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Datasheet for the decision of 21 June 2012

Case Number: T 1662/10 - 3.2.08

Application Number: 02078834.5

Publication Number: 1293577

IPC: C21D 1/10, C21D 9/32, H05B 6/40

Language of the proceedings: EN

Title of invention:
Induction processing with the aid of a conductive shield

Applicant:
The Boeing Company

Headword:
-

Relevant legal provisions:
EPC Art. 56, 111(1)

Keyword:
"Remittal - (no)"
"Inventive step - (no)"

Decisions cited:
T 0170/86

Catchword:
-

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Case Number: T 1662/10 **-** 3.2.08

D E C I S I O N
of the Technical Board of Appeal 3.2.08
of 21 June 2012

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 9 March 2010 refusing European patent application No. 02078834.5 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: T. Kriner
Members: M. Alvazzi Delfrate
I. Beckedorf

Summary of Facts and Submissions

I. By decision posted on 9 March 2010 the examination division refused European Patent application No. 02 078 834.5.

II. The appellant lodged an appeal against this decision on 11 March 2010, paying the appeal fee on the same day. The statement setting out the grounds for appeal was filed on 9 July 2010.

III. Oral proceedings before the board of appeal were held on 21 June 2012. The appellant requested that the appealed decision be set aside and that the case be remitted to the department of first instance, alternatively, that a patent be granted on the basis of one of the set of claims filed as main request with letter of 21 May 2012 and as auxiliary request with letter of 9 July 2010.

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

"A method for induction heating a workpiece made of an alloy showing an austenitizing or solution temperature and a fusion or melt temperature, the workpiece having at least one current concentrating surface, wherein the workpiece comprises corrosion resistant steel, wherein the workpiece is a gear comprising a plurality of teeth extending radially from a root region and made of a ferrous alloy characterized by an austenitizing temperature and a fusion temperature less than 222°C, 400°F, higher than the austenitizing temperature, and the method comprising the steps of:

placing a non—magnetic, electrically conductive shield in proximity to the current concentrating surface of the workpiece to provide a shielded portion of the workpiece including the root region of the gear and an unshielded portion of the workpiece including the teeth of the gear;
providing a magnetic coil;
positioning the gear with the conductive shield in place within the magnetic coil;
exposing the workpiece with the shield in place to a time varying magnetic field having a frequency sufficient to induce eddy currents in a skin depth of a surface of the shield and the workpiece;
wherein the unshielded teeth of the gear are heated to a temperature higher than the austenitizing or solution temperature and the shielded root region of the gear is heated to a temperature less than the fusion or melt temperature; and
quenching the workpiece."

Claim 1 of the auxiliary request reads as follows:

"A method for heat treating a gear, the gear made of a material characterized by an austenitizing or solution temperature and a fusion or melt temperature, the gear comprising a plurality of gear teeth extending radially from a root region of the gear, the method comprising the steps of:
placing a non—magnetic conductive shield in proximity to the root region of the gear;
exposing the gear with the shield in place to a source of time varying magnetic flux, wherein the magnetic flux varies with a frequency sufficient to induce eddy currents in a skin depth of a surface of the gear and

wherein the shield is in sufficiently close proximity to at least substantially reduce the eddy currents in the root region of the gear, wherein the conductive shield is made of a material more highly conductive than the alloy of the gear, and the shield is greater than 3 skin depths thick, wherein the conductive shield is made of a material selected from the group consisting of aluminium, gold, and alloys thereof, wherein the gear material comprises corrosion resistant steel."

V. The following documents play a role in the present decision:

D1: JP -A- 55 113836 (as well as an English translation of D1; D1A);
D3: US -A- 574 751; and
D5: GB -A- 2 328 448.

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

Remittal

The present main and auxiliary requests corresponded in essence to the fourth and fifth auxiliary requests underlying the appealed decision, which had been found by the examining division to lack an inventive step in view of D1.

By contrast, in its communication annexed to the summons to the oral proceedings the board of appeal indicated that D5, which was not mentioned in the decision under appeal, could be seen as the closest

prior art. Hence, the appellant was confronted with a new line of attack. In order to give the appellant the opportunity of having this new line of attack examined not only in appeal proceedings, but at two levels of jurisdiction, the case should be remitted to the department of first instance, in agreement with the decision T 170/86.

Main request

Before the priority date, gears made of corrosion resistant steel with a gap between austenitizing temperature and fusion temperature of less than 222°C were not treated by induction hardening but rather by the plating treatment discussed in paragraph [0006] of the application in suit, which was to be seen as the closest prior art.

Moreover, even among the documents relating to induction hardening, D1 could not be considered to be the most relevant one. D3, which, as the application in suit, recognized the importance of acting on the distribution of the eddy currents, was more relevant than D1, which sought to obtain a shielding effect based on the heat conduction of the shield.

In any event, the subject-matter of claim 1 of the main request involved an inventive step even when starting from D1. This document did not disclose the application of induction hardening to corrosion resistant steel with a gap between austenitizing and fusion temperature of less than 222°C. Moreover, the fact that it focussed on avoiding quenching cracks and did not mention the problems associated with such a small temperature gap

clearly showed that such an application was not to be considered.

Moreover, although induction heating of gears had been known for a number of years, there was no prior art document disclosing its application to gears made of corrosion resistant steel. Hence, there was a prejudice in the art against that application and it was not obvious to apply the method of D1 to such materials.

In addition, the feature according to which the shielded portion of the workpiece included the root region of the gear was also not known from D1, because according to this document only the central region of the gear was covered by the shield. Since D1 was not concerned with the suppression of the eddy current but merely with the transmission of heat, which did not require covering the root region, it was also not obvious to provide this feature.

As a consequence, the subject-matter of claim 1 of the main request involved an inventive step.

Auxiliary request

As already explained, D1 neither disclosed the application of its method to corrosion resistant steels nor that the shield was in sufficiently close proximity to at least substantially reduce the eddy currents in the root region of the gear.

Moreover, the features according to which the conductive shield is made of a material selected from the group consisting of aluminium, gold and alloys

thereof and the shield is greater than 3 skin depths thick were also not known from D1. In particular, the latter feature could not be clearly derived from Figures 7 and 8 of D1, as the examining division stated, since this document did not mention the skin depth at all.

Furthermore, it was clear from paragraphs [0022] to [0025] of the application in suit that the selection of the thickness of the shield was not an arbitrary choice, but provided an efficient shielding. Since this selection was not hinted at by D1, an inventive step of claim 1 of the auxiliary request was justified on this ground too.

Reasons for the Decision

1. The appeal is admissible.

2. The appellant's request to remit the case to the department of first instance is based on the wish to have the line of attack starting from D5 examined not only in the appeal proceedings, but at both the administrative and judicial instance. Hence, in order to decide on this request, it must first be considered whether it is necessary for the present decision to consider this line of attack or if it is sufficient to consider the line chosen by the examining division in the decision under appeal, wherein D1 was selected as the most relevant prior art.

3. Claim 1 of the main request - Inventive step in view of D1

3.1 D1 undisputedly discloses a method for induction heating a workpiece made of an alloy showing an austenitizing or solution temperature and a fusion or melt temperature, the workpiece having at least one current concentrating surface, wherein the workpiece is a gear (2) comprising a plurality of teeth (21) extending radially from a root region and made of a ferrous alloy (for instance S45C, see example), the method comprising the steps of:
placing a non—magnetic, electrically conductive shield (4, 41) in proximity to the current concentrating surface of the workpiece to provide a shielded portion of the workpiece and an unshielded portion of the workpiece including the teeth of the gear (see Figures 3 and 5);
providing a magnetic coil (3);
positioning the gear with the conductive shield in place within the magnetic coil (see Figures 3 and 5);
exposing the workpiece with the shield in place to a time varying magnetic field having a frequency sufficient to induce eddy currents in a skin depth of a surface of the shield and the workpiece (see claim);
wherein the unshielded teeth of the gear are heated to a temperature higher than the austenitizing or solution temperature and the shielded root region of the gear is heated to a temperature less than the fusion or melt temperature (see claim); and quenching the workpiece (see page 6 of D1A, first full paragraph).

3.2 Present claim 1 does not define what is to be understood as the "root region" of the gear. Accordingly, said region is considered to comprise not

only the edges of the roots but also the region in their vicinity.

D1 discloses that the shield extends up to the vicinity of said edges (see D1A, paragraph bridging pages 3 and 4) so that it is possible to achieve a zero depth of hardened layer at said edge regions (see D1A, page 6, lines 7-10). Hence, although it is true that in Figures 2 to 6 the shield (4, 41) does not extend to reach the edges of the root (22) of the teeth, D1 discloses a method wherein the shielded portion of the workpiece includes the root region of the gear.

Therefore, the sole feature that distinguishes the method according to claim 1 of the main request from the method known from D1 is its application to a workpiece of corrosion resistant steel with a fusion temperature less than 222°C, 400°F, higher than the austenitizing temperature.

3.3 To decide whether or not an inventive step in view of D1 is present, it must thus be established whether or not it was obvious to apply the known method to a workpiece made of corrosion resistant steel in accordance with claim 1.

The appellant submitted that this was not the case, since there was a prejudice in the art against the treatment of gears made of corrosion resistant steels by induction hardening, and D1 did not address the problem of materials having a small gap between austenitizing and fusion temperature.

These arguments are not convincing. First there is no evidence of the existence of said prejudice. The lack of documents cited by the appellant in this respect could at most support the novelty of the treatment of gears made of corrosion resistant steels by induction hardening, but does not prove the existence of a prejudice, i.e. an opinion or preconceived idea widely or universally held by experts in that field, against it.

Moreover, the fact that D1 does not mention any problems concerning materials with a small temperature gap between austenitizing and fusion temperature indicates merely that no hindrance is seen in this respect, and not that the method disclosed in this document is not to be applied to said materials.

Hence, there was no reason not to apply the method according to D1 to a gear made of corrosion resistant steel with a gap between austenitizing and fusion temperature of less than 222°C. Rather on the contrary, this was an obvious choice when the gear was to be used in a corrosion-prone environment, where said corrosion resistant steels are commonly used.

Accordingly, the subject-matter of claim 1 of the main request does not involve an inventive step in view of D1.

4. Claim 1 of the auxiliary request - Inventive step in view of D1

4.1 For the reasons given above, D1 discloses a method for heat treating a gear, the gear made of a material with

an austenitizing or solution temperature and a fusion or melt temperature, the gear comprising a plurality of gear teeth extending radially from a root region of the gear, the method comprising the steps of:
placing a non—magnetic conductive shield in proximity to the root region of the gear;
exposing the gear with the shield in place to a source of time varying magnetic flux, wherein the magnetic flux varies with a frequency sufficient to induce eddy currents in a skin depth of a surface of the gear (see Figures 3 and 5 and claim) and wherein the conductive shield is made of a material more highly conductive than the alloy of the gear (see D1A, page 4, second full paragraph).

Moreover, as also already explained, D1 discloses that the shield extends into the root region of the gear. Hence, in said region the eddy currents are reduced. Accordingly, contrary to the appellant's view, D1 discloses that the shield is in sufficiently close proximity to at least substantially reduce the eddy currents in the root region of the gear.

Hence, the claimed method is distinguished over the method known from D1 by its application to corrosion resistant steels, and by the features according to which the conductive shield is made of a material selected from the group consisting of aluminium, gold, and alloys thereof, and the shield is greater than 3 skin depths thick.

4.2 The feature according to which the conductive shield is made of a material selected from the group consisting

of aluminium, gold, and alloys thereof cannot be associated to any technical effect.

Contrary to what has been submitted by the appellant the same applies to the feature according to which the shield is greater than 3 skin depths thick. In particular paragraphs [0022] to [0025] of the application in suit merely indicate that the thickness of the shield should generally be a minimum of about 10 skin depths and are completely silent on a possible effect of the selection of a range of greater than 3 skin depths for the thickness.

Hence, both these features are arbitrary choices, which merely address the problem of choosing an appropriate material and an appropriate thickness for the shield.

4.3 According to D1, the shield is made of a metal having good thermal conductivity such as, for example, brass or copper (see D1A, page 4, last paragraph). Since aluminium, gold, and alloys thereof are materials known for exhibiting a good thermal conductivity, their choice as an appropriate material for the shield of D1 was obvious.

Moreover, as can be seen from Figure 8, in the example of D1 the hardened layer extends about 1-1.5 mm into the gear. The thickness of said hardened layer depends on the extent to which the eddy currents penetrate into the material, i.e. the skin depth. Hence, said skin depth is also of the order of about 1-1.5 mm. As Figure 7 shows that the shield has thickness of 4 mm a thickness of the shield greater than 3 skin depths is not far removed from that of the shield disclosed in

the example of D1. Hence, a thickness in accordance with claim 1 was an obvious choice for an appropriate thickness for the shield used in the method disclosed in D1.

Moreover, it has already been explained for the main request that the feature according to which the gear material comprises corrosion resistant steel cannot justify an inventive step.

Therefore, the subject-matter of claim 1 of the auxiliary request does not involve an inventive step in view of D1.

5. Accordingly, the subject-matter of claim 1 of both the main and the auxiliary request lacks an inventive step in view of D1, which was chosen as most relevant prior art by the examining division. As a consequence, it is not necessary to consider its obviousness in view of other, possibly even closer prior art, be it the plating treatment discussed in paragraph [0006] of the application in suit, D3 or indeed D5.

Therefore, it is superfluous to consider the obviousness of the claimed subject-matter starting from D5 in the appeal proceedings, let alone at two instances as requested by the appellant. Already for this reason, without the need to consider whether or not the introduction of a line of attack starting from D5 would have justified a remittal of the case to the department of first instance, the request of remittal is not granted.

6. As to the requests to grant a patent based on the claims filed as main request with letter of 21 May 2010 and as auxiliary request with letter of 9 July 2010, they cannot be granted either, since the subject-matter of claim 1 of both said requests does not involve an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

V. Commare T. Kriner