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Bezeichnung der Erfindung: Storage arrangements for nuclear fuel elements
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : G21C 19/06

ENTSCHEIDUNG / DECISION

vom / of / du 9 March 1989

Anmelder / Applicant / Demandeur : The English Electric Company Limited (GB)

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant : Nukem GmbH (FRG)

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Articles 100(a) and 102(3) EPC

Schlagwort / Keyword / Mot clé : "Main, second, third and fourth auxiliary requests: Inventive step (no).
First auxiliary request: Clarity (no)"

Leitsatz / Headnote / Sommaire

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Case Number : T 66/88

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 9 March 1989

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Decision under appeal :
Decision of the Opposition Division of the European Patent Office dated 9 September 1987 revoking European patent No. 0 061 819 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : K. Lederer
Members : E. Turrini
G.D. Paterson

Summary of Facts and Submissions

I. The Appellant (Patentee) is owner of European patent No. 0 061 819 (application number 82 300 167.2).

II. The Respondent (Opponent) filed opposition against the European patent on the ground that its subject matter is not patentable within the terms of Articles 52 to 57 EPC. This statement was based inter alia on the following documents:

GB-A-1 583 303 (D1) (equivalent to DE-A-2 711 405),
GB-A-1 018 618 (D3) and
GB-A-2 046 162 (D6) (equivalent to DE-A-2 913 540).

III. The Opposition Division revoked the patent on the ground of lack of inventive step in the subject-matter of Claim 1.

IV. The Appellant lodged an appeal against the decision.

V. Oral proceedings were held during which the Respondent explained that he is a potential licensee of the patent in suit and he supports now the point of view of the Appellant.

At the end of the oral proceedings both the Appellant and the Respondent requested that the decision under appeal be set aside and that the patent be maintained

- as main request, with the claims as granted,

- as first auxiliary request, with Claim 1 amended as in the grounds of appeal filed on 23 March 1988,

- as second, third and fourth auxiliary requests, with the claims handed over during oral proceedings on 9 March 1989.

VI. Claim 1 of the main request reads as follows:

"A storage arrangement for nuclear fuel comprising a plenum chamber (1) having a base (2) pierced with a plurality of openings, with respective containers (3) extending downwards therefrom, the plenum chambers forming an air-filled enclosure associated with an exhaust system (10, 11, 12) for exhausting air from the enclosure through filters (12) so as to maintain the interior of the enclosure at sub-atmospheric pressure, and the arrangement including means (18, 14, 15, 16) for producing a flow of cooling fluid over the exterior of the containers, characterised in that each container comprises an open-topped tube (3) sealed to a respective opening so as to form a fixed part of the storage arrangement and extending downwards into a further chamber (13), the plenum chamber (1) and the interiors of the tubes constituting a common storage volume isolated from the further chamber (13), said further chamber, having at least one lower opening (14) and at least one upper opening (15) located adjacent opposite sides of the chamber, and communicating with separate upwardly extending ducts (18, 16) which are open to the atmosphere at spaced lower and upper positions respectively, such that air is caused to flow across the chamber and hence over the tube surfaces by a natural thermosyphon action, and the arrangement incorporating means for transferring fuel into and from the tubes through the roof of the plenum chamber."

Claims 2 to 5 are dependent on Claim 1.

VII. Claim 1 of the first auxiliary request corresponds to Claim 1 of the main request amended as follows:

inserting after "(13)", in line 32 of column 5 of the patent specification, the words "the height of the plenum chamber (1) being small compared with the height of the further chamber (13),", and inserting after "flow" in line 42 of column 5 of the patent specification, the word "transversely".

Claims 2 to 5 are dependent on Claim 1.

VIII. Claim 1 of the second auxiliary request corresponds to Claim 1 of the main request amended as follows:

substituting in line 21 of column 5 of the patent in suit the word "chambers" with "chamber", and inserting after "through" in line 46, column 5 of the patent specification the expression "penetrations in".

Claims 2 to 5 are dependent on Claim 1.

IX. Claim 1 of the third auxiliary request corresponds to Claim 1 of the main request amended as follows:

substituting in line 21 of column 5 of the patent specification, the word "chambers" with "chamber", and

adding at the end of the claim after cancellation of the point, the following wording:

"characterised further in that the roof (4) of the plenum chamber (1) comprises a plate supported for sliding movement on the side walls (7) of the plenum chamber, and having a series of penetrations (5) less than the number of storage tubes, each of the penetrations normally being

closed by a plug (6), and the degree of movement of the plate and the positions of the penetrations being such that the plate is movable to a position in which a penetration is immediately over a selected storage tube, to allow fuel to be placed into or removed from the tube by a transfer mechanism located above the plenum chamber."

Claims 2 to 4 are dependent on Claim 1.

X. Claim 1 of the fourth auxiliary request corresponds to Claim 1 of the main request amended as follows:

substituting in line 21 of column 5 of the patent specification, the word "chambers" with "chamber",

inserting after "13", in line 32 of column 5 of the patent specification, the words "the height of the plenum chamber (1) being less than the height of the further chamber (13), and",

inserting after "flow" in line 42 of column 5 of the patent specification, the word "transversely", and

inserting after "through" in line 46 of column 5 of the patent specification, the expression "penetrations in".

Claims 2 to 5 are dependent on Claim 1.

XI. The Appellant supported his request essentially by the following arguments:

The subject-matter of the patent in suit includes a combination of features with interrelated functions so that it is not possible to examine the features separately one from the others in evaluating the inventive step.

The vertical disposition of the storage tubes sealed at the roof of the plenum chamber has the advantage of inserting and extracting the fuel vertically so as to avoid any load to the side walls of the tubes.

The prior art does not help in choosing this solution. Indeed, document D1 indicates a solution with vertical tubes, but this solution was not considered satisfactory from the cooling point of view (cf. document D6, page 1, lines 85 to 87) and instead of it a horizontal tube solution was proposed (cf. document D6, Figure 2), i.e. there was a prejudice in disposing the tubes in the vertical position because of lack of efficient cooling. The invention overcomes said prejudice by realising a storage arrangement which, while keeping a satisfactory transversal flow of cooling air, allows a vertical disposition of the tubes. This is obtained by locating the input and output openings of the further chamber at opposite sides of said chamber and communicating with separate ducts which communicate with the atmosphere at spaced different levels.

The skilled man could not deduce these features even from prior art document D3, since said document describes a storage arrangement in which the space over the tubes is kept at a pressure higher than the pressure in the cooling flow room, i.e. the storage arrangement of document D3 is not comparable with that of document D1 or D6. Furthermore, in document D3 the air flows radially in the transverse direction so that flow instabilities are generated due to the increasing flow cross-section in the direction of the air motion.

Another important feature of the patent in suit is the presence of means for transferring vertically the fuel

elements into and from the tubes through the roof of the plenum chamber, which allows the plenum chamber to be made shallow, and thus allows the electric power necessary for evacuating the plenum chamber to be reduced.

This is not the case for the arrangement according to document D3, where the fuel elements cannot be transferred merely in the vertical direction from the vertical tube 21 to the storage tubes 18, but require a more complicated movement in the conical plenum chamber 19.

For all these reasons, the presence of an inventive step should be acknowledged.

XII. The Respondent stressed the position of the Appellant by fully supporting his arguments.

He emphasised inter alia that none of the prior art documents suggests fuel transfer means similar to those proposed by the invention in suit. E.g. the space (19) over the tubes described in document D3 needs to have at least the height of a fuel element, the solution being therefore completely different from that of the invention in suit.

He also emphasised that a combination of documents D1 and D3 is not possible, due to their different subject-matter. In this context, the Respondent drew attention to the fact that, while in document D1 the plenum chamber is kept under vacuum, in document D3, the chamber over the tubes is kept at a pressure higher than the atmosphere pressure, this solution allowing the storage tubes to be filled with cooling liquid.

The Respondent concluded that the combination of features of the patent in suit shows clearly the presence of an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. Main request.

2.1 There is no formal objection under Article 123(2) EPC to the current version of claims and specification.

2.2 Novelty.

2.2.1 Document D1 discloses a storage arrangement for nuclear fuel (description: page 1, lines 9 to 14) comprising a plenum chamber (10) having a base (3) pierced with a plurality of openings (Figure 1), with respective containers, i.e. cans (4), extending downwards therefrom, the plenum chamber forming an air-filled enclosure associated with an exhaust system for exhausting air from the enclosure through filters so as to maintain the interior of the enclosure at sub-atmospheric pressure (description: page 2, lines 64 to 75), and the arrangement including means (5, 6, 7) for producing a flow of cooling fluid over the exterior of the containers (4). Each container (4) comprises an open topped tube sealed to a respective opening (Figure 1; description: page 2, lines 40 to 42) extending downwards into a further chamber (9), the plenum chamber (10) and the interiors of the tubes constituting a common storage volume isolated from the further chamber (9) (description: page 2, lines 40 to 46 and 49 to 53), said further chamber (9) having at least one lower opening (5) and at least one upper opening (6),

and communicating with separate upwardly extending ducts (Figures 1 and 2; description: page 2, lines 25 to 29) open to the atmosphere, such that air is caused to flow across the further chamber and hence over the tube surfaces by a natural thermosyphon action (description: page 1, line 94 to page 2, line 5), the arrangement incorporating means for transferring fuel into and from the tubes through the plenum chamber (description: page 2, lines 54 to 68).

Thus, the subject-matter of Claim 1 differs from the storage arrangement according to document D1 in that:

- the open-topped tubes form a fixed part of the storage arrangement;

- the lower and upper openings are located adjacent opposite sides of the further chamber;

- the extending ducts open to the atmosphere are spaced at lower and upper positions respectively; and

- the means for transferring fuel into and from the tube effect the transfer through the roof of the plenum chamber.

2.2.2 Document D3 describes a storage arrangement for nuclear fuel (description: page 1, lines 9 to 12) comprising a plenum chamber (19) having a base (16) pierced with a plurality of openings (Figure 2), with respective containers (18) extending downwards therefrom, the plenum chamber forming an enclosure, the arrangement including means (24, 25, 26, 32, 33, 34, 36) for producing a flow of cooling fluid over the exterior of the containers. Each container comprises an open-topped tube (18) sealed to a respective opening (17) so as to form a fixed part of the

storage arrangement (description: page 1, lines 51 to 61) and extending downwards into a further chamber (13 in Figure 1, description: page 1, lines 45 to 47), the plenum chamber and the interior of the tubes constituting a common storage volume isolated from the further chamber, said further chamber having one lower opening (the bottom of central passage 34) and one upper (annular) opening (at the levels of line II-II in Fig. 1) located adjacent opposite sides (central passage and periphery) of the chamber, and communicating with separate upwardly extending ducts (25, 26 plus "chimney") which are open to the atmosphere (description: page 1, lines 72 to 76) at spaced lower and upper positions respectively (Figure 1), such that air is caused to flow across the chamber and hence over the tube surfaces by a natural thermosyphon action (description: page 1, lines 13 to 28), and the arrangement incorporating means for transferring fuel into and from the tubes through the roof (12) of the plenum chamber (19) (description: page 2, lines 33 to 37).

Thus, the subject-matter of Claim 1 distinguishes over the storage arrangement according to document D3 in that the enclosure of the plenum chamber is air-filled and is associated with an exhaust system for exhausting air from the enclosure through filters so as to maintain the interior of the enclosure at sub-atmospheric pressure.

On the contrary, the enclosure (19) of document D3 is filled with CO_2, and maintained at a pressure slightly higher than that of the atmospheric pressure so that the storage tubes can contain cooling liquid.

2.2.3 The remaining cited documents do not come closer to the subject-matter of Claim 1.

2.2.4 For these reasons, the subject-matter of Claim 1 is considered to be novel in the sense of Article 54 EPC.

2.3 Inventive step.

2.3.1 The nearest prior art, in the Board's view, is constituted by the storage arrangement described in document D1.

Starting from the disclosures of said document, the technical problem to which the features of Claim 1 appear to afford a solution, is to simplify the fuel transfer to and from its final position in the tubes and to improve the effectiveness of the cooling system.

2.3.2 There can be seen no positive contribution to an inventive step in the recognition of the technical problem per se, since simplified operation and improved system effectiveness are common goals in any technical field. Furthermore, the need for an improved cooling system efficiency with reference to the cooling system of document D1, is also emphasised in document D6 (description: page 1, lines 92 to 108).

2.3.3 As far as the solution of said technical problem is concerned, the skilled man would look at prior art storage arrangements for nuclear fuel and he would indeed be expected to consider document D3 because this document concerns also storage of fuel elements after removal of the elements from the core of the reactor though within the reactor.

The skilled man would find in document D3 the teaching of sealing the open-topped tubes so as to form a fixed part of the storage arrangement and of transferring the fuel into and from the tubes through the roof of the plenum chamber, simplifying in this way the storage operations.

Furthermore, he would be taught by document D3 to locate the lower and upper openings adjacent opposite sides of the chamber and to space the upwardly extending ducts at spaced lower and upper positions respectively, thus improving the cooling efficiency.

He would therefore obtain the subject-matter of Claim 1 without the need of any inventive ingenuity.

2.3.4 The Board cannot share the view that there was any prejudice in disposing the tubes in the vertical position.

It is true that document D6 outlines that the flow of the cooling air in the arrangement according to document D1, whereby the tubes are positioned vertically, is not satisfactory and that document D6 suggests inter alia an horizontal disposition of the tubes (but without excluding vertical disposition, see Fig. I) together with special arrangement of the air in- and outlets.

Such suggestion cannot deter the skilled person from seeking other solutions, with the tubes in a vertical position and indeed document D3 suggests such a solution.

The advantage pointed out by the Appellant that the flow of air through the further chamber according to claim 1 is substantially constant whereas it is decreasing from the center towards the periphery in the arrangement known from D3, is considered as a bonus which automatically occurs when transferring the cooling flow principle known from D3 where it is applied to the annular form of the further chamber, to a rectangular form known from D1.

Furthermore, the Board of Appeal sees no reason why the skilled man would be discouraged to apply the teaching of document D3 to the arrangement of document D1. The feature that the upper space (plenum chamber) in connection with the tubes described in document D3 is at a pressure higher than the atmospheric pressure, does not hinder applying features disclosed in document D3 to the arrangement of document D1 as before mentioned.

Finally, the fact that in document D3 the transfer of fuel through the roof of the plenum chamber needs a complicated movement in order to pass the fuel element from the discharge tube 21 to the storage tubes 18, is not in contradiction with the subject-matter of Claim 1 of the patent in suit as defined by the feature claimed in the last three lines of the claim.

2.3.5 For these reasons, the subject-matter of Claim 1 of the main request is considered to lack an inventive step within the meaning of Article 56 EPC and said claim is therefore not acceptable (Article 52(1) EPC).

Claims 2 to 5 are not acceptable either because of their dependency on Claim 1.

3. First auxiliary request.

3.1 There is no objection under Article 123(2) EPC of Claim 1, since the additional features with respect to the wording of Claim 1 of the main request are unambiguously deducible from Figure 1, even if the storage arrangement is present in diagrammatic form.

3.2 The feature of Claim 1 that the height of the plenum chamber is small compared with the height of the further chamber, is considered lacking clarity insofar as the

expression "small compared" is vague, i.e. it does not define unambiguously the range of values of the ratio between the height of the plenum chamber and the height of the further chamber.

3.3 While lack of clarity is not a ground for opposition, an amended patent has to meet the requirements of the EPC (Article 102(3) EPC) and thus also the requirements of Article 84 EPC.

3.4 For these reasons, Claim 1 of the first auxiliary request is not acceptable.

The same applies to Claims 2 to 5 due to their dependency on Claim 1.

4. Second auxiliary request.

4.1 The introduction in the wording of Claim 1 of the main request of a reference to the "penetrations" does not infringe Article 123(2) EPC, the penetrations being mentioned in the original description.

4.2 However, the introduction of such feature does not substantially change the reasoning utilised in judging whether the subject-matter of Claim 1 of the main request involves an inventive step.

It is admitted that the arrangement according to document D3 shows only one penetration. However, the utilisation of more than one penetration is considered a working option.

4.3 Thus, the subject-matter of Claim 1 of the second auxiliary request lacks an inventive step in the sense of Article 56 EPC and said claim is therefore not acceptable under Article 52(1) EPC.

Claims 2 to 5 are not acceptable because of their dependency on Claim 1.

5. Third auxiliary request.

5.1 There is no objection under Article 123(2) EPC to Claim 1, since its subject-matter is a mere combination of Claims 1 and 2 of the patent specification (cf. section 2.1 of the present decision).

5.2 As far as the inventive step of the subject-matter of Claim 1 is concerned, the additional features with respect to Claim 1 of the main request refer to details concerning the roof of the plenum chamber and the transfer mechanism for fuel elements. These additional features are usual in storage arrangements for nuclear fuel and their combination with the other features of the claim is considered routine for the skilled man.

By way of example, reference is made to prior art document GB-A-2 061 798 mentioned in the patent specification, where said additional features are substantially mentioned. Indeed, the embodiment of Figure 1 of said document shows an enclosure (1, 2, 3) kept at sub-atmospheric pressure (description: page 2, lines 70 and 71) for storing fuel element assemblies (6), whereby the roof (3) comprises a plate supported for sliding movement (arrows A) on the side walls (2), and having a series of penetrations (4) whose number can be less than the number of fuel element assemblies, each of the penetrations normally being closed by a plug (5), and the degree of movement of the plate (3) and the positions of the penetrations being such that the plate is movable to a position in which a penetration is immediately over a selected fuel element assembly (6), to allow fuel to be

placed into or removed by a transfer mechanism (7) located above the roof (description: page 2, lines 100 to 118).

5.3 For these reasons, the subject-matter of Claim 1 of the third auxiliary request is considered to lack an inventive step within the meaning of Article 56 EPC and said claim is therefore not acceptable under Article 52(1) EPC.

The same applies to Claims 2 to 4 due to their dependency on Claim 1.

6. Fourth auxiliary request.

6.1 The features of Claim 1 concerning the transverse flow and the penetrations in the roof are disclosed in the original application as already discussed before. Also the feature that the height of the plenum chamber is less than the height of the further chamber is considered to be deducible from Figure 1. There is therefore no objection under Article 123(2) EPC.

6.2 Concerning the inventive step, firstly the skilled man would be taught by document D3 to provide a transverse flow (Figure 1: arrows indicating the flow direction) in order to improve the cooling effectiveness. Secondly, the skilled man having in mind the storage arrangement of document D3 and wishing to reduce the height of the plenum chamber, e.g. for space reasons, would renounce the advantage of having only one penetration by reducing the height of the chamber and transferring the charge/discharge equipment outside the plenum chamber, obtaining in this way the features of Claim 1 concerning the height of the plenum chamber and the penetrations. A combination of the above-mentioned additional features of Claim 1 of said auxiliary request with the subject-matter of Claim 1 of the main request is considered routine.

6.3 For the foregoing reasons the subject-matter of Claim 1 of the fourth auxiliary request does not involve an inventive step in the sense of Article 56 EPC and the claim does therefore not define patentable subject-matter (Article 52(1) EPC).

The same is valid for Claims 2 to 5 because of their dependency on Claim 1.

7. Accordingly, neither the maintenance of the impugned patent as granted nor the maintenance of the patent in one of the amended forms as requested by the Appellant in his second, third or fourth auxiliary request, are allowable under Article 100(a) EPC.

The maintenance of the patent in amended form as requested by the Appellant in his first auxiliary request is not allowable because it does not even meet the requirements of Article 84 of the EPC, as required inter alia by Article 102(3) EPC. Therefore, the question of inventive step of its subject-matter need not to be answered.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

F. Klein K. Lederer