BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

A		B		C	X

File Number: T 43/92 - 3.4.1

Application No.: 86 104 068.1

Publication No.: 0 196 598

Title of invention: Spacer grid of a nuclear reactor fuel assembly

Classification: G21C 3/34

D E C I S I O N
of 2 December 1992

Applicant: Westinghouse Electric Corporation

Opponent: Siemens Aktiengesellschaft, Berlin und München

Headword:

EPC

Keyword: "Inventive step (no)"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 43/92 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 2 December 1992

Appellant : (Opponent)
Siemens Aktiengesellschaft,
Berlin und München
Postfach 22 16 34
W-8000 München 22 (DE)

Representative :
Kübel, Martin (authorised employee)
Siemens Aktiengesellschaft

Respondent : (Proprietor of the patent)
Westinghouse Electric Corporation
Westinghouse Building
Gateway Center
Pittsburgh
Pennsylvania 15222 (US)

Representative :
Patentanwälte
Dipl.-Ing. R. Holzer
Dipl.-Ing. (FH) W. Gallo
Ludwigstrasse 26
W-8900 Augsburg (DE)

Decision under appeal :
Decision of the Opposition Division of the European Patent Office dated 12 November 1991 rejecting the opposition filed against European patent No. 0 196 598 pursuant to Article 102(2) EPC.

Composition of the Board :

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

Summary of Facts and Submissions

I. The Respondent is owner of European patent No. 0 196 598.

Claim 1 as granted reads as follows:

"1. A nuclear fuel rod spacer grid for laterally supporting the substantially parallel spaced and substantially cylindrical fuel rods in a nuclear fuel assembly and comprising a plurality of straps interleaved in an egg-crate-like manner to define fuel-rod receiving cells each of which is bounded by portions of said straps having formed thereon dimples and, opposite thereto, springs biased a fuel rod extending therethrough against the dimples, each of said dimples (46) and each of said springs (48) having a surface (70; 56) which bears against the peripheral surface of the fuel rod (18), characterized in that said surface (70; 56) of each of said dimples and each of said springs is substantially part-cylindrical and contoured so as to cradle the fuel rod."

Claims 2 to 8 are dependent on Claim 1.

II. This patent was opposed by the Appellant on the ground of lack of inventive step inter alia in view of the prior art which can be derived from documents:

D3: DE-A-2 001 327, and
D4: DE-C2-2 345 878.

During the opposition procedure the Appellant filed further documents, among them being also document

D5: DE-A-2 111 349.

III. The Opposition Division rejected the opposition on the ground that none of the six documents cited by the Appellant discloses the central idea of the patent under appeal, i.e. to minimise a rubbing action between the fuel rod cladding and the grid springs and dimples (fretting) by contouring the surface of each spring and each dimple so as to "cradle" the fuel rod, wherein the claimed term "cradle" implies the existence of larger areas of contacts between the fuel rod and the dimple or spring surface according to the description of the patent under appeal, col. 2, lines 16-23, and col. 5, lines 8-16. Document D3 describes a spacer grid of another kind and concerns the problem of destructive contact between grid and fuel rods solved by minimising their contact area. Document D4 does not disclose the characterising features of the invention as claimed. Document D5 was disregarded by the Opposition Division in accordance with Article 114(2) EPC:

IV. The Appellant lodged an appeal against the decision of the Opposition Division.

V. In a communication accompanying a summons to oral proceedings the Board introduced document D5 into the proceedings under Article 114(1) EPC and informed the parties of facts on which the Board based its provisional view that the subject-matter of Claim 1 might possibly be regarded as obvious in view of the cited documents.

VI. Oral proceedings were duly held on 2 December 1992 at the end of which the Appellant (Opponent) requested that the decision under appeal be set aside and that the European patent No. 0 196 598 be revoked.

The Respondent (Patentee) requested that the appeal be dismissed and that the patent be maintained as granted.

VII. In support of his request, the Appellant made essentially the following submissions:

(a) As demonstrated by several of the cited documents including document D4, grids as defined by the wording of the preamble of Claim 1 of the patent under appeal represents state of the art which is very widely applied in the field of nuclear fuel assembly.

(b) According to the characterising portion of Claim 1 of the patent under appeal the flat bearing surfaces of the conventional dimples and springs are changed into "part-cylindrical" surfaces which - according to the technical meaning of the claimed term "cradle" as disclosed in the description of the patent under appeal - is furthermore contoured so as to provide a locating face close to the fuel rod. These bearing surfaces have primarily the technical aim to position a fuel rod in the centre of a cell and at such a distance from the cell walls that an effective cooling of the rod can be realised.

(c) The use of such a part-cylindrical bearing surface which provides a locating face close to the fuel rod is known for dimples from document D3, Fig. 3 and page 2, line 26 to page 3, line 2. Fig. 3 of document D3 discloses radii of curvature for the peripheral surfaces of dimple and fuel rod which radii are identical to those claimed in the embodiment according to Claim 2 of the patent under appeal. Though document D3 discloses a different type of grid, a skilled person clearly derives from Fig. 3 the advantageous positioning properties of a part-cylindrical bearing surface close to the rod with its bearing forces directed to the centre of the rod.

(d) The size of a bearing surface for a fuel rod is generally known to be a compromise between an optimal positioning requiring a large locating face and an optimal cooling requiring a small locating face. Fretting - i.e. corrosion of the fuel rod cladding by a rubbing action between the rod and its positioning means - is a very old problem which was conventionally solved by appropriately thick cladding walls. The technical trend to having a prolonged service life of economically produced fuel rods without enforced wall thicknesses created the need for seeking a different solution of the problem of fretting. Since it is generally known in the art that a lower bearing pressure produces a lower amount of rubbed-off material, reducing the bearing pressure (for example at a constant mounting force directed against the fuel rod) by providing a larger area for the bearing surface would be obvious.

(e) Moreover, document D5 teaches on page 3, lines 22 to 24, that fretting often only appears until a close fitting (satte Anlage) between a resiliently mounted dimple and a fuel rod is achieved. Such a statement discloses the fact that fretting decreases with an increasing area of the bearing surface for the fuel rod, and renders as well the claimed "cradling" obvious.

VIII. The above submissions were contested by the Respondent who argued essentially as follows:

(a) The cited prior art does not hint at replacing the flat bearing surfaces of the dimples and springs of the spacer grid disclosed in document D4 by part-cylindrical surfaces which cradle the fuel rods in

the sense of conforming the bearing surfaces of dimples and springs to the tubular rod faces and thus creating instead of a line contact a bearing surface with a larger area as disclosed in the description of the invention, col. 2, lines 16-23, and col. 5, lines 8-16.

(b) The term "cradle" as used in the invention specifies the orientation of the part-cylindrical surface whereby the axis of the surface extending through the centre of the radius of curvature lies parallel to the longitudinal axis of the fuel rods. An equality of the radii of curvature of the faces of rod, dimple and spring would be too narrow a definition of the term, in particular in the case of the spring, which is able to conform to the rod face by elastical deformation.

(c) The part-cylindrical bearing surfaces 4 of dimples 3 in Fig. 3 of document D3 avoid jamming as a result of thermal expansion and are not intended to avoid the fretting caused by fuel rod vibrations. Moreover, the three-point bearing of the fuel rod by using only dimples in document D3 represents a totally different mounting concept, so that a skilled person would never think of using a part-cylindrical face of a dimple in a grid with dimples and springs such as disclosed in document D4.

(d) Though the problem of fretting and abraded cladding particles in the cooling circuit has been known for a long time and the teaching of document D3 was known for 15 years, only the inventor recognised the importance of providing a cradling part-cylindrical bearing surface as a means for solving the fretting problem. Such a long-felt need would clearly indicate

the presence of an inventive step in the subject-matter of Claim 1.

(e) The spacer grid disclosed in Fig. 3 of document D5 uses three dimples mounted on ring-shaped spring 22a only as an alternative. The term "satte Anlage" in document D5, page 3, line 23 does not mean a snug or close fitting but the opposite to a loose mounting. The rubbing action between the dimples and springs in document D5 creates **flat** bearing surfaces. Also the drawings of this document do not disclose part-cylindrical bearing surfaces, consistent with the fact that the fretting problem is solved differently, namely by enlarging the wall thickness of the cladding in the bearing region.

IX. At the conclusion of the oral proceedings, the decision was announced that the decision of the Opposition Division is set aside and that the European patent is revoked.

Reasons for the Decision

1. Inventive step

1.1 From the nearest prior art according to document D4 it is known in the wording of the preamble of Claim 1:

"A nuclear fuel rod spacer grid (see D4, 24 in Fig. 1) for laterally supporting the substantially parallel spaced and substantially cylindrical fuel rods (18 in Fig. 3) in a nuclear fuel assembly (10 in Fig. 1) and comprising a plurality of straps (28, 29 in Fig. 2) interleaved in an egg-crate-like manner (see slits 30 in Fig. 2 and column 3, line 51) to define fuel-rod receiving cells each of which is bounded by portions of said straps (see

Fig. 3) having formed thereon dimples (34 in Fig. 2 and 3) and opposite thereto, springs biased (32 in Fig. 2 and 3, col. 4, line 7) a fuel rod extending therethrough against the dimples, each of said dimples and each of said springs having a surface which bears against the peripheral surface of the fuel rod (Fig. 3, and springs 32 and dimples 60 in Fig. 9)."

1.2 Starting from the nearest prior art disclosed in document D4, the objective technical problem underlying the patent under appeal is to reduce the rubbing action between the fuel rod cladding and the grid springs and dimples, i.e. "fretting", caused by rod vibrations due to the coolant and/or moderator fluid flow in the reactor core; see the description of the patent under appeal, col. 1, lines 46 to 52, and col. 2, lines 12, 13 and 16-23. Both parties admitted that this problem has been known in the art for a long time; see paragraphs VII(d) and VIII(d). Hence, the formulation of the objective problem does not contribute to an inventive step in the subject-matter of Claim 1.

1.3 The above problem is solved according to the characterising part of Claim 1 by replacing the flat dimple and spring surfaces which bear against the peripheral surface of the fuel rod by "substantially part-cylindrical" surfaces which are "contoured so as to cradle the fuel rod", wherein this functional feature has the technical meaning of presenting to the fuel rods larger bearing surfaces, which are capable of distributing vibrational or shock-induced forces over larger areas, as disclosed in the description of the patent under appeal, col. 2, lines 19 to 21.

1.4 In the embodiment disclosed in Figure 3 of document D3 the dimple and the fuel rod have identical radii of curvature

as claimed in Claim 2 of the patent under appeal. The description of document D3, page 2, line 26, to page 3, line 2, teaches explicitly that between dimple and fuel rod a contiguous mating surface is created which corresponds to that "between a rotating shaft and a bearing shell". In the Board's view, it belongs to the skilled person's general knowledge that such mating surfaces are able to distribute vibrational or shock-induced forces over larger areas in the technical sense of the claimed term "cradle". Such an interpretation of the term "cradle" is also in line with the Respondent's definition of this term in para. VIII(b). For these reasons, the technical means claimed in the characterising part of Claim 1, i.e. a "substantially part-cylindrical" bearing surface which is "contoured so as to cradle the fuel rod" is held to be known from document D3 in respect of the dimples.

1.5 It is evident that fretting is caused by a relative movement between fuel rods and dimples and/or springs. Therefore it would be obvious to a skilled person that the fretting can be reduced primarily by avoiding this relative movement. In the nearest prior art according to document D4 it would therefore be necessary to prevent lateral sliding of the fuel rod along the flat bearing surfaces of dimples and springs. In the Board's view, a mere routine analysis of the forces occurring in the bearing shell according to Figure 3 of document D3 leads a skilled person to recognise -irrespective of the particular mounting system of the fuel rods in document D3 - that a replacement of the flat dimple surface in document D4 by the cradling part-cylindrical dimple surface of document D3 results in protruding cylindrical segments on both sides of the middle line, which segments by their geometrical shape impede lateral movement of the fuel rod in a direction normal to this middle line. Hence,

contrary to the Respondent's view in paragraph VIII(c) above, in the Board's view a skilled person is able to recognise that the cradling part-cylindrical contour of dimples such as disclosed in Figure 3 of document D3 represent also a technical means for impeding said sliding movement and thus for reducing fretting.

1.6 For the reasons indicated in paragraphs 1.4 and 1.5, making use of the dimple contour according to document D3 in the spacer grid disclosed in document D4 has to be regarded as obvious. In the Board's view, a skilled person is able to foresee on the basis of an analogous thinking that using the cradling part-cylindrical contour of document D3 not only for the dimples in the grid of document D4 but also for the springs, will reduce fretting also in the bearing region of the springs. An elastic deformation of a spring when cradling the fuel rod - as put forward by the Respondent in paragraph VIII(b) - is not disclosed in the patent under appeal and, for this reason, cannot support an inventive step underlying the subject-matter of Claim 1.

1.7 The above-shown obvious replacement of the flat bearing surfaces of dimples and springs in the grid of document D4 by the cradling part-cylindrical ones of document D3 will automatically transform for the technical purposes of reducing fretting via a geometrical impediment of the relative movement of the fuel rod the line of document D4 into a large area contact. In the Board's view, a skilled person only needs a basic knowledge of mechanics to foresee that (keeping constant the mounting force exercised on the fuel rod) such an enlargement of the bearing area reduces automatically the bearing pressure exercised on the cladding surface and leads automatically to a lower rate of rubbed-off material. Moreover - irrespective of the shape of the particular bearing faces

in the grid disclosed in document D5 (see paragraph VIII(e) above) - the Board regards that the teaching in document D5, page 3, lines 22-24, shows that reduction in fretting due to larger bearing areas was also known in the specific art of spacer grids for nuclear fuel rods. The term "satte Anlage" disclosed in document D5 clearly means "close or snugly fitting"; see as expert opinion R. Ernst: "Dictionary of Engineering and Technology" Vol. I, 4th edition, 1980, page 744. For these reasons, the Board is not able to follow the Respondent's view according to paragraph VIII(a) above.

1.8 Weighing probabilities, the Board regards it more likely that a cladding with a lower wall thickness in a nuclear fuel rod for a prolonged service life (see paragraph VII(d) above) is only a more recent constructional development requiring a skilled person to deviate from the conventional solutions and to reconsider the fretting problem. Thus, the Board does not share the Respondent's opinion that a long-felt need existed for the solution claimed in Claim 1; see paragraph VIII(d) above.

1.9 For the reasons set out in detail above, the subject-matter of Claim 1 is held to be the result of an analogous use of the cradling part-cylindrical bearing faces according to document D3 in the dimples and springs of the spacer grid disclosed in document D4. Therefore, in the Board's judgment, Claim 1 lacks an inventive step within the meaning of Article 56 EPC.

2. Claims 2 to 8 fall because of their dependency on an unallowable Claim 1.

Order

For these reasons, it is decided that:

The Decision of the Opposition Division is set aside.
The European patent is revoked.

The Registrar: The Chairman:

M. Beer G.D. Paterson