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**Datasheet for the decision  
of 28 October 2009**

**Case Number:** T 0432/08 - 3.2.08

**Application Number:** 02716370.8

**Publication Number:** 1469093

**IPC:** C22C 38/00

**Language of the proceedings:** EN

**Title of invention:**

Steel wire for heat-resistant spring, heat-resistant spring  
and method for producing heat-resistant spring

**Applicant:**

Sumitomo (SEI) Steel Wire Corp.

**Headword:**

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**Relevant legal provisions:**

EPC Art. 123

**Relevant legal provisions (EPC 1973):**

EPC Art. 54, 56

**Keyword:**

"Novelty and inventive step (yes) - after amendments"

**Decisions cited:**

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**Catchword:**

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**Case Number:** T 0432/08 - 3.2.08

**DECISION**  
**of the Technical Board of Appeal 3.2.08**  
**of 28 October 2009**

**Appellant:** Sumitomo (SEI) Steel Wire Corp.  
1-1, Koyakita 1-chome  
Itama-shi, Hyogo 664-0016 (JP)

**Representative:** Cross, Rupert Edward Blount  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 16 October 2007  
refusing European application No. 02716370.8  
pursuant to Article 97(1) EPC 1973.

**Composition of the Board:**

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

## Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division posted on 16 October 2007 to refuse European patent application No. 02 716 370.8. The examination division reasoned that the subject matter of the independent claims of the main, first and second auxiliary requests then under consideration either lacked novelty or inventive step, respectively, having regard to the technical teaching given in documents

D1: JP-A-2000-239804 and

D1a Computer translation of document D1 into English language.

The appeal was received at the European Patent Office on 14 December 2007 and the appeal fee was paid on the same date. The statement setting out the grounds of appeal was received on 18 February 2008.

II. Oral proceedings before the Board took place on 28 October 2009. The appellant requested that

- the decision under appeal be set aside and
- a patent be granted on the basis of the main request filed during the oral proceedings before the Board and replacing all former requests.

Independent claim 1 reads as follows:

"A method for producing a heat-resistant spring, the method comprising the steps of:

(i) performing solution treatment at a temperature of 950 to 1200°C for a period of: (0.3 to 5 minutes) x (the diameter of the wire expressed in mm) on a wire containing:

- (a) 0.01 to 0.08 wt% C, 0.18 to 0.25 wt% N, 0.5 to 4.0 wt% Mn 16 to 20 wt% Cr, and 8.0 to 10.5 wt% Ni,
- (b) at least one constituent selected from 0.1 to 3.0 wt% Mo, 0.1 to 2.0 wt% Nb, 0.1 to 2.0 wt% Ti, and 0.3 to 2.0 wt% Si, and optionally also 0.2 to 2.0 wt% Co, and
- (c) Fe and unavoidable impurities, both of which constitute the remainder;

(ii) drawing the solution-treated wire to reduce the area of the wire by 50 to 70% to form a drawn wire;

(iii) forming a spring from the drawn wire; and

(iv) treating the spring with low-temperature annealing at a temperature of 450 to 600°C, and

wherein the wire has

- (d) a tensile strength of at least 1,300 N/mm<sup>2</sup> and less than 2,000 N/mm<sup>2</sup> before being treated by low temperature annealing; and
- (e) a maximum crystal-grain diameter of less than 12 •m in the • phase (austenite) in a transverse cross section of the wire."

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

D1a as the closest prior art disclosed a process for producing a heat resistant stainless steel spring which was formed of a wire having a composition within the elemental ranges set out in step (i) as claimed. The known process did, however, not disclose any limitation for the duration of the solution treatment set out in step (i) of claim 1, and for the reduction of area in

the range of 50 to 70% featuring in step (ii) when reducing the diameter of the solution heat treated wire by drawing. Moreover, document D1a was silent on controlling the maximum diameter of the gamma crystal grain size which was in the claimed method restricted to less than 12  $\mu$ m. Adhering to these processing conditions effectively improved the high-temperature sag resistance of the steel spring. Vis-à-vis the disclosure of document D1a, the claimed method therefore was novel and involved an inventive step.

### **Reasons for the Decision**

1. The appeal is admissible.
2. *Amendments; Article 123(2) EPC*

Claim 1 of the main request results from a combination of original claims 1 and 6 and the conditions for the solution treatment and the reduction of area given on page 8, lines 4 to 8 and page 8, line 20 to page 9, line 5 of the originally filed application.

Dependent claims 2 to 4 correspond to claims 3, 4 and 7 as originally filed.

Hence, there are no formal objections to the present claims with respect to Article 123(2) EPC.

3. Novelty

Document D1a relates to a method for producing heat resistant stainless steel springs from a wire

comprising the steps of solution heat treating the wire between 950 and 1100°C, reducing it to the desired diameter by drawing followed by low temperature annealing between 400 and 650°C (see D1a, paragraphs [0014], [0018],[0043], Table 5, [0045]). The steel composition given in D1a, Table 8, sample 8 consisting of 0.07% C, 0.20% N, 1.20% Mn, 18% Cr, 10% Ni, 2.0% Mo, 1.0% Si, 1.0% Co, balance Fe and exhibiting a tensile strength of 1742 N/mm<sup>2</sup> before low temperature annealing meets the process conditions set out in features (a) to (d), (iii) and (iv) of claim 1.

The claimed process contrasts with the prior art in that D1a does not disclose the processing conditions specified in step (i), i.e. the time period for carrying out the solution treatment and also in step (ii) of reducing the area of the wire by 50 to 70%. In addition, D1a does not deal with the control of the maximum diameter of austenite grain size which is required to fall within the limits specified in feature (e) in claim 1.

Consequently, the method defined in claim is novel over the disclosure of document D1a.

#### 4. Inventive step

4.1 Starting from document D1a as the closest prior art, the objective technical problem underlying the present application therefore resides in providing a method for producing heat-resistant steel springs exhibiting an excellent high-temperature sag resistance at a temperature as high as 350 to 500°C.

4.2 The novel features identified above are considered to solve this problem. In particular controlling the duration of the solution treatment, as defined in claim 1, step (i), effectively permits limiting the maximum austenite grain size diameter within the claimed range. As is evident from the specification, Table 1, comparative example 4, the austenite grain diameter of 14.6  $\mu\text{m}$ , which is well above the claimed limit of 12  $\mu\text{m}$ , increases the residual shearing strain percentage (see Table 2) which vice versa means that the sag resistance of the spring is impaired by the presence of austenite grain sizes larger than claimed.

Document D1a teaches that the average grain size in the cross section of the steel wire should range from 0.5 to less than 5  $\mu\text{m}$  by carrying out the solution treatment between 950 to 1100°C in order to improve the heat resistant characteristics of the wire.

Notwithstanding that restriction, the document fails to give any limitation for the maximum diameter of the austenite grain size which in the claimed process has been shown to adversely affect the high-temperature sag resistance above a maximum size of 12  $\mu\text{m}$ .

4.3 As to feature (ii), the passage on page 8, line 20 to page 9, line 5 of the specification underlines the importance to adhere to the reduction rate of 50 to 70% when drawing the wire. In fact, below 50% reduction a sufficiently high elastic limit cannot be achieved, whereas above 70% excessive dislocations are generated so that in both cases a sufficiently high sag resistance cannot be attained. In support of the beneficial effect provided by the restriction of the reduction rate, the appellant drew attention to the

experimental report enclosed with its letter of 28 September 2009. The test results given in Table 2 of the report confirm that this feature contributes to the solution of the technical problem in that the wire exhibits a significantly improved high-temperature sag resistance when drawn within the claimed reduction of area of 50 to 70 % over reduction rates outside the claimed range. By contrast, document D1a does not deal with the reduction rate. In the specific example given in D1a, paragraph [0031], a 9.5 mm wire rod is reduced by drawing to 1 mm which means a reduction rate of 89% well outside the claimed range.

- 4.4 In conclusion, on the basis of the technical teaching given in document D1a a skilled person, faced with problem of improving the high temperature sag resistance of a stainless steel spring, would not be prompted to choose in an obvious manner the distinguishing technical features of the claimed method. The subject matter of claim 1 therefore involves an inventive step.

The dependent claims 2 to 4 relate to preferred embodiments of the method set out in claim 1 and are, therefore, also allowable.



## 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 grant a patent on the basis of the following documents:

claims: 1 to 4 according to the main request  
filed during the oral proceedings before  
the Board on 28 October 2009;

description: to be adapted to the new claims;

drawings: Figure 1 as originally filed.

The Registrar:

The Chairman:

V. Commare

T. Kriner