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**D E C I S I O N**  
**of 28 May 2002**

**Case Number:** T 0383/00 - 3.2.3

**Application Number:** 91306958.9

**Publication Number:** 0470751

**IPC:** F25B 9/12

**Language of the proceedings:** EN

**Title of invention:**

Improvements in and relating to dilution refrigerators

**Patentee:**

Frossati, Giorgio, et al

**Opponent:**

Oxford Instruments (UK) Limited

**Headword:**

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**Relevant legal provisions:**

EPC Art. 54, 56

**Keyword:**

"Novelty (main request: no)"

"Inventive step (auxiliary request: yes)"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0383/00 - 3.2.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.3**  
**of 28 May 2002**

**Appellant:** Oxford Instruments (UK) Limited  
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**Representative:** Skone James, Robert Edmund  
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**Respondent:** Frossati, Giorgio  
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**Representative:** Hitchcock, Esmond Antony  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 8 February 2000  
rejecting the opposition filed against European  
patent No. 0 470 751 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

**Chairman:** C. T. Wilson  
**Members:** J. du Pouget de Nadaillac  
J. P. B. Seitz

## Summary of Facts and Submissions

- I. The appeal is directed against the decision dated 8 February 2000 of an opposition division of the European Patent Office, which rejected the opposition against the European patent EP-B-0 470 751.

Claim 1 of said patent reads as follows:

"A dilution refrigerator comprising a still (4) and a mixing chamber (6), the two being connected together by a heat exchanger (10) providing a low flow impedance path for fluid circulating between the still (4) and the mixing chamber (6), characterised in that the whole is made entirely of plastics material."

- II. In its decision, the opposition division held that, contrary to the opponent's opinion, the subject-matter of claim 1 was new and involved an inventive step, having in particular regard to the following documents:

D4: L. Del Castillo et al., "Improved Heat Exchange in Dilution Refrigerators by Use of Continuous Plastic Exchangers", pages 640 to 645, Vol. 4, Low Temperature, 13 Conference, 21 to 25 August 1972

D6: Copy of a letter dated 21 March 1990 from Cryogenic Consultants Limited to Dr. Alan Usher, the University of EXETER, Department of Physics, said letter being in fact an offer for sale of an ultra low temperature high field cryomagnetic system comprising u.a. a dilution refrigerator which is described in this paper and mentioned as being developed by Professor Giorgio Frossati, an

inventor cited in the patent in suit (the proprietor of the patent did not dispute that the contents of this letter were available to the public).

III. The appellant(opponent) filed the notice of appeal on 10 April 2000, paying the appeal fee at the same time. In the statement of grounds of appeal, which was received on 8 June 2000, it reiterated its objection that claim 1 was anticipated by the disclosure of D6.

In a letter which was received on 19 December 2000, the respondent, proprietor of the patent, contested that D6 referred to a refrigerator entirely made of plastic material.

IV. In response to a communication pursuant to Article 11(2) RPBA, in which the board of appeal expressed its provisional opinion, inter alia its doubt as to the novelty of the subject-matter of claim 1 in view of D6, the respondent indicated by a fax received on 23 May 2002 that it would not be represented at the oral proceedings and, without commenting on the arguments put forward in said communication, filed an auxiliary request, comprising a new set of eleven claims and an amended description.

Claim 1 of this auxiliary request reads as follows:

"A dilution refrigerator comprising a still (4) and a mixing chamber (6), the two being connected together by a heat exchanger (10) providing a low flow impedance path for fluid circulating between the still (4) and the mixing chamber (6), characterised in that the whole is made entirely of plastics material and the heat

exchanger comprises a bellows configuration formed of a plurality of annular discs (20) formed of plastics material foils, the inner and outer circumferences of adjacent discs (20) being joined in alternating succession to form the bellows (18)."

Dependent claims 2 to 11 concern further embodiments of the apparatus according to claim 1.

- V. Oral proceedings took place on 28 May 2002, without the respondent according to Rule 71(2) EPC. During these proceedings, a new document was submitted by the appellant, namely:

D12: EP-A-0 363 248.

- VI. The arguments of the appellant in writing and during the oral proceedings can be summarised as follows:

In the impugned decision, the first instance has placed undue emphasis on the words "available commercially", which appeared in item 4 of D6, and then in view of these words has deduced that the refrigerator disclosed in this prior art is not made entirely of plastics, although the same passage refers to the non-metallic construction of the refrigerator, completely eliminating problems with eddy current heating. Hence, D6 anticipates the subject-matter of claim 1 as granted.

The claims according to the auxiliary request should not be considered as admissible because they were very late-filed, namely filed less than one week before the date of the oral proceedings, although the respondent had plenty of time to file them before. The appellant

had not sufficient time to examine these new claims and to find new prior art documents which could be opposed to them. There is moreover no justification for this late-filing and the combination of features brought into the new claim 1 is quite new, being based u.a. on a dependent claim 5, which was not originally filed, so that this combination was not searched as such.

According to the patent in suit, the purpose of the bellows configuration is to obtain a heat exchange area as large as possible. This object is common for all heat exchangers and the solution itself is obvious. Depending on what is meant by the term "bellows", one can assume that Figure 1 of D4 shows a bellows configuration. D12, further, shows that a bellows can be included in a cooling device.

VII. In its written submissions the respondent essentially submitted the following arguments:

D6 indicates that it discloses the "first plastic dilution refrigerator available commercially". Other prior art documents mentioned by the appellant have shown that, until the date of D6 disclosure, dilution refrigerators only made during research works, hence not commercially available, were disclosed as being made partially of plastics. D6 therefore relates to the first such refrigerator which is commercially available, not to a refrigerator being entirely made of plastics material. Moreover, in D6, there is no further description as to which parts of the dilution refrigerator are made of plastics. The purpose of completely eliminating eddy current heating does not necessarily mean that the still is made of plastics. It can be a metallic still, which is located outside the

magnetic field, thus avoiding eddy current heating, as was the case in the dilution refrigerators according to the previous research works, which consequently solved this problem already. Therefore, the feature of additionally making the still from plastics cannot be unambiguously derived from D6.

None of the prior art documents cited by the appellant discloses a bellows construction of a heat exchanger.

VIII. The appellant requested the decision under appeal to be set aside and the European patent EP-B-0 470 751 to be revoked.

The respondent requested in writing the appeal to be dismissed and the patent to be maintained as granted or, subsidiarily, on the basis of the auxiliary request submitted on 23 May 2002, namely:

- Claims 1 to 11, filed on 23 May 2002;
- Description, column 1 to column 5, line 48, filed on 23 May 2002, and
- Figures 1 and 2 of the patent, as granted.

### **Reasons for the decision**

1. The appeal is admissible.
2. *Novelty of the subject-matter of claim 1 as granted (main request of the respondent) having regard to D6*

As indicated in the introductory part of this document, the major components of a dilution refrigerator system are separately described. In particular, item 3, the

cryostat, is distinguished from item 4, the dilution refrigerator **insert**. It is indicated in page 3 that the complete magnet assembly is designed for top loading into the cryostat and that further this magnet assembly is manufactured for dimensional compatibility with and to allow top loading of the dilution refrigerator insert. On the basis of this information, the skilled person would understand that the said "dilution refrigerator insert" is the unit, which usually is inserted into the cryostat, namely the unit which comprises the still, the heat exchanger, the mixing chamber and the inner vacuum can (briefly: IVC). This person moreover knows that the ancillary equipment, such as those mentioned in the two last paragraphs of page 4, are located externally to the cryostat and do not form part of the insert as such (see, for example, items 8 and 9). It seems consequently that the expression "dilution refrigerator" essentially concerns the subject-matter of item 4, namely the dilution refrigerator **insert**. Moreover, the fact that the magnet coils are loaded into the cryostat restricts the problems with eddy current heating with respect to the elements of the dilution refrigerator insert, and not to the ancillary equipment located externally of the cryostat. Apparently, in D6, the helium bath or helium insert, mentioned by the respondent (proprietor of the patent) in his reply (page 2, last paragraph) to the statement of grounds of appeal, is also distinguished from the dilution refrigeration insert.

D6, then, discloses a **plastic or non-metallic** dilution refrigerator, which "completely eliminates problems with eddy current heating of the refrigerator". In the decision under appeal, it is argued that the expression "first plastic dilution refrigerator" is to be seen in



connection with the words "available commercially", as given at the bottom of page 3. However, in D6, there are other passages in which similar expressions are used, but alone, that is to say without focusing on commercial purposes, see page 2 ("**all plastic** insert refrigerator"), and pages 3, 4 and 5 ("non-metallic (insert) refrigerator"). Thus, the person skilled in the art, reading these expressions and knowing, further, that for already more than fifteen years dilution refrigerator inserts with heat exchanger(s) and mixing chamber **made of plastic** were known, can only understand these expressions as meaning that, in addition to the heat exchanger and the mixing chamber, at least the still is also made of plastic. Item 4 seems clearly to emphasize that the development made by Professor Frossati concerns the non-metallic aspect of the insert, which eliminates problems with eddy current heating. If only the heat exchanger and the mixing chamber were made of plastic, as argued by the respondent, a new development would not exist.

Thus, the subject-matter of claim 1 as granted is disclosed by this document and consequently is not new (Articles 52 and 54 EPC).

3. *Allowability of the documents according to the auxiliary request*

3.1 As late-filed

This was the essential objection raised by the appellant as to the admissibility of these claims. Since they were filed six days before the date of the oral proceedings, and moreover without justifications for the late submission, the objection of the appellant

is understandable. However, it has to be seen that these new claims are a response to the negative provisional opinion of the board of appeal, which was annexed to the summons to oral proceedings and could have surprised the respondent since D6 was interpreted in a way different from that of the first instance in the impugned decision. Moreover, the criterion for allowing new claims is not only the time of filing, but also the obvious allowability of the amendments which are introduced. In many decisions of the board of appeals, amended claims were considered to be admissible even when filed shortly before or during the oral proceedings.

Claim 1 of the auxiliary request is a mere combination of granted claims 1, 2 and 5 and this combination merely relates to a further and technically easy aspect of the present invention, namely the bellows configuration of the heat exchanger, which is the main and sole feature of dependent claim 2 as granted. A combination of granted claim 1 with the features of the dependent claim 2, as granted, was clearly to be expected. The features of the granted claim 5, as such, do not seem to be of great importance, since they only explain how, in this particular invention, the bellows configuration is obtained and nothing more. They concern therefore only a particular embodiment of a bellows configuration. Thus, it cannot be said that a "new combination" was claimed. Moreover, during the examination proceedings, there was already a proposal from the applicant to claim in a main independent claim the combination of a dilution refrigerator made completely of plastics with the heat exchanger comprising a bellows configuration. Therefore, the filing of these new claims cannot be considered as

being surprising and, indeed, was expected by the appellant itself, since already in its grounds of opposition he stated that the use of a bellows configuration in a heat exchanger was well known in the art and reserved its right to cite additional documents to prove this. More than three years to find documents supporting this statement were then at its disposal. There is also no difficulty about an examination as to the formal allowability of these new claims, so that finally the board sees no valid reason to refuse these new claims.

It is also to be noted that a bellows configuration was claimed in dependent claim 2 as originally filed and that this dependent claim 2 is mentioned in the search report, so that, contrary to the appellant's view, this aspect of the invention was the subject-matter of a search, at least in the main technical field of the present invention, namely the refrigeration field.

Therefore, although late-filed, the new claims are admissible.

### 3.2 Compatibility with Articles 123 and 84 EPC

As already said, claim 1 of the auxiliary request is a combination of claims 1, 2 and 5, as granted. These claims are supported by the description as originally filed, in particular by the passage at the bottom of page 6 relating to the bellows configuration. Thus, said claim 1 complies with Article 123(2) and (3) EPC. This claim is moreover clear as such (Article 84 EPC). These issues were not contested by the appellant.

In the description, only the passage repeating the

wording of the granted claim 1 was deleted and replaced by a simple reference to the new claim 1.

Therefore, the documents according to the auxiliary request comply with the main formal requirements of the EPC.

4. *Patentability of the subject-matter of claim 1 according to the auxiliary request*

According to the description of the patent in suit, column 4, lines 32 to 34, "the bellows configuration provides a very large surface area whilst also providing a relatively low impedance path". Thus, starting from D6, the problem to be solved is to obtain a dilution refrigerator of the kind described in D6 with a greater heat exchange surface area and a low impedance path.

None of the prior art documents cited by the appellant discloses a dilution refrigerator having a heat exchanger, which comprises a bellows configuration:

D4, which was the sole document originally mentioned by the appellant against this particular feature of the present invention, discloses the use of plastics foils which are alternately plain or provided with channels and glued the one to the other for providing heat exchangers having a large exchange area for a required impedance. However, these foils are merely stacked one above the other, so that the board, interpreting the term "bellows" as usual, cannot see how a bellows configuration can be shown or suggested by Figure 1 of this document. It is to be noted that the author of this document, although being faced with the same

problem as the present invention, discloses another solution.

D12, submitted by the appellant during the oral proceedings before the board and thus being late-filed, is to be disregarded, since it is irrelevant: it first describes a cooling device for X-rays tubes and, thus, concerns a particular technical field which has nothing to do or has no similarity with dilution refrigerators, so that a person skilled in the art, looking for a solution to the above mentioned problem, would not have even considered this particular technical field.

Moreover, the only bellows mentioned in this document is a reduced part of a closure which maintains against the internal wall of the X-rays tube housing a latent heat material, which, together with the usual cooling fluid, helps to cool more quickly the device during its short operation periods by melting and absorbing immediately heat during these periods and, then, by solidifying during the rest of the time. The purpose of the bellows is merely to allow the closure to follow the change of volume of the material during this process. It has therefore no function in the heat exchange process itself, and, thus, cannot suggest to use bellows for improving a heat exchanger.

Thus, these documents lead to the conclusion that the subject-matter of claim 1 according to the auxiliary request is not only new under Article 54 EPC but, further, involves an inventive step within the meaning of Article 56 EPC. The appellant has not filed evidence proving that the use of bellows is common in the heat exchanger construction. Hence, the patent can be maintained on the basis of the amended documents.

**Order**

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

1. The decision under appeal is set aside.
  
2. The case is remitted to the first instance with the order to maintain the patent as amended in the following version:

Claims 1 to 11 and the description filed together as the auxiliary request on 23 May 2002, together with the Figures as granted.

The Registrar:

The Chairman:

A. Counillon

C. T. Wilson