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D E C I S I O N
of 24 October 2003

Case Number: T 0489/01 - 3.2.2

Application Number: 92919641.8

Publication Number: 0610231

IPC: C22C 33/02

Language of the proceedings: EN

Title of invention:
Powder metal alloy process

Applicant:
STACKPOLE Limited

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
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Case Number: T 0489/01 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 24 October 2003

Appellant: STACKPOLE Limited
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 20 December 2000 refusing European application No. 92919641.8 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. Ries
Members: M. G. Noël
E. Dufrasne

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dated 20 December 2000 to refuse European patent application No. 92 919 641.8.

The ground of refusal was that the subject matter of claim 1 of the main request lacked novelty and that the subject matter of the auxiliary request did not involve an inventive step having regard to the documents

D2: US-A-5 108 493 and
D4: DE-A-3 219 324

II. On 13 February 2001 the appellant (applicant) lodged an appeal against the decision and paid the prescribed fee on the same day.

III. At the end of the oral proceedings which took place on 24 October 2003, the appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the claims 1 to 9 enclosed with the letter of 24 September 2003 (main request) or on claims 1 to 8 submitted at the oral proceedings (auxiliary request).

IV. Independent claim 1 reads as follows:

"1. A process comprising blending carbon, lubricant, and at least one separate ferro-alloy powder selected from

ferro manganese particles
ferro chromium particles
ferro molybdenum particles

ferro vanadium particles
ferro silicon particles

with compressible elemental iron powder to form a blended mixture, the at least one separate ferro alloy powder having a mean particle size in the range of 8 to 12 µm and a maximum particle size of 25 µm; pressing the mixture to form an article; and sintering the article in either a reducing atmosphere or in a vacuum at a temperature of between 1250°C and 1350°C."

Claim 1 of the auxiliary request differs from the main request by (amendment in bold letters):

"1. A process comprising blending carbon, lubricant, and **at least two** separate ferro alloy powders selected from ...."

V. The appellant argued as follows:

Document D2 discloses a powder composition which comprises an admixture of two different pre-alloyed iron-based powders. As disclosed in D2, column 2, lines 18 to 23, and column 3, lines 3 to 10, the first powder consists of a pre-alloy of iron with molybdenum in an appropriate quantity to impart sufficient strength to the final article. The second pre-alloyed powder component is a ferro-alloy of Fe, C and least one transition element selected from Cr, V, Mn and Nb.
As to the main request, the essential distinguishing feature between the claimed process and that disclosed in document D2 resides in using elemental iron powder rather than a pre-alloyed powder of iron with molybdenum as a first powder component. In so doing,

the compressibility of the powder mixture is improved and significant cost savings are achieved since there is no need for preparing a first pre-alloyed powder as required by the known process. The claimed process results in higher densities of the final products and in a considerable commercial benefit.

As to the auxiliary request, the majority of the examples given in document D2 provide the use of a second pre-alloyed iron-based powder with one single transition element. There is only one example in the second trial which provides two transition elements chromium and manganese. However, there is no indication anywhere in this document to incorporate the two transition elements in anything other than a master pre-alloyed iron-based powder. This could be concluded from document D2, column 2, lines 31 to 34. In particular, there is no suggestion for concluding or implying that two separate and different pre-alloyed iron-based powders in combination with elemental iron powder should be used as stipulated in the claimed process. Hence, the process defined in claim 1 of the auxiliary request involves 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 claims 1 to 4, 6 and 7 as filed. Dependent claims 2 to 9 correspond to claims 5, 17, 20, 19, 8, 9 and 12.

The description has been suitably adapted to the amended claims.

Hence, there are no formal objections to the claims and the description as amended with respect to Article 123(2) EPC. This statement also applies to the claims of the auxiliary request.

3. *The closest prior art*

3.1 According to the established jurisprudence, the closest prior art for assessing inventive step is normally a prior art document disclosing subject matter for the same purpose or aiming at the same objective as the claimed invention and having the most relevant technical features in common, i.e. requiring the minimum of structural modifications and constituting the easiest route for the skilled man to arrive at the claimed solution. A further criterion for the most promising starting point is the similarity of the technical problem (cf. Case law of the Boards of Appeal of the EPO, 4th edition, 2001, I-D, 3.1, 3.2 and 3.5).

3.2 In view of the principles referred to in the previous paragraph, document D4 which was considered as being novelty destroying (for the claims of the main request) and as constituting the closest prior art (for the claims of the auxiliary request) in the decision under appeal cannot be accorded that status since the claims as amended now stipulate an additional technical feature, namely the specific particle size of the ferro-alloy powder(s).

3.3 Like the present application, document D2 aims at providing a powder-metallurgical (P/M) method for manufacturing alloyed steel precision parts which exhibit a high density, better homogeneity, good dimensional accuracy, hardenability and strength (cf. D2, column 1, lines 7 to 24, column 6, lines 29 to 37; cf. the application page 3, 5th full paragraph). Moreover, the powder composition according to document D2 should retain a good compressibility and be less likely to form oxides during its production and storage (cf. D2, column 2, lines 7 to 13). To this end, a first iron-based pre-alloyed powder comprising 0.5 to 3 wt% molybdenum is mixed with a second pre-alloyed powder which is a ferro-alloy of iron, carbon and at least one transition element selected from chromium, manganese, vanadium and niobium. The ferro-alloys which are commercially available in the form of coarse or lump powders are ground to a maximum grain size of about 25 µm and, more preferably, to an average particle size in the range of 5 to 15 µm or about 10 µm (cf. D2, column 3, line 3 to column 5, line 16). In addition to the ferro-alloy and the molybdenum containing iron-based pre-alloy, the steel powder composition can comprise other metallurgically appropriate additives such as carbon (graphite) and/or a lubricant (e.g. zinc stearate and synthetic waxes; cf. D2, column 5, line 64 to column 6, line 18). After blending and compacting the powder mixture, the green body is sintered at a temperature ranging from 1204° to 1316°C (2200° to 2400°F) in a reducing atmosphere. As can be seen from the examples given in column 7, the green bodies were pressed with a compaction pressure of about 40 tons/in^2 and sintered at 1260°C in a dissociated ammonia atmosphere. These process steps comply with the process

conditions specified in the present application. Based on these considerations, document D2 represents the closest prior art.

4. *Inventive step*

4.1 The claimed (P/M) process differs from this prior art D2 by using elemental iron powder as a first powder component rather than a molybdenum containing iron-based pre-alloyed powder as required in document D2. In doing so, the compressibility of the powder mixture is improved and the process is rendered more cost effective. Consequently, the objective problem underlying the present application vis-à-vis the teaching given in document D2 resides (a) in improving the compressibility of the powder and (b) in making the process more economical. This evaluation has been acknowledged by the appellant at the oral proceedings.

4.2 The claimed solution is, however, obvious to a person skilled in the field of powder metallurgy, as is shown in the following.

Also in the process disclosed in document D2, the compressibility of the powder blend is an essential physical property. In its discussion of the technical background reflecting the skilled person's basic technical knowledge, document D2 notes that pre-alloyed powders entail the drawback of a lower compressibility compared with pure iron powder or elemental powders. This disadvantage results from the solution hardening effect the alloying substances have on each powder particle (cf. D2, column 1, lines 54 to 61). To cope with the reduced compressibility of pre-alloyed powders,

document D2 stipulates a maximum content of 3 wt% Mo or less for the first pre-alloyed iron-based powder, since beyond this level the powder begins to lose compressibility. More preferably, the molybdenum content is restricted to 0.8 to 0.9% or even to 0.85% Mo which has been found a particularly useful compromise.

Starting from document D2 and faced with the problem of further improving the compressibility of the powder mixture, a skilled person would, therefore, resort to elemental iron powder in replacement of the 0.85% molybdenum containing pre-alloyed powder since soft elemental iron powder exhibits the highest compressibility. This finding is corroborated by the well known conventional (P/M) methods which uses mixtures of (i) elemental iron powder with (ii) ferro-alloy powder(s) for producing alloyed steel parts. Reference is made in this context for instance to the document D4 which discloses such a starting powder mixture. It further goes without saying that by using commercially available pure iron powder in combination with ferro-alloy powder, the steps of preparing, melting, atomizing and grinding of a Fe-0.85%Mo alloy can be dispensed with so that the (P/M) process per se is simplified and rendered more flexible and less costly. Using elemental iron powder was therefore an obvious choice to improve the compressibility and to reduce costs, even if a certain loss in strength has to be tolerated due to the absence of small amounts of Mo.

4.3 Consequently, the subject matter of claim 1 of the main request does not involve an inventive step.

5. *Auxiliary request*

5.1 Claim 1 of the first auxiliary request further stipulates that the powder mixture comprises elemental iron powder and at least two separate ferro alloy powders. In the appellant's view and with respect to D2, column 2, lines 28 to 34, this process route is not suggested in document D2 which discloses only two different powders, the second powder being a Fe-X ferro-alloy or a "master alloy powder" including some or all the components selected from Cr, Mn, V and Nb.

5.2 The appellant is right in saying that document D2 does not disclose a specific example comprising the blend of iron powder with two separate ferro-alloy powders. Sample 5 in trial 2 only specifies the (final) alloy composition comprising Cr + Mn. Although document D2 mentions in column 4, lines 2 to 6 that the ferro-alloy must include "at least one" metal selected from Cr, Mn, V and Nb and may include other transition elements as well, the most preferred embodiments are those in which no transition element other than Cr, Mn, V and Nb is present (cf. D2, column 4, lines 22 to 24). This teaching is in line with the disclosure in D2, column 4, line 59 to column 5 line 20 and column 6, line 60 to column 7, line 10 saying that chromium, vanadium, manganese and niobium are incorporated by commercially available (separate) Fe-Cr, Fe-Mn, Fe-V and Fe-Nb ferro-alloys. D2 neither explicitly discloses nor suggests that a master alloy powder consisting of a multi-component ferro-alloy has to be prepared, as alleged by the appellant. In fact, nothing in document D2 is actually teaching away from using one or more separate ferro-alloys to form the second powder. On the

contrary, the easiest and cheapest method for producing a multi-component alloy is blending separate powders selected from elemental iron powder with one or two or more commercially available ferro-alloy powders. This processing route is well known to those skilled in powder metallurgy and is for instance described in document D4, page 6, last paragraph to page 7, first paragraph and example 1, irrespective of whether or not the final sintering temperature of 1150°C to 1250°C in this known process is lower than that stipulated in the claimed process.

5.3 Consequently, claim 1 of the auxiliary is also not allowable for lack of inventive step of its subject matter.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

V. Commare R. Ries