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D E C I S I O N
of 31 July 1996

Case Number: T 0169/94 - 3.4.1

Application Number: 89300371.5

Publication Number: 0324660

IPC: H01L 39/12

Language of the proceedings: EN

Title of invention:

Novel superconductors and processes for their preparation

Applicant:

UNIVERSITY OF ARKANSAS

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 84, 54(3)

Keyword:

"Novelty (yes)"

"Remitted to the Examining Division for further prosecution"

Decisions cited:

T 0007/86

Catchword:

-



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Chambres de recours

Case Number: T 0169/94 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 31 July 1996

Appellant:

UNIVERSITY OF ARKANSAS
Fayetteville
Arkansas 72701 (US)

Representative:

Sheard, Andrew Gregory
Kilburn & Strode
30 John Street
London WC1N 2DD (GB)

Decision under appeal:

Decision of the Examining Division of the European
Patent Office dated 29 September 1993 refusing
European patent application No. 89 300 371.5
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: G. D. Paterson
Members: H. J. Reich
R. K. Shukla

Summary of Facts and Submissions

I. European patent application No. 89 300 371.5 (publication No. 0 324 660) containing a set of claims 1 to 10 as filed on 27 May 1993 and designating contracting states AT, BE, CH, DE, FR, GB, GR, LI, LU, IT, NL and SE was refused by a decision of the Examining Division.

Independent claims 1, 4, 6 and 9 of this set of claims read as follows:

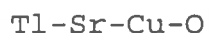
"1. A superconducting compound of the general formula:



wherein:

R represents a Group 2A element other than barium.

4. A compound of the general formula:



6. A process for the preparation of a superconducting compound of the general formula:



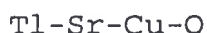
wherein:

R represents a Group 2A element other than barium;
the process comprising:

- (a) mixing BaCO_3 with CuO ;
- (b) grinding the resultant mixture and heating;

- (c) mixing the resultant mixture with Tl_2O_3 and a carbonate or oxide of R;
- (d) regrinding the mixture; and
- (e) heating the mixture in flowing oxygen.

9. A process for the preparation of a superconducting compound of the general formula:



the process comprising:

- (a) mixing $SrCO_3$ and CuO ;
- (b) grinding the resultant mixture;
- (c) heating the mixture;
- (d) mixing the resultant mixture with Tl_2O_3 ;
- (e) regrinding the mixture and optionally pressing into a pellet;
- (f) heating the mixture, optionally in flowing oxygen."

Claims 2 and 3 are dependent respectively on claim 1 and claims 1 and 2; claims 7 and 8 are dependent respectively on claim 6 and claim 7 and claim 10 is dependent on claim 9.

Dependent claim 5 has the following wording:

"5. A compound as claimed in claim 4 of the general formula:



wherein:

y is greater than or equal to 0.2 and less than or equal to 5;

u is greater than or equal to 0.5 and less than or equal to 15;

v is greater than or equal to $y+u$ and less than or equal to $2+y+u$."

- II. One of the reasons for the refusal was that the subject-matter of claims 4 and 5 as cited above did not satisfy the requirement of novelty (Articles 52(1) and 54(3) EPC) having regard to document:

D3: EP-A-0 321 184

which designates the same Contracting States. According to the decision, document D3 discloses on page 3, lines 3 to 9 in combination with Example 10 and comparative Example 9 on page 5, lines 46 and 49 a compound having the general formula according to the scope of claim 4 and a superconducting compound " $Sr_2 Tl_3 Cu_2 O_y$ " and a non-superconducting compound " $Sr_2 Tl_2 Cu_2 O_y$ " with $y > 4$ for both the compounds. It was held in the decision that both these compounds fell within the scope of claim 5, since, in the notation used in claim 5, for the superconducting compound $y = u = 0.66$ and $v > 4/3$ and for the non-superconducting compound $y = u = 1$ and $v > 2$ - and thus lay within the ranges defined in claim 5 i.e.: $0.2 \leq y \leq 5$, $0.5 \leq u \leq 15$ and $0.7 \leq v \leq 22$.

- III. A further reason for the refusal was that claim 4 as cited above did not meet the requirements of Article 84 EPC, since not all compounds of the general formula $Tl-Sr-Cu-O$ are high temperature superconductors. Therefore, claim 4 does not include all the essential features needed to solve the technical problem addressed in the application. Furthermore, the Examining Division took the view that the claims of the application lacked clarity inter alia in the following respects:

Claim 1 specifies a five element compound and claim 3 a four element compound, since claim 3 includes the alternative "y has a value...equal to zero". The formulae "Tl-R-Ba-Cu-O" used in claims 1, 2, and 6 to 8 and "Tl-Sr-Cu-O" used in claims 4, 9 and 10 cannot be considered to define a compound, since the composition of said compound is not specified by such formulae. The amendments suggested by the Examining Division in its communication dated 22 January 1993, paragraph 5 to replace the expressions "Tl-R-Ba-Cu-O" and "Tl-Sr-Cu-O" with the formulae "Tl R_y Ba₂ Cu_u O_v" and "Tl Sr_y Cu_u O_v" respectively so as to overcome the above objection were not accepted by the applicant.

IV. The applicant lodged an appeal against this decision, and paid the appeal fee eleven days after the period for filing the Notice of Appeal had expired. Upon a notification by the EPO that payment of the appeal fee was too late, the applicant filed an application for re-establishment and duly paid the corresponding fee. In an interlocutory decision T 169/94 - dated 15 May 1995, the Board decided that the applicant's right to appeal is re-established, and that the notice of appeal is considered to have been filed in due time.

V. With the grounds of appeal, the applicant filed amended sets of claims. In order to overcome the objection of the Examining Division concerning lack of novelty, a disclaimer was introduced into the wording of claims 4 and 9 reading: "excluding the compound Sr₂ Tl₃ U₂ O_y, where y is more than 4" and the subject-matter of claims 4 and 9 was restricted to a "superconducting" compound. The appellant submitted that the limitation of claim 4 to "superconducting" compounds also meets one of the objections of the Examining Division under

Article 84, i.e. the objection that claim 4 does not include all the essential features of the invention. In order to clarify claim 3, the alternative "y has a value...equal to zero" in this claim was cancelled.

However, in the claims of the main and first auxiliary requests the formulae "Tl-R-Ba-Cu-O" and Tl-Sr-Cu-O" which had been held to be unclear by the Examining Division, were maintained. The Applicant submitted that these expressions are standard practice in the chemical field and clearly set out the elements (components) of the compound so that none of these elements can be deleted, nor can additional elements be included.

VI. In a communication pursuant to Article 110(2) EPC, the Board informed the appellant inter alia, of its following preliminary views in respect of the main request:

Claims 1, 4, 6 and 9 of the main request define a formula for a superconducting compound wherein the symbols of the atoms are combined by hyphens. Such a presentation of a formula will be interpreted by a skilled reader as a structural formula with the hyphens as monovalent bonds between the atoms. Such a formula is not "general" as indicated in said claims but narrows the definition to a compound having a molecule consisting of **one** of each atom enlisted. This also means, for instance, that in claim 4 the formula: "Tl-Sr-Cu-O" not only represents a total formula $Tl Sr_y Cu_u O_v$ with $y=u=v=1$ but also that the structure of the molecule to be protected is fixed in the sense that for instance the Sr-atom is monovalently linked to Tl and Cu. Such interpretation would contradict the broader claiming in dependent claims 3 and 5 and be inconsistent with the disclosure of the invention. Moreover, it cannot be excluded that the word "general" might be

interpreted as meaningless and that the subject-matter of claims 1, 4, 6 and 9 might be regarded as restricted to the particular atomic structure of the molecule with each hyphen as one valency of the linkage. Hence the subject-matter of claims 1, 4, 6 and 9 of the main request appears not to be clear.

It was suggested that the subject-matter for which protection is sought could be clarified by defining it in terms of a complete formula for the compound with unspecified (open) indices for each element, and stating that the indices "y, z, u and v are not equal to zero".

VII. In reply to the Board's communication, the appellant agreed with the amendments of the claims proposed by the Board, and requested that the case be remitted to the Examining Division for further prosecution on the basis of claims 1 to 10 filed on 9 April 1996, with further amendments to claim 9 as agreed in a telephone conversation dated 13 June 1996.

Independent claims 1, 4, 6 and 9 filed on 9 April 1996 and further amended on 13 June 1996 read as follows:

"1. A superconducting compound of the general formula:



wherein:

R represents a Group 2A element other than barium, and y, z, u and v are not equal to zero.

4. A superconducting compound of the general formula:



wherein:

y, u and v are not equal to zero, excluding the compound $\text{Sr}_2 \text{Tl}_3 \text{Cu}_2 \text{O}_v$ where v is more than 4.

6. A process for the preparation of a superconducting compound of the general formula:



R represents a Group 2A element other than barium and y, z, u and v are not equal to zero; the process comprising:

- (a) mixing BaCO_3 and CuO ;
- (b) grinding the resultant mixture and heating;
- (c) mixing the resultant mixture with Tl_2O_3 and a carbonate or oxide of R;
- (d) regrinding the mixture; and
- (e) heating the mixture in flowing oxygen.

9. A process for the preparation of a superconducting compound of the general formula:



wherein y, u and v are not equal to zero, excluding the compound $\text{Sr}_2 \text{Tl}_3 \text{Cu}_2 \text{O}_v$ where v is more than 4, the process comprising:

- (a) mixing SrCO_3 and CuO ;
- (b) grinding the resultant mixture;
- (c) heating the mixture;
- (d) mixing the resultant mixture with Tl_2O_3 ;

- (e) regrinding the mixture and optionally pressing into a pellet;
- (f) heating the mixture, optionally in flowing oxygen."

Claims 2 and 3 are dependent on claim 1, and claims 7 and 8 are dependent on claim 6. Dependent claim 5 has the following wording:

"5. A compound as claimed in claim 4, wherein:

y is greater than or equal to 0.2 and less than or equal to 5;

u is greater than or equal to 0.5 and less than or equal to 15;

v is greater than or equal to $y+u$ and less than or equal to $2+y+u$."

Reasons for the Decision

1. *Article 84 EPC - claims 1, 3, 4, 6 and 9*

1.1 Claims 1, 4, 6 and 9 define the compounds by way of a complete formula which is standard practice in the chemical field. Such a complete formula defines all the elements of the compound in both qualitative and quantitative respects.

1.2 The objection of the Examining Division concerning a lack of clarity in the wording of claim 3 (see paragraph III above) is no longer relevant having regard to the present wording of claim 3, since the alternative "y has a value...equal to zero" has been cancelled.

- 1.3 It is left open whether the introduction of the term "superconducting" removes the objection of the Examining Division that claim 4 does not include all the essential features needed to solve the posed problem, since this question can only properly be decided in the context of an examination of inventive step.

The functional limitation of claim 4 to "superconducting compounds" only excludes from the subject-matter of claim 4 non-superconducting compounds such as $Sr_2 Tl_2 Cu_2 O_y$ disclosed in document D3, page 5, line 49. However, since the first instance has not yet examined whether the subject-matter of the claims involves an inventive step in the sense of Article 56 EPC, the objective problem to be taken into account in the examination of Article 84 EPC cannot be finally defined at the present stage of proceedings. It is open to the Examining Division in its future examination of inventive step (see point 6 below) to decide whether or not it is necessary to specify the problem as the provision of "high temperature" superconductors or even superconductors with transition temperatures above $100^\circ K$ or $120^\circ K$.

2. *Article 54 EPC - claims 4 and 5*

- 2.1 The novelty objection of the Examining Division against claim 4, based on Example 10 of document D3 at page 5, line 46, has been removed by way of disclaimer. The anticipation of the subject-matter of claim 4 by comparative example 9 disclosed in document D3, page 5, line 49 has been removed by introducing the functional feature "superconducting".

- 2.2 Document D3, page 3, lines 3 to 9 discloses the general formula $A_z B_x C_y O_z$, wherein A is an element or a group of elements selected from alkaline earth metal elements; and B is an element or a group of elements selected from the group of elements consisting of bismuth, lead and thallium. In accordance with previous decisions of the Boards of Appeal concerning the disclosure of general **structural** formulae (for instance T 7/86, OJ EPO 1988, 381) the Board regards a disclosure of a class of chemical compounds defined only by a general **complete** formula having at least two variable groups of elements (in the present case A_z and B_x) as not being equivalent to a specific disclosure of each of the individual compounds which would result from the combination of all possible variants within such groups.
- 2.3 For the above reason the Board finds that the compounds defined in claim 4 of the present request are novel with regard to the state of the art disclosed in document D3. Claim 5 is dependent on claim 4, and defines particular stoichiometrical compositions of the compounds claimed in claim 4, and is therefore also novel having regard to document D3.
3. For the reasons set out in detail above, the facts on which the refusal of the present application was based in the decision of the Examining Division, do not prejudice the grant of a European patent on the basis of claims 1 to 10 of the present request as filed on 9 April 1996 and as further amended on 13 June 1996.
4. The amended wording of claim 1 of the present request, wherein $y=0$ is explicitly excluded, now avoids the objection of double patenting with regard to document EP-A-0 324 661 (D2); see the notification of the Examining Division dated 22 January 1993, paragraph 3.

5. In the Board's view the remaining documents cited in the European Search Report do not prejudice the novelty of the subject-matter of the claims of the present request.
6. The communications of the Examining Division on file clearly show that the present application has not yet been examined by the Examining Division with respect to all of the requirements of the EPC: in particular the question of inventive step has yet to be examined. Therefore, the Board has decided to remit the case to the Examining Division for further prosecution on the basis of the claims.

Order

For these reasons it is decided that:

1. The decision of the Examining Division is set aside.
2. The case is remitted to the first instance for further examination of the application on the basis of claims 1 to 10 as filed on 9 April 1996 with claim 9 as further amended on 13 June 1996.

The Registrar:

The Chairman:

M. Beer

G. D. Paterson

