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**Datasheet for the decision
of 12 December 2008**

Case Number: T 0821/07 - 3.2.02

Application Number: 00948270.4

Publication Number: 1136578

IPC: C22C 16/00

Language of the proceedings: EN

Title of invention:

Zirconium alloy for nuclear fuel assembly

Patentee:

mitsubishi heavy industries, ltd., et al

Opponent:

FRAMATOME ANP

Headword:

-

Relevant legal provisions:

EPC Art. 123(2), (3)

Relevant legal provisions (EPC 1973):

EPC Art. 54, 56

Keyword:

"Novelty (no)"

"Inventive step (no)"

"Added subject-matter (yes)"

"Scope of protection enlarged (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0821/07 - 3.2.02

DECISION
of the Technical Board of Appeal 3.2.02
of 12 December 2008

Appellant: MITSUBISHI HEAVY INDUSTRIES, LTD.
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 15 March 2007
revoking European patent No. 1136578 pursuant
to Article 102(1) EPC 1973.

Composition of the Board:

Chairman: T. Kriner
Members: R. Ries
A. Pignatelli

Summary of Facts and Submissions

I. This appeal is against the decision of the opposition division dated 15 March 2007 to revoke European patent No. 1136578. The opposition division held that the subject matter of claim 1 as granted and according to the auxiliary request then on file lacked novelty with respect to the technical disclosure of document

O2: US-A-4 992 240.

As compared with the alloys known from document O2, no additional technical effect was identified that could be attributed to the composition of the Zr alloy defined in claim 1 as granted and according to the auxiliary request then on file.

II. The appellant (patent proprietor) lodged an appeal against this decision. The appeal was received at the European Patent Office on 15 May 2007 and the appeal fee was paid on the same date. The statement setting out the grounds of appeal was received on 23 July 2007 and included in the annex two amended sets of claims (1st and 2nd auxiliary requests: claims 1 and 2 amended).

III. In addition to document O2, the following prior art has been referred to on appeal:

O4': JP-A-63-213629 (translation into French)

O5': JP-A-63-33535 (translation into French)

IV. Oral proceedings were held on 12 December 2008 at the end of which the following requests were made:

The appellant (patent proprietor) requested that

- the decision under appeal be set aside,
- the patent be maintained as granted (main request)

or

on the basis of the claims of one of the auxiliary requests 1 and 2 filed with the statement of grounds of appeal on 23 July 2007 or of the auxiliary request 3 filed on 12 November 2008.

The respondent (opponent) requested that the appeal be dismissed.

V. Independent claim 1 as granted reads as follows:

"1. Zr alloy for nuclear fuel assembly, comprising Fe, Cr, Sn and Nb and further comprising O positively and, wherein said Zr alloy comprises:

Sn of 0.2 to 0.6 weight%;
Nb of 0.45 to 0.55 weight%;
Fe of 0.27 to 0.33 weight%;
Cr of 0.36 to 0.44 weight%; and
O of 0.10 to 0.16 weight%,
the balance being Zr and inevitable impurities, which impurities comprise Ta and/or 0.1 weight% or less of Ni."

Claim 1 of the first auxiliary request further includes the wording (in bold letters):

"1. Zr alloy... less Ni, **wherein at least one of Sn and Nb exists in a solid-solution state and the total amount of Sn and Nb is 0.7 weight% or more.**"

In addition to the first auxiliary request, claim 1 of the second auxiliary request includes the feature (in bold letters):

"1. Zr-alloy...or more, **and wherein the Nb content is larger than the Sn content.**" which is replaced in claim 1 of the third auxiliary request by:
"and wherein Sn is substantially 0 weight%."

VI. The appellant's arguments are summarized as follows:

Document O2 representing the closest prior art disclosed the composition of a Zr alloy overlapping the claimed alloy. The degree of overlap for Sn, Nb, Fe and Cr was, however, small and the ranges selected for these constituents were narrow. In particular with regard to the Nb content in the range of 0.45 to 0.55 wt%, the claimed Zr alloy constituted a novel selection from the Zr-alloys disclosed in document O2. The skilled person would derive from the general teaching of O2 (Nb: 0 to 0.5 wt%) in combination with the preferred embodiments, i.e. the examples summarised in Table 1, that the Nb content should be kept low or be even zero, as shown in example 9. Consequently he would not take into account Nb contents up to the upper limit of 0.5 wt%, as required for the claimed alloy. Moreover, the Nb and iron contents of comparative example 10 as the closest structural composition fell outside the claimed ranges. Starting from the example 10, an increase of the amounts of both Fe and Nb was needed which meant that a multiple selection was necessary to arrive at the zirconium alloy claimed in the patent. Moreover, a technical effect could be attributed to the claimed Zr alloy which exhibited an improved corrosion

resistance and low hydrogen pick-up rates while the endurance (strength) and dimensional stability of the alloy were maintained. Although this combination of properties was not disclosed in the patent specification, it was sufficiently demonstrated by the test results submitted as samples A to D and showing optimum overall results for niobium contents of about 0.5%. This optimum combination of properties was neither derivable from document O2 alone nor from the combined technical teaching of documents O2 and O4' which proposed the addition of about 0.06% Nb to improve general corrosion resistance, or any other document so that a skilled person was not motivated to restrict the Nb-range to 0.45 to 0.55% as claimed in the patent. Hence the Zr alloy defined in claim 1 as granted represented a novel and purposive selection from the prior art disclosed in document O2.

The same reasoning applied to claim 1 of the first to third auxiliary requests which required that the total of (Sn+Nb) was equal to 0.7 % or more. This elemental limitation which helped to suppress a decrease in strength was not disclosed in the known prior art. Therefore, the claimed subject matter was novel. The feature in claim 1 of the second auxiliary request that the Nb-content was larger than the Sn-content was derivable from paragraph [0013] disclosing a ratio of Sn/Nb in the range of 0 to 100. Sn being "substantially 0" actually meant "about 0.2% Sn" and had a basis in paragraph [0019] of the patent specification. The amendments to claim 1 of the second and third auxiliary requests thus satisfied Articles 123(2) and (3) EPC, respectively. None of the cited documents taken individually or in combination would prompt a skilled

person to choose a total of $(\text{Sn}+\text{Nb}) \geq 0.7$ to improve the alloy's endurance. An inventive step was therefore given.

VII. The respondent's arguments are summarized as follows:

The zirconium alloy set out in claim 1 of the main and first auxiliary requests did not represent a novel selection from the Zr-alloy known from O2 or O4'. The amendments to claim 1 of the second and third auxiliary requests are not allowable since they contravene the requirements of Article 123(2) and 123(3) EPC, respectively. None of the requests was therefore allowable.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 The patent under consideration relates to a Zr-base alloy provided for structural members in a nuclear fuel assembly which exhibit a high endurance (relative strength tested at 385°C), a high corrosion resistance, low hydrogen absorption capacity and in-reactor thermal stability. In particular, an improvement of the alloy's corrosion resistance while maintaining its strength (endurance) is aimed at (see the patent, paragraphs [0006] to [0009]; column 4, lines 40 to 43). To meet this combination of properties, the claimed alloy comprises specific amounts of Sn, Nb, Fe, Cr and Oxygen within the elemental ranges defined in claim 1.

2.2 Like the patent at issue, document O2 is concerned with the composition of a Zr-SnFeCrNb alloy that is designed for nuclear reactor components (see O2, column 2, lines 37 to 42). The known Zr alloy is said to reduce the rate of corrosion due to the reaction with high temperature water or steam while simultaneously preventing a decrease in mechanical strength which is given in terms of the relative yield stress determined at 385°C (see O2, column 3, lines 9 to 22, column 4, lines 1 to 5; Table 1).

In the following comparative table, the compositions of the claimed Zr-alloy and that given in document O2 are summarized:

Element	patent-at-issue (in wt%)	O2: US-A-4 992 240 (in wt%)	O2, Sample 10
Sn	0.2 to 0.6	0.4 to 1.2	0.57
Nb	0.45 to 0.55	up to 0.5	0.206 ↓
Fe	0.27 to 0.33	0.2 to 0.4	0.23 ↓
Cr	0.36 to 0.44	0.1 to 0.6	0.40
O	0.10 to 0.16	0.134 to 0.171 (*)	0.148
Ta and/ or Ni	less than 0.1		
Zr	balance	balance	balance

(*) It is noted that the oxygen content is not disclosed as a range but the examples given in Table 1 comprise oxygen contents between 0.134% (sample 2) and 0.171% (sample 9).

As to guarantee a relative yield stress of at least 1, the sum of the weight proportions of the components of the known alloy need to satisfy the formula:

$$0.18 \cdot \%Sn + 0.15 \cdot (\%Fe + \%Cr) + 0.13 \cdot \%Nb + 4.72 \cdot \%O \geq 0.95$$

(see O2, column 2, line 50 to column 3, line 3; see Figure 3). It is also noted that the composition of comparative sample 10 only results in a value of 0.92 for the above formula and, in consequence thereof, reaches a relative yield stress of only 0.94 rather than 1.0 as desired.

- 2.3 It was common ground to the parties and to the Board that an overlap exists between the composition of the claimed alloy and that given in document O2. When applying the criteria (a) to (c) for the novelty of a selection, known e.g. from "The Case Law of the Boards of Appeal of the EPO, I.C.4.2.1, the range of overlap can be seen in the present case as narrow and the composition of the examples as sufficiently far removed from the claimed range. Criteria (a) and (b) are therefore met.

However, the composition selected from the ranges of the alloy of O2 and defined in claim 1 as granted is rated as being an arbitrary rather than a "purposive" selection, as required by criterion (c), because it is not associated with a specific technical effect unknown from O2. Given that the patent at issue fails to provide a specific and complete example, reference has to be made in this context to Figure 1 of the patent which discloses two values for the endurance of 0.81 at 385°C for a Zr-alloy comprising 0.73%(Sn+Nb), and of 0.89 for an alloy comprising 0.8%(Sn+Nb), respectively. Both results are, however, below the value of 0.94 of the relative yield stress at 385°C reported for

comparative example 10 and far below the value of 1 aimed at for the alloys of O2. As compared to document O2, the endurance values are significantly impaired rather than improved by the claimed Zr alloy. The results for the corrosion increment reported in Figure 2 of the patent at issue cannot help to change this reasoning since they relate to Zr-alloys comprising 0.7% Sn or 0.8% Sn, respectively, i.e. Sn contents outside the range of 0.2 to 0.6% Sn defined in claim 1.

The Board does not concur with the appellant's restricted reading of document O2 which focuses essentially on the illustrating examples. Although in O2 only example 9 is said to be "according to the invention" and is Nb-free, the remaining examples 2 to 10 actually include niobium, e.g. up to 0.206% (sample 10). The disclosure of document O2 is, however, not restricted to the examples. Following the general technical teaching of O2, the alloy can comprise niobium up to 0.5%. Nothing is found anywhere in this document implying that Nb-contents of 0.3, 0.4 or even up to 0.5% run the risk of impairing one or several of the alloy's specific properties and therefore should be avoided or even excluded. In the absence of any warning or hint, a skilled person putting into practice the known alloy would have no reason to exclude higher amounts of niobium (i.e. up to 0.5%) from his considerations but would work in the whole range.

- 2.4 When discussing the issue of novelty, it is also noted that the additional test results for examples A to D in support of the alloy's performance, such as hydrogen pick up ratio, corrosion resistance or dimensional stability which have been submitted by the appellant

during the opposition period and in the appeal procedure, cannot be taken into consideration, since they have no basis in the application as originally filed or in the patent as granted and therefore represent new subject matter.

2.5 In view of the above considerations, the subject matter of claim 1 of the main request lacks novelty with respect to the technical disclosure of document O2.

3. *First auxiliary request*

3.1 Novelty

The technical feature of $(\text{Sn}+\text{Nb}) \geq 0.7$ in claim 1 of the first auxiliary request is not disclosed in the prior art. Hence, novelty of the subject matter of claim 1 cannot be disputed.

3.2 Inventive step

Starting from document O2 as the closest prior art, the problem underlying the patent at issue resides in avoiding or suppressing a decrease in strength of the known Zr-alloy to less than 20% while improving the corrosion resistance, hydrogen absorption quantity and dimensional stability (see the patent specification, paragraphs [0006] to [0009] [0025]).

This problem is solved in particular by limiting the total of (%Sn + %Nb) in the solid solution state to 0.7% or more. Figure 1 of the patent discloses the total of (Sn+Nb) of two zirconium alloys without, however, providing a complete composition. Likewise,

the solid solution state of (Sn+Nb) is said in column 4, lines 1 to 3 of the specification to be influenced by the processing time and temperature but the patent fails to comprise any indication as to how the solid solution state is actually achieved.

The comparative table given in point 2.2 shows that the Zr-alloy known from document O2 comprises at least 0.4 wt% Sn and up to 0.5 wt% Nb and that the claimed proviso of $(\text{Sn+Nb}) \geq 0.7$ is satisfied by the majority of the examples featuring Table 1. It is also evident from O2, Figure 1 that the endurance values at 385°C obtained by the known Zr alloy are far above those achieved by the examples of the claimed Zr-SnFeCrNb alloy and, therefore, it has to be concluded that the identified problem has been already solved successfully by the Zr alloy known from document O2.

Turning to the "improved corrosion resistance" attributed to the claimed Zr-alloy, the patent neither comprises specific information about the type of corrosion nor test results of an alloy composition falling within the claimed ranges. Contrary to the appellant's position, a person skilled in the technical field of Zr-alloys is very well aware of the fact that the corrosion resistance (i.e. uniform, local, general corrosion) of Zr-SnCrFe alloys of the claimed type is significantly improved by the addition of niobium in the range of 0.06 to about 0.5%. Reference is made in this context to document O4', page 5/7, lines 23 to 25; lines 32 to 36. The beneficial influence of niobium upon the corrosion resistance is confirmed by the disclosure of document O5' page 3/6 which likewise proposes the addition of 0.05 to 0.5% Nb and which is

cited only for corroboration and not as further evidence. Consequently, adding up to 0.5 wt% niobium to a Zr alloy comprising 0.4 to 1.2 wt% of Sn in order to improve its corrosion resistance is obvious to a person skilled in this field of metallurgy. Based on these considerations it can be inferred that the claimed proviso of $(\text{Sn}+\text{Nb}) \geq 0.7$ is generally met by the corrosion resistant Zr alloys known by the prior art 02 and 04'.

The decrease of the hydrogen absorption quantity is said in the patent column 3, lines 3 to 6 to coincide with the improvement of the corrosion resistance and thus is rated as representing a dependent property. As regards the "improved dimensional stability", the patent does not comprise any technical information as to how this property is determined and thus could be compared with the prior art. Hence, both relative properties cannot add inventive matter to the subject matter of claim 1 of the first auxiliary request.

Claim 1 of the first auxiliary request is, therefore, not allowable for lack of inventive step of its subject matter.

4. *Second and third auxiliary request*

- 4.1 The term "wherein the Nb content is larger than the Sn content" featuring in amended claim 1 of the second auxiliary request has no basis in the patent specification or the application as filed and therefore represents added subject matter which contravenes Article 123(2) EPC.

4.2 The term "wherein Sn is substantially 0 weight%" included in claim 1 of the third auxiliary finds support in paragraph [0019] of the patent specification. Apart from being contradictory to the claimed Sn-range of 0.2 to 0.6% and therefore violating Article 84 EPC, the amendment entails the problem of enlarging the scope of claim 1 by allowing Sn in the range from "substantially 0 weight% to 0.6 weight%". In that respect, the Board cannot share the appellant's interpretation that the term "substantially 0 wt% Sn" equals "about 0.2 wt% Sn". Objection therefore arises under Article 123(3) EPC.

Hence, claim 1 of the second and third auxiliary request are not allowable either.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

V. Commare

T. Kriner