometer (figure 1; column 3, lines 9 to 16 and 35 to 40), this cable being intended for transmitting high-frequency signals for testing integrated circuits. D1 specifies that the plated silver layer is strained by plastic working to improve the surface of the silver layer and prevent the disturbance of the waveform of a high frequency signal caused by the skin effect (column 2, lines 19 to 46). Moreover, according to the passage of column 4, lines 35 to 37, "The testing high-frequency signals flow through the skins, i.e. the plated Ag layers 11, of the inner conductors 12" of the coaxial cables under test. Thus, the Board is of the opinion that the thickness of the silver layer in D1 is about the skin depth of the conductive coating in a high frequency range. Therefore, the two layers 10 and 11 of D1 respectively form a conductive base and a conductive coating, the coating being disposed upon the base and having a thickness substantially equal to the skin depth of said coating in the signal frequency range. D1 thus discloses a coaxial cable implying all the steps of the method covered by independent claim 12 of the main request (Article 54 EPC). The main request is not allowable.

*Claim 1 of auxiliary request A- Novelty*

5. For reasons identical to those given in the foregoing, the scope of claim 1 of the auxiliary request A is so broad as to cover a composite conductor comprising a conductive coating made of silver and disposed upon a

conductive base made of nickel, the thickness of said coating being substantially equal to a skin depth of said coating in a pre-determined frequency range. It is immediately apparent that providing a silver coating will cause a redistribution of current within the conductor. Thus, D1 discloses a coaxial cable comprising all the features of the composite conductor covered by claim 1 of auxiliary request A (see above, paragraphs 3 and 4). The auxiliary request A is not allowable (Article 54 EPC).

*Claim 1 of auxiliary request B- Inventive step*

6. For reasons identical to those given in the foregoing, the scope of claim 1 of the auxiliary request B is so broad as to cover a coaxial cable comprising a conductor having a conductive coating made of silver, which is disposed upon a conductive base made of nickel and has a thickness substantially equal to a skin depth of said coating, a dielectric material disposed about said conductor, an outer conductor disposed about said material and an insulating jacket disposed about the outer conductor, wherein the outer conductor is defined by a conductive coating made of silver and disposed upon a conductive base made of nickel.
  
7. D1 (figure 1) discloses a coaxial cable 3 comprising a central conductor comprising a conductive coating made of silver 11, disposed upon a conductive base made of nickel 10, the thickness of said coating being substantially equal to a skin depth of said coating (see above, paragraph 4), a dielectric material 13 disposed about said conductor, an outer conductor 14 disposed about the dielectric material, and an insulating jacket

15 disposed about the outer conductor, as the coaxial cable which is covered by claim 1 of the auxiliary request B.

8. The outer conductor 14 of the cable disclosed in D1 is a plated layer of copper or silver, or may be a meshed copper sheet or a copper pipe (column 3, lines 47 to 49). Therefore, the coaxial cable according to claim 1 of the auxiliary request B, at the level of generality of the wording of said claim, differs from the coaxial cable disclosed in D1 by an outer conductor (21) which is a composite conductor comprising a conductive coating, which in particular can be made of silver, and disposed upon a conductive base, which in particular can be made of nickel.
  
9. According to column 1 of D1, lines 24 to 42, the waveforms of the high-frequency signals are disturbed by skin effect due to deterioration of the surface roughness of very fine copper wires. This technical problem is solved in the coaxial cable of D1 by using for the inner conductor a composite conductor in which a very fine steel wire has a plated nickel layer, which itself is coated by a silver layer. Having regard to the outer conductor of D1, which may be a copper pipe, the man skilled in the art would be faced with a technical problem similar to that encountered for the inner conductor because such a copper pipe would have to be very fine. Thus, it would be obvious to the skilled person to consider applying the solution used already for the inner conductor of D1 and thereby arrive at a coaxial cable comprising all the features of claim 1. Thus, the auxiliary request B is not allowable (Article 56 EPC).

*Independent claim 11 of auxiliary request C, independent claim 9 of auxiliary request C1 and claim 1 of auxiliary requests D and D1- Novelty*

10. In view of the foregoing (paragraph 3), the subject-matter of independent claim 11 of the auxiliary request C, independent claim 9 of the auxiliary request C1 and claim 1 of the auxiliary requests D and D1 lacks novelty for reasons similar to those given for claim 12 of the main request.

*Claim 1 of auxiliary requests E and E1- Novelty*

11. In view of the foregoing (paragraph 5), the composite conductor set out in claim 1 of the auxiliary requests E and E1 lacks novelty for reasons similar to those applying to claim 1 of the auxiliary request A.

*Claim 1 of auxiliary requests F and F1- Inventive step*

12. In view of the foregoing (paragraphs 7, 8 and 9), the coaxial cable set out in claim 1 of the auxiliary requests F and F1 lacks an inventive step for reasons similar to those applying to claim 1 of the auxiliary request B.
13. Since none of the versions of the claims according to the requests on file meets the requirements of novelty and inventive step of the EPC, it is not necessary to decide whether said claims contravene Article 123(2) EPC, and the appeal has to be dismissed.



**Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:

U. Bultmann

M. Ruggiu