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**Datasheet for the decision
of 4 November 2014**

Case Number: T 0324/12 - 3.2.08

Application Number: 03254456.1

Publication Number: 1382697

IPC: C22C19/05

Language of the proceedings: EN

Title of invention:

Superalloy for single crystal turbine vanes

Applicant:

CANNON-MUSKEGON CORPORATION

Headword:

Relevant legal provisions:

EPC Art. 56

RPBA Art. 13(1)

Keyword:

Inventive step - (no)

Late-filed facts - admitted (no)

Decisions cited:

T 1891/08, T 0624/91, T 0075/02

Catchword:



**Beschwerdekammern
Boards of Appeal
Chambres de recours**

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Case Number: T 0324/12 - 3.2.08

D E C I S I O N
of Technical Board of Appeal 3.2.08
of 4 November 2014

Appellant:
(Applicant)

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Representative:

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Decision under appeal:

**Decision of the Examining Division of the
European Patent Office posted on 15 September
2011 refusing European patent application No.
03254456.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman M. Alvazzi Delfrate
Members: C. Herberhold
C. Schmidt

Summary of Facts and Submissions

I. By its decision posted on 15 September 2011 the Examining Division refused European patent application No. 03254456.1.

II. In its decision the examining division held that the subject-matter of the main and second auxiliary requests then on file were not new over

Document D1: WO-A-02/070764.

The first auxiliary request was found to contravene the requirements of Article 123(2) EPC. Moreover, the examining division was of the view that the subject-matter of auxiliary request 2 did not involve an inventive step over

Document D2: "CMSX®-486, A NEW GRAIN BOUNDARY STRENGTHENED SINGLE CRYSTAL SUPERALLOY", Ken Harris and Jackeline B. Wahl, Proceedings of the ASME TURBO EXPO 2002, June 3-6, 2002, Amsterdam ("EXHIBIT A").

The decision also considered the evidence provided by the appellant in

Document D3: "EXHIBIT B", Cannon-Muskegon Corporation.

III. The appellant (applicant) lodged an appeal against that decision in the prescribed form and within the prescribed time limit.

IV. Oral proceedings before the Board of Appeal took place on 4 November 2014.

During the oral proceedings the appellant filed

Document D5: "Jacqueline B. Wahl and Ken Harris:
CMSX-486® SINGLE CRYSTAL ALLOY - PRODUCTION EXPERIENCE
AND DEVELOPMENT OF AN IMPROVED VERSION", Proceedings of
TURBO EXPO 2006: Power for Land Sea & Air, 8 -
11 May 2006, Barcelona, Spain,

which was however not admitted into the proceedings.

V. At the end of the oral proceedings the appellant
requested:

That the decision of the Examining Division be set
aside and that a patent be granted on the basis of the
main request as filed during the oral proceedings on
4 November 2014, or - auxiliarily - on the basis of the
first or third auxiliary request as filed with letter
dated 11 January 2012.

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

"A nickel-base superalloy comprising, in percentages by
weight, from 4.7% to 4.8% chromium, (Cr), from 9.0% to
10.0% cobalt (Co), from 0.6% to 0.8% molybdenum (Mo),
from 8.4% to 8.8% tungsten (W), from 4.3% to 4.8%
tantalum (Ta), from 0.6% to 0.8% titanium (Ti), from
5.6% to 5.8% aluminum (Al), from 2.8% to 3.1% rhenium
(Re), from 1.1% to 1.5% hafnium (Hf), from 0.06% to
0.08% carbon (C), from 0.012% to 0.020% boron (B), from
0.004% to 0.010% zirconium (Zr), the balance being
nickel and incidental impurities."

Independent claims 5 and 9 respectively refer to a
single crystal casting prepared from a nickel-base
superalloy having the composition defined in claim 1
and to a nickel-based turbine vane, turbine blade, or

multiple turbine vane segment cast from a nickel-based superalloy having the composition defined in claim 1.

VII. Auxiliary requests:

The auxiliary requests (Aux. 1, Aux. 3) differ from the main request (MR) in that the claimed ranges for certain elements comprised in the nickel-base superalloy have been further narrowed, as can be seen in the following table:

Element wt%	MR	Aux. 1	Aux. 3
Cr	4.7% - 4.8%	4.8%	4.8%
Co	9.0% - 10.0%	9.2% - 9.3%	9.2%
Mo	0.6% - 0.8%	0.7%	0.7%
W	8.4% - 8.8%	8.5% - 8.6%	8.5%
Ta	4.3% - 4.8%	4.5%	4.5%
Ti	0.6% - 0.8%	0.7%	0.7%
Al	5.6% - 5.8%	5.6% - 5.7%	5.69%
Re	2.8% - 3.1%	2.9%	2.9%
Hf	1.1% - 1.5%	1.2% - 1.3%	1.26%
C	0.06% - 0.08%	0.07% - 0.08%	0.072%
B	0.012% - 0.020%	0.015 - 0.016%	0.016%
Zr	0.004% - 0.010%	0.005%	0.005%
Ni	balance	balance	balance

VIII. The following further documents played a role for the present decision:

D2p: Lecture foils of the presentation "CMSX®-486, A NEW GRAIN BOUNDARY STRENGTHENED SINGLE CRYSTAL SUPERALLOY" by Ken Harris and Jacqueline B. Wahl, Cannon-Muskegon Corporation, held at the ASME TURBO

EXPO 2002, Jun 3-6, Amsterdam, The Netherlands, filed by the appellant with letter dated 9 July 2014;

D4: Sims, C., Stoloff, N., Hagel, W., "SUPERALLOYS II", John Wiley and Sons (1987), pages 223-225.

IX. The essential arguments of the appellant can be summarised as follows:

Inventive step - Main request

Even if the appellant's own presentation at the conference ASME TURBO EXPO 2000 was to be considered as the closest prior art, the alloy of the present invention was still considerably different from the one disclosed at the conference, in particular in that it had a lower chromium range. In fact the alloy disclosed in D2p essentially corresponded to the alloy discussed in document D1, which was an earlier version of the CMSX-486® alloy but did not have the advantageous reduction in the chromium content of the presently claimed alloy.

In view of the development of the Cr content from 8 over 6 to 5 wt% throughout the alloy development illustrated on slide 11 of D2p, the person skilled in the art would understand that a Cr content of 5% was the absolute lower limit which could be employed without losing the hot corrosion resistance required. A Cr value of 4.8 wt% was thus in contradiction to the teaching of D2p and would not have been chosen by the skilled person.

As pointed out in the application on page 3, lines 43 to 46, the narrower chromium range unexpectedly reduced the amount of the Re, W, Cr rich TCP phase in the alloy

following high-temperature, long term, stressed exposure without adversely affecting alloy properties, such as hot corrosion resistance, as compared with known conventional nickel-based superalloys.

The narrowed chromium range furthermore surprisingly allowed for a large rhenium range of 2.8 - 3.1 wt%, in which the beneficial reduction of TCP phase as well as the excellent hot corrosion resistance were present. D2p was entirely silent on the availability of such an enlarged Re range.

Even if the reduction of TCP phase was not derivable from the short term testing of the type presented in Figures 1 to 8 and in Tables 2 to 6 of the application, the appellant had to be given the benefit of the doubt with respect to said technical effect. Indeed, the comparison of Figure 20 of D2 with the right lower optical micrograph in document D3 showed that the alloy of the invention (having a chromium content of 4.8 wt%) had substantially the same amount of TCP phase formation after 3770.8 hours as the alloy of D2p - having a chromium content of 5% - after 2258.4 hours of testing both at 2000°F. Irrespective of the fact that both tests had been performed at different stress levels - 7.7 ksi for the alloy of the present invention versus 8.3 ksi for the alloy disclosed in D2p - this convincingly showed the beneficial effect of the inventive reduction in chromium range on phase stability.

Therefore, the CMSX-486® alloy according to the invention, having a Cr content of 4.7-4.8 wt% and resulting in surprisingly lower TCP phase formation upon long term high-temperature stressed exposure, was inventive over the CMSX-486® alloy disclosed in D2p.

Inventive step - Auxiliary requests

In the auxiliary requests, several further elemental ranges had been carefully optimized, thus further enhancing the technical effect of the unexpectedly reduced amount of TCP phase formation while maintaining hot corrosion resistance in the alloy. D2p did not give any indication towards this carefully selected optimized balance of the elemental compositions, such that the person skilled in the art would not have had any reason to employ these modifications. While it was true that there were no data proving the invoked technical effect for some of these modified elemental ranges, it had to be taken into account that the required experiments were extremely labour intensive and expensive.

Admissibility of document D5

Document D5 disclosed in Figure 1 further experimental data, in particular with respect to a superior stress rupture life behaviour of the CMSX-486® alloy having a Cr content of 4.8 wt% over the CMSX-486® alloy according to D2p when testing up to more than 10,000 hours. The document was only filed late, i.e. during the inventive step discussion of auxiliary request 3, because it referred to the further reduction in chromium as "tuning", a word which might have wrongly been interpreted by the Board as an indication of routine modification rather than as a sign of inventive activity. Nevertheless, the further experimental data provided proof of the presence of the technical effect of the inventive alloy over the alloy disclosed in D2p and should thus despite their late filing be taken into account when deciding on inventive step.

Reasons for the Decision

1. The appeal is admissible.
2. Admissibility of document D5:

The appellant has provided document D5 at the latest possible moment during the oral proceedings, i.e. at a time where the discussion about inventiveness of auxiliary requests 3 was coming to an end.

The submission of a document which had been known to the appellant for a long time (it originates from the same inventors as the application) at this extremely late stage cannot be conducive to an efficient procedure.

Moreover, independently of its late filing, the document is not of *prima facie* relevance for the following reasons:

Firstly, the alloy described in D5 is different from the one claimed in auxiliary request 3 (see Table I of D5 which discloses an elemental composition corresponding to the one of auxiliary request 1 rather than to the one of auxiliary request 3), so that this document cannot contribute to the inventive step discussion of auxiliary request 3.

Secondly, in Figure 1, which, according to the appellant, contained the decisive additional information, there is no *prima facie* indication towards a significant change in the stress-rupture life data at 1093°C (the temperature mentioned by the appellant). In

fact, the regression line drawn in the double logarithmic plot appears to be quite similar if not identical to the one shown on slide 22 of D2p (see in particular the data point close to 200 hrs. / 100MPa and the point triplet close to 2000 hrs. / 60MPa, which appear to be the same in both diagrams and which also allow to compare the regression lines in the respective diagrams). Thus, although it is true that Figure 1 of D5 contains more data points than the stress-rupture life curve shown on slide 22 of D2p, the stress-rupture life properties appear to be as they are to be expected from extrapolation of the regression line on slide 22 of D2p.

Therefore, D5 does not add *prima facie* any information in respect of the effect already disclosed in D2p.

Thus, the Board decided to not admit document D5 into the proceedings in accordance with Article 13(1) RPBA.

3. Main request - Inventive step:

3.1 Closest prior art:

An oral presentation disclosing alloy CMSX®-486 was given by the inventors of the present invention at the conference TURBO EXPO 2002, which took place from June 3-6, 2002, i.e. about one month before the priority date of the present application. With letter dated 9 July 2014, the appellant provided the lecture foils of said presentation and requested (see page 8, point 2b of said letter) to consider said document instead of document D2, D2 being only a post published summary of the presentation at the conference.

The lecture foils have thus been uncontestedly shown to the audience at the TURBO EXPO 2002 conference and

their content has thereby been made available to the public, before the date of filing of the priority document of the European patent application. Consequently, the content of the lecture foils forms part of the state of the art in accordance with Article 54(2) EPC. This finding has not been challenged by the appellant.

On slide 11, D2p discloses the nominal chemistry of the alloy CMSX-486®. It is noted that the alloy of the present invention carries the same name as the one disclosed in D2p, although there is - at least in absolute numbers - a difference in the Cr content.

The table below shows the nominal chemistry of alloy CMSX-486® disclosed in D2p next to the respective ranges claimed in claim 1 of the main request:

Element	MR	Cmsx®-486 D2p
Cr	4.7% - 4.8%	5
Co	9.0% - 10.0%	9.3
Mo	0.6% - 0.8%	0.7
W	8.4% - 8.8%	8.6
Ta	4.3% - 4.8%	4.5
Ti	0.6% - 0.8%	0.7
Al	5.6% - 5.8%	5.7
Re	2.8% - 3.1%	3
Hf	1.1% - 1.5%	1.2
C	0.06% - 0.08%	0.07
B	0.012% - 0.020%	0.015
Zr	0.004% - 0.010%	0.005
Ni	balance	balance

As can be seen from the table, the only potential difference between the subject-matter of claim 1 and the disclosure of D2p is in the Cr content. Thus, alloy CMSX-486® as disclosed in D2p, which is a grain boundary strengthened single crystal alloy with improved creep-rupture strength (see slide 11 of D2p), is of a composition which is closer to the one of the invention than the composition of any other of the superalloys CM 247 LC®, CMSX-3®, CM 186LC®, or CMSX®-681 shown on slide 11 of D2p or discussed as prior art in the application. Alloy CMSX-486® as disclosed in D2p is thus considered to be the closest prior art.

3.2 Technical effect and problem to be solved:

According to the application (see paragraph [0006] of the A-publication), "the nickel-base super alloys of this invention exhibit outstanding stress-rupture properties, creep-rupture properties and reduced rejectable grain defects as compared with conventional directionally solidified columnar grain casting alloys and single crystal casting alloys." Moreover (see paragraph [0016]), the "narrower chromium range unexpectedly reduces the amount of TCP phase (Re, W, CR, rich) in the alloy following high-temperature, long term, stressed exposure without adversely affecting alloy properties, such as hot corrosion resistance, as compared with known conventional nickel-based superalloys".

3.2.1 The term "as compared with known conventional nickel-based superalloys" in the patent specification has to be read as meaning "as compared with the superalloys CM 247 LC®, CMSX-3®, CM 186LC®", because these are the

conventional superalloys discussed in the application (see for instance paragraph [0026]).

The outstanding stress- and creep-rupture properties are only evidenced in the patent specification in comparison with the stress- and creep-rupture properties of these conventional alloys and of experimental alloy CMSX-681® (see Tables 2-4), but not in contrast to the alloy CMSX-486® as disclosed in D2p, although this alloy, having been developed by the inventors of the present application, was well known to the appellant.

Furthermore, the detailed results of the stress-rupture and creep-rupture tests as shown in Tables 2-6 of the specification for an alloy CMSX-486® according to the invention (having a nominal Cr content of 4.8 wt%, see Table 1) are exactly, i.e. up to the last digit behind the decimal point, identical to the stress- and creep-rupture tests shown in document D1 for a CMSX-486® alloy which has a Cr content of 5 wt% (see tables 1 to 6) and which - as repeatedly stated by the appellant in the oral proceedings - substantially corresponds to the alloy presented during the conference TURBO EXPO 2000, i.e. to the alloy disclosed in D2p.

It is noted that the measurement data disclosed in D1 can be used in order to evaluate whether a certain technical effect (in the present case the presence of improved stress- and creep-rupture properties or of a reduction in the amount of TCP phase) has been convincingly shown, irrespective of whether D1 qualifies as prior art in accordance with Article 54(2) EPC or not. This is because such factual data is not influenced by the date at which the information was created or published. Analogously, the appellant can

rely on post-published comparison tests - possibly measured only after a new piece of prior art has been introduced - in order to establish a surprising technical effect (such as e.g. D3, see below).

Therefore, while the evidence provided credibly shows a considerable improvement of the stress- and creep-rupture properties in comparison with the conventional nickel-based superalloys CM 247 LC®, CMSX-3®, CM 186LC®, or in comparison with the experimental superalloy CMSX®-681, it does not show any change in the stress- and creep-rupture properties in comparison with a CMSX-486® alloy having a Cr content of 5 wt% such as the one disclosed in D2p.

Thus, with respect to the closest prior art, i.e. with respect to the CMSX-486® alloy disclosed in D2p, the technical problem of providing a nickel-based superalloy having outstanding stress-rupture and creep-rupture properties has already been solved.

- 3.2.2 In view of the second technical effect invoked by the appellant, according to which "with the present patent application the amount of TCP phases was further reduced in view of the superalloy provided by D1" (statement of grounds of appeal, page 3, second paragraph), the technical problem was formulated as to provide a nickel-based superalloy exhibiting a reduced amount of TCP phase formation without affecting alloy properties such as hot corrosion resistance (see paragraph [0007] of the application).

In this context, the Board agrees with the appellant's analysis in the consecutive sentence of the statement of grounds (statement of grounds of appeal, page 3, second paragraph), namely that "neither the amount of

reduced TCP phase nor the effects connected therewith are observable from short-term testing of the type presented in Figs. 1 to 8 and Tables 2 to 6 (Rem: of the application) which can not illustrate the long-term benefits".

In view of the known fact that TCP phase negatively affects stress- and creep-rupture properties (see e.g. D4, page 224) it is not plausible that two alloys having - according to the data presented - identical (short-term) stress- and creep-rupture properties (i.e. the CMSX-486® alloy having a Cr content of 5.0 wt% and the CMSX-486® alloy of the present invention having a Cr content of 4.8 wt%) would show a significantly different amount of TCP phase formation.

In order to demonstrate a significantly lower amount of TCP phase formation in the CMSX-486® alloy according to the invention (Cr content 4.8 wt%) compared with the CMSX-486® alloy disclosed in D2p (Cr content 5 wt%), the appellant has provided optical photos of the gage area of the two alloys after testing at 1093°C for 2258.4 hrs with a stress of 57 MPa (alloy disclosed in D2p, see Figure 20 of D2) and after testing - at the same temperature - for 3770.8 hrs with a stress of 53.1 MPa (D3, Exhibit B, see the photo in the right lower corner which has the same scale as Figure 20 of D2). According to the appellant, a comparison between the two micrographs showed substantially the same amount of TCP phase formation in both alloys, although it took 3770.8 hours for the alloy containing 4.8% chromium to form substantially the same amount of TCP phase that the alloy containing 5.0% chromium formed in only 2258.4 hours (statement of grounds of appeal, page 3, last paragraph to page 4, first paragraph). In its communication accompanying the summons to oral

proceedings the Board had stated that it was questionable whether the photographs taken after different stressed exposures were at all comparable and whether a single photograph could be used to determine the level of TCP formation in the alloy. This communication further stated that a quantitative analysis of the amount of TCP formation in both alloys was appropriate (see item 3.2.4 of the Board's communication). It seems that also the appellant agrees with the necessity to base such an analysis on statistically collected findings and on the overview of many microscopic pictures, and had indeed performed such experiments ("The scientific work of the inventors is of course also based on statistically collected findings and on the overview of many microscopic pictures", see letter dated July 9, 2014, page 10, first paragraph, emphasis added by the Board). However, although in possession of the data, the appellant chose to not provide these as further evidence.

In view of the fact that the onus of proof for a technical effect alleged by the appellant lies with the appellant (see e.g. T75/02, point 3.4.1 of the reasons), the Board comes to the conclusion that the technical effect invoked by the appellant, i.e. the significantly reduced amount of TCP phase formation in the CMSX-486® alloy having a Cr content of 4.8 wt% compared with the amount of TCP phase formation in the CMSX-486® alloy having a Cr content of 5.0 wt%, has not been convincingly demonstrated.

3.3 Since no amelioration in respect of the nominal composition CMSX-486® disclosed in D2p can be acknowledged, the problem underlying the claimed invention has to be reformulated in a less ambitious way and is considered to be the provision of an alloy

composition with properties comparable to those exhibited by the alloy CMSX-486® in the nominal composition disclosed in D2p.

- 3.4 The appellant has pointed out that the nominal amount of Cr (5 wt%) disclosed in D2p was outside the claimed Cr range (4.7-4.8 wt%). However, it has to be taken into account that document D2p discloses the nominal chemistry of the alloy CMSX-486®. In practice, an alloy produced aiming at this nominal composition will deviate somewhat from this target (see e.g. T1891/08, point 2.2 of the reasons, T624/91, point 3.2 of the reasons). In fact, when rounded to the accuracy employed for chromium in the Table on slide 11 of D2p, the limits for the chromium range claimed would be indistinguishable from the nominal value disclosed. In the appellant's view no information about the accuracy of the respective elemental values could be derived from said Table, the number of digits after the decimal point being determined by spatial constraints in the respective column rather than by technical considerations. However, in said Table different elemental contents are given with different accuracy. Whereas for example the titanium content of alloy CMSX-3® is given as 1.0, i.e. with an accuracy extending down to the first digit after the decimal point, the chromium content of the CMSX-486® alloy is specified as 5 wt%, i.e. without any digit after the decimal point and therefore with less accuracy. Hence, the Board is of the opinion that the scientific notation was used in the Table, giving the value up to the respective last significant digit, as can be seen for example from the value for Zr (0.010 wt%) in alloy CM247LC® or in the value for titanium (1.0 wt%) in alloy CMSX-3®. Accordingly, D2p discloses that a greater variation is allowed for the Cr content, which is indicated with a

lower precision, than for elements whose content is given with higher precision.

Therefore, the composition according to claim 1 exhibits elemental ranges which would be considered by a metallurgist aiming to produce the CMSX-486® alloy of D2p. Hence, it was obvious for the person skilled in the art to consider this composition for providing an alloy with properties comparable to the nominal composition disclosed in D2p. Accordingly, the subject-matter of claim 1 does not involve an inventive step.

3.5 Even assuming - in the appellant's favour - that the technical effect of reduced TCP phase formation would have been convincingly proven, the Board is of the opinion that the solution as defined in claim 1 for solving the problem to provide a nickel-based superalloy exhibiting a reduced amount of TCP phase would still be obvious to the person skilled in the art for the following reasons:

3.5.1 As also acknowledged by the appellant, TCP phase was known to be Re, W, and Cr rich. TCP formation has also been well known for decades to have detrimental effects on long term stress- and creep-durability (see e.g. D4, page 224) - the reduction of TCP phase thus being *per se* an obvious developmental aim for the skilled person.

From slide 11 of the D2p presentation the person skilled in the art can obtain the information that in the history of alloy development leading finally to the CMSX-486® alloy disclosed in D2p (as shown in the sequence on slide 11) the chromium content had been progressively decreased (8->8->6->5->5 wt%), while the two other elements of which the TCP phase is rich (W and Re) had been varied considerably less. In

particular the Re content had been left constant in the latest developments.

Therefore, in order to solve the problem of providing a nickel-based superalloy exhibiting a reduced amount of TCP phase, it was considered obvious to try a further decrease in Cr content, i.e. a decrease of an element in which the TCP phase is rich and the reduction of which had been shown to be beneficial in view of stress- and creep-durability in past developments.

Furthermore, in view of the fact that the presence of Cr is known to be important for hot corrosion resistance, it was also obvious to the person skilled in the art that the Cr content can only be reduced with care.

The Board thus comes to the conclusion that the optimization of the Cr content in view of two known opposing criteria (reduction of TCP phase vs. conservation of hot corrosion resistance) - though expensive and laborious - has to be considered routine experimental work for the person skilled in the art.

- 3.5.2 The appellant was of the opinion that the table on D2p, slide 11 marked the absolute limits of elemental content which the person skilled in the art would not go beyond. In particular - before the invention was made - in view of the teaching in D2p, a Cr content of 5 wt% had to be considered the lowest limit possible in order to maintain the hot corrosion resistance required. In this context, some scepticism could allegedly be gathered from D2p that the oxidation resistance might be low as a result of the low chromium percentage (appellant's letter dated 9 July 2014).

However, on slide 34 of D2p it is explicitly stated that the environmental properties of the CMSX-486® alloy disclosed in D2p are expected to be similar to the ones of CM 186LC®, an alloy having a Cr content of 6 wt%. Therefore, D2p rather provides an indication that a reduction in Cr content performed with due care can be made without the absolute fear of a deterioration of the environmental properties.

- 3.5.3 The appellant has further pointed out that the narrower Cr range according to the invention also allowed to choose the Re content within a relatively wide range of 2.8-3.1 wt%. D2p provided no indication whatsoever towards the applicability of such a broad Re range.

However, for the invention to be considered obvious, it is not necessary that the particular Re range of 2.8-3.1 wt%, i.e. the specific upper and lower limits or a certain extent of the claimed range, can be derived from the prior art in an obvious way. If an obvious modification of the CMSX-486® alloy in prior art D2p leads to an embodiment falling within the claimed range and thus within the scope of the claim, then the claim lacks an inventive step. In the present case, starting from the CMSX-486® alloy disclosed in D2p - which has a Re content of 3 wt% - it was obvious to optimize the Cr content in view of the two known opposing criteria, which thus makes a Cr content in the claimed range obvious. The alloy resulting from said optimization has a Re content of 3 wt%, the claimed solution thus not being inventive over D2p.

- 3.6 Therefore, the subject-matter of claim 1 of the main request does not involve an inventive step over the disclosure in D2p.

4. Auxiliary requests - Inventive step:

4.1 In the auxiliary requests the elemental ranges have been further reduced with respect to the main request as can be appreciated in the following Table. Values which are different in terms of absolute number from the disclosure of D2p are marked in grey; the nominal chemistry as disclosed on slide 11 of D2p has also been indicated for convenience.

Element	MR	Aux. I	Aux. III	CMSX-486® D2p
Cr	4.7% - 4.8%	4.8%	4.8%	5
Co	9.0% - 10.0%	9.2% - 9.3%	9.2%	9.3
Mo	0.6% - 0.8%	0.7%	0.7%	0.7
W	8.4% - 8.8%	8.5% - 8.6%	8.5%	8.6
Ta	4.3% - 4.8%	4.5%	4.5%	4.5
Ti	0.6% - 0.8%	0.7%	0.7%	0.7
Al	5.6% - 5.8%	5.6% - 5.7%	5.69%	5.7
Re	2.8% - 3.1%	2.9%	2.9%	3
Hf	1.1% - 1.5%	1.2% - 1.3%	1.26%	1.2
C	0.06% - 0.08%	0.07% - 0.08%	0.072%	0.07
B	0.012% - 0.020%	0.015 - 0.016%	0.016%	0.015
Zr	0.004% - 0.010%	0.005%	0.005%	0.005
Ni	balance	balance	balance	balance

Also for the narrower compositions of the auxiliary requests, no improvement has been demonstrated in respect of the properties exhibited by the alloy disclosed in D2p. Therefore, also for auxiliary requests 1 and 3, the problem to be solved is considered to be the provision of an alloy with properties comparable to those exhibited by said nominal composition.

4.1.1 Auxiliary request 1:

In the case of auxiliary request 1, the sole possibly additional difference is in the Re content. However, the Re content defined in the first request (2.9 wt%) - although not exactly identical in number - comes extremely close to the nominal content in D2p (3 wt%). Furthermore, as confirmed by the appellant, the alleged effect of the narrowed Cr range applies over a large Re range, i.e. there is no technical effect linked to a change of Re content from 3 wt% to 2.9 wt%. Therefore, for analogous reasons to those explained for the main request, the selection of the claimed amount of 2.9 wt% Re was an obvious choice to solve the problem cited above.

Hence, the subject-matter of claim 1 of the auxiliary request 1 does not involve an inventive step.

4.1.2 Auxiliary request 3:

Analogous considerations apply for the elemental contents of Co, W, Al, Hf, C, and B defined in auxiliary request 3. The claimed values are either technically identical (Al, C), or so close to the nominal value disclosed in D2p that they would be considered without the need for an inventive activity for solving the problem defined above.

Accordingly, the subject-matter of claim 1 of auxiliary request 3 does not involve an inventive step either.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



V. Commare

M. Alvazzi Delfrate

Decision electronically authenticated