BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [ ] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 15 March 2007

Case Number: T 1255/05 - 3.2.07

Application Number: 00311633.2

Publication Number: 1113083

IPC: C22B 9/18

Language of the proceedings: EN

Title of invention:
Method for controlling flux concentration in guide tubes

Applicant:
GENERAL ELECTRIC COMPANY

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 123(2)

Keyword:
"Novelty (third to fifth auxiliary request - no, eighth auxiliary request - yes)"
"Extension beyond content of the application as originally filed (eighth auxiliary request - no)"
"Inventive step (eighth auxiliary request - no)"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1255/05 - 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 15 March 2007

Appellant: GENERAL ELECTRIC COMPANY
1 River Road
Schenectady
NY 12345 (US)

Representative: Pedder, James Cuthbert
London Patent Operation
General Electric International, Inc.
15 John Adam Street
London WC2N 6LU (GB)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 18 April 2005 refusing European application No. 00311633.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: H. Meinders
Members: H. Hahn
I. Beckedorf

Summary of Facts and Submissions

I. The applicant lodged an appeal against the decision of the Examining Division to refuse the European patent application No. 00 311 633.2.

The Examining Division held that the subject-matter of claim 1 of the main, the first and the second auxiliary request lacked novelty over D1 (= US-A-5 809 057) and that the subject-matter of claim 1 of the third auxiliary request, all requests as filed at the oral proceedings of 24 March 2005, lacked an inventive step in view of D1.

II. With a communication dated 29 January 2007 accompanying the summons to oral proceedings, the Board presented its preliminary opinion with respect to the claims 1 of these four requests underlying the appealed decision and maintained on appeal, and on claims 1 to 9 of the fourth auxiliary request as filed together with the grounds of appeal dated 23 August 2005.

The subject-matter of claim 1 of all requests was considered to extend beyond the content of the application as originally filed. This was due to the incorporation of new definitions in claim 1 which had no basis in the application as originally filed and because some features thereof were taken from specific embodiments of the application but had been generalised by omitting features which were only disclosed in combination with other features of these specific embodiments. The Board additionally considered these omitted features to represent essential features. Thus

all requests were considered to contravene Articles 84 and 123(2) EPC.

Although these requests did not appear to be formally allowable the Board also made substantive remarks with respect to said requests, as regards novelty and inventive step, referring to D1 as well as to D2 (= EP-A-0 874 206).

III. With letter dated 15 February 2007 the appellant submitted a new main request and auxiliary requests 1 to 8 in combination with further arguments.

IV. Oral proceedings before the Board were held on 15 March 2007.

The appellant finally requested that the decision under appeal be set aside and that a patent be granted on the basis of either the claims 1 to 10 of the third, fourth, or fifth subsidiary request as filed with its letter dated 15 February 2007, or that a patent be granted on the basis of claim 1 of the eighth subsidiary request as filed during these oral proceedings. The remaining main and subsidiary requests as filed with its letter dated 15 February 2007 were withdrawn.

V. Claim 1 according to the third subsidiary request reads as follows:

"1. A method for refining metal comprising:
contacting an unrefined metal with a slag in a crucible (12) with a discharge guide tube (22); and
passing a current through the slag to cause the metal to melt to a liquid condition; characterised by

directing an electromagnetic flux along an interior flux concentrating configuration of the discharge guide tube (22) having a constriction (133) between the ends of the discharge guide tube (22) concentrating electromagnetic flux in a central orifice (32) of the discharge guide tube (22) and consequently generating heat which heats the melted liquid metal and thus controls the flow condition of the melted liquid metal as it is discharged from the crucible (12) through the discharge guide tube (22)."

VI. Claim 1 according to the fourth subsidiary request differs from claim 1 of the third subsidiary request in that it additionally specifies in its preamble the materials of the discharge guide tube (22) to be "**of copper or other heat and electrically conductive material**" and that the wording in the characterising portion "between the ends of the discharge guide tube (22)" is replaced by "between the ends of the **tube**".

VII. Claim 1 according to the fifth subsidiary request differs from claim 1 of the fourth subsidiary request in that in its preamble the feature "**the discharge guide tube (22) comprising a base plate (28), a cooling system (40) and an induction heating system (38) having primary coils (38a) and secondary coils (38b) surrounding an extension of the base plate (28) with a gap defined therebetween**" is incorporated and in that in the characterising portion it is further specified that said electromagnetic flux is directed **"from the induction heating system (38)".**

VIII. Claim 1 according to the eighth subsidiary request reads as follows:

"1. A method for refining metal comprising: contacting an unrefined metal with a slag in a crucible (12) with a discharge guide (22) of copper or other heat and electrically conductive material, the discharge guide (22) comprising a base plate (28) having an extension (29) on its side away from the crucible (12), a central orifice (32) extending from the crucible to the end of the extension (29), a cooling system (40) and an induction heating system (38) having primary coils (38a) and secondary coils (38b) surrounding the extension of the base plate (28) with a gap defined therebetween to permit movement of induction heating system (38) relative to the extension (29); and
directing an electromagnetic flux along an interior flux concentrating configuration in the central orifice (32) comprising:
a first central orifice portion (131);
a second central orifice portion (135);
a reduced diameter central orifice portion (132) of a reduced diameter as compared to the first and second central orifice portions (131, 135);
a first inclined central orifice ramp portion(130); and
a second inclined central orifice ramp portion (134);
wherein the first inclined central orifice ramp portion (130) extends from the first central orifice portion (131) to the reduced diameter central orifice portion (132), and the second inclined central orifice ramp portion (134) extends from the reduced diameter central orifice portion (132) to the second central orifice portion (135)

directing the electromagnetic flux in the central orifice (32) of the discharge guide (22) in the reduced diameter central orifice portion (132) and consequently generating heat which heats the melted liquid metal and thus controls the flow condition of the melted liquid metal as it is discharged from the crucible (12) through the central orifice (132)."

IX. In addition to document D1 the following document submitted during the oral proceedings before the Board was considered:

E-mail from Mr William T. Carter dated 14 March 2007 sent to Mr Jim Pedder

X. The appellant argued essentially as follows:

The subject-matter of claim 1 of the third to fifth subsidiary request and of the eighth subsidiary request is novel over the process of D1 because the discharge guides shown in D1 do not contain a constriction in the central orifice (i.e. the tube), let alone one having the specified first inclined central orifice ramp portion, a reduced diameter central orifice portion and a second inclined central orifice ramp portion. A constriction is not a simple reduction of the diameter of a tube. It requires a specific shape of the tube which allows to provide a proper flow of the melt and to control the speed of the melt flow by controlling the temperature thereof. To obtain an appropriate magnetic flux the constriction must have two wider portions on both ends of the tube. The arrangement of the embodiment according to figure 11 of D1 does not show such a constriction which concentrates the

magnetic field. Likewise the embodiment according to figure 13 of D1 is not effective and is purely an arrangement to be connected with a piping without influencing the flow rate of the melt. Furthermore, according to the passage at column 9, lines 40 to 49 of D1 the magnetic field of the induction coils only controls the slag skull but not of the melt flow in the tube. Contrary to the control of the slag skull as described in D1 the present invention enables to control the temperature of the melt. Portion 152 of the embodiment of the central orifice according to figure 7 of the present application forms the wider portion of the constriction which also helps to concentrate the magnetic flux. This embodiment represents an alternative solution.

Claim 1 of the eighth subsidiary request is based on claim 1 and page 9, lines 18 to 20 and page 14, lines 4 to 15 and figure 6 of the application as originally filed. Furthermore, claim 1 of the eighth subsidiary request comprises all essential features so that the requirements of Articles 84 and 123(2) EPC are met.

The process of claim 1 of the eighth subsidiary request is novel over D1 and involves an inventive step. The specific arrangement for concentrating the magnetic flux in the orifice is neither disclosed nor suggested in D1. The inventors found that a temperature control of the refined metal in the central orifice is possible by concentrating the magnetic flux in the central orifice having such a constriction whereby at high power applied the molten stream flow rate decreases due to electromagnetic effects at the orifice which decreases the diameter of the stream (compare E-mail of

Mr Carter). The process using the apparatus arrangement according to D1 is not suitable for the intended purpose since it does not provide a concentration of magnetic flux. Furthermore, it is essential according to the invention that the said orifice comprises the three parts of the first inclined ramp portion, the reduced diameter central portion and the second inclined ramp portion. The further distinction with respect to D1 is the gap between the extension of the base plate and the induction heating system for allowing vertical movement of that heating system which allows to provide the magnetic flux at the correct position of the said constriction. The combination of these features - constriction and vertical movement of the induction heating system - results in the control of the melt flow in said orifice. Such an effect is neither described in D1 nor foreseeable by the skilled person. In this context it should be considered that the inventors of D1 are the same as those of the present application. Therefore claim 1 of the eighth subsidiary request involves an inventive step.

Reasons for the Decision

1. *Novelty (Article 54 EPC)*

Fifth subsidiary request

1.1 The Board comes to the conclusion that claim 1 of the more restricted fifth subsidiary request lacks novelty over the disclosure of D1 for the following reasons:

1.1.1 D1 discloses an electroslag apparatus 10 comprising a melt guide 22 for enclosing a bottom of an electroslag refining crucible 12. An ingot 14 is resistively heated and melted by carrying electrical current from an electrical current power supply 20a through it and through the slag 18. A discharge guide tube in the form of a central drain 32 extends through the base plate 28 for draining the melt by gravity from the reservoir 24. Said base plate 28 comprises cooling means 26. Induction heating coils 38a, 38b are mounted below the base plate lower surface for heating the melt (see column 3, line 53 to column 5, line 61). The induction coils heat the melt by transmitting electromagnetic energy through the slots 34 whereby the heating of the melt 14a into and through the drain 32 may be controlled for controlling the thickness of the ingot skull 14b above the base plate 28 as well as through the drain. The draining flow rate of the melt 14a may thereby be accurately controlled for achieving a steady state operation of the electroslag refining corresponding with the melting rate of the ingot 14 (see column 6, line 14 to column 7, line 22; column 9, lines 40 to 49; figures 1 to 4).

1.1.2 D1 is as such silent with respect to a gap between the induction coils and the said extension of the melt guide 22. However, the present wording also allows for a gap existing between the primary and the secondary induction coils. Such an arrangement is clearly derivable from figures 9 and 11 of D1.

1.1.3 The embodiment of figure 11 of D1 shows a melt guide 22E which - likewise as the melt guide 22D according to figure 9 - has an extension in the direction of said

discharge guide tube - central drain 32 - which is surrounded by primary and secondary coils for induction heating of the melt. In the context of figures 2 to 4 and figures 9 to 10 it is stated that the primary coils 38a are arranged according to D1 closely adjacent and surrounding the drain 32 for heating the melt 14a discharged **therethrough** and for controlling the thickness of the skull formed **therein**, i.e. in the discharge guide tube while the secondary coils 38b transmit electromagnetic energy into melt 14a in the reservoir 24 (see column 6, lines 14 to 26; column 7, lines 7 to 22; column 9, lines 20 to 64; column 10, lines 53 to 60; figures 9, 11 and 13).

1.1.4 Hence the melt guide according to figure 11 of D1 comprises a drain 32 (i.e. the discharge guide tube) which at the entry side from the crucible 12 comprises a first inclined ramp portion 32a extending to a second inclined ramp portion, and further extending to a reduced diameter portion 32b. To the Board this suffices to qualify as a "constriction between the ends of the guide tube" as claimed. The constriction 32b ends at the lower end of the extended insert 42E (see also column 9, line 57 to column 10, line 7). Furthermore, said constriction portion 32b in said drain 32 of the melt guide 22E is concentrically surrounded by the primary coil 38a of the heating system 38.

1.1.5 Applying current to said primary coil 38a of the melt guide arrangement of figure 11 (compare point 1.1.4 above) generates an electromagnetic field. This electromagnetic field creates heat and an electromagnetic flux in said drain 32. By increasing

the current and thereby increasing the electromagnetic field also the resulting heat is increased whereby the skull 14b is re-melted. By generating said heat and said electromagnetic flux the metal is kept molten in said drain 32 and the flow of the molten metal through said drain 32 is controlled. On the other hand by reducing the current and in consequence decreasing the electromagnetic field, its flux will be reduced and a resulting skull will be formed in said drain 32 whereby the flow of molten metal will be decreased. The electromagnetic flux produced in said drain 32 will depend upon the profile of the latter and the flux in the constriction 32b will be higher than that created in the aforementioned inclined ramp portions of the remainder of the drain 32.

1.1.6 In this context the Board points out that in the description of the present application it is described what happens to the flow of the molten metal in such an arrangement comprising a central orifice 32 having a constriction 133 when current is applied to the primary coil 38a. The application mentions that by applying an electromagnetic field from the primary coil 38a onto the central orifice 32 a magnetic flux depending upon the interior profile of the central orifice 32 is generated which creates heat therein and this heat then heats the molten metal but likewise re-melts the skull 14b that is disposed proximate the central orifice 32. By reducing the current in the primary coil 38a the flux and the heat will be decreased whereby more skull 14b around the area of the orifice is formed (see e.g. page 12, second paragraph to page 14, first paragraph; page 15, third paragraph to page 16, second paragraph).

As a consequence, the appellant's arguments that according to the present application the temperature would be controlled whereas according to D1 the skull would be controlled cannot be accepted.

1.1.7 The appellant's argument that the drain 32 according to figure 11 of D1 would not contain a constriction cannot be accepted either. This is due to the fact that the schematic drawings of the application show configurations of the central orifice (32), for which the description states that they comprise an angled and stepped profile which can comprise any angle for the inclined ramp portions and of which all lengths may vary (see page 14, lines 4 to 6 and lines 16 to 25). Consequently, the configuration according to figure 11 of D1 is not excluded by these definitions.

1.1.8 The appellant's argument concerning the magnetic effect caused in the constriction at applied high power cannot be accepted either since claim 1 does not comprise a corresponding limiting feature but only defines that the electromagnetic flux generates "heat which heats the melted liquid metal and thus controls the flow condition of the melted liquid metal as it is discharged from the crucible through the discharge guide tube (22)".

1.1.9 The appellant's argument that the constriction must have two wider portions on both sides thereof to obtain an appropriate magnetic flux cannot be accepted either, taking account of the embodiment according to figure 7 of the present application which comprises a single constriction portion 235 that extends over the entire central orifice 232 length and terminates at the wall

151 (see page 17, lines 6 to 24). Also the statement that portion 152 would be part of the central orifice cannot be accepted in view of said passage at page 17 of the application, which states the opposite.

1.1.10 The process of D1 inherent to the use of the embodiment including said melt guide comprising a constriction in its drain 32 in accordance with figure 11 is thus considered to meet all the requirements of the process of claim 1 of the fifth subsidiary request. Hence claim 1 of the fifth subsidiary request lacks novelty and thus does not meet the requirement of Article 54 EPC. The fifth subsidiary request is therefore not allowable.

Third and fourth subsidiary requests

1.2 Since claim 1 of the fifth subsidiary request is narrower in scope than claim 1 of the third and of the fourth subsidiary request (compare points V to VII, above) the above conclusion with respect to claim 1 of the fifth subsidiary request applies *mutatis mutandis* to claim 1 of the third and of the fourth subsidiary request.

The Board therefore concludes that claim 1 of the third and of the fourth subsidiary request does not meet the requirements of Article 54 either. Consequently, the third and the fourth subsidiary request are not allowable, too.

Eighth subsidiary request

1.3 Taking account of the wording of claim 1 of this request which requires a central orifice which comprises a first central orifice portion; a second central orifice portion; a reduced diameter central orifice portion of a reduced diameter as compared to the first and second central orifice portions; a first inclined central orifice ramp portion; and a second inclined central orifice ramp portion; wherein the first inclined central orifice ramp portion extends from the first central orifice portion to the reduced diameter central orifice portion, and the second inclined central orifice ramp portion extends from the reduced diameter central orifice portion to the second central orifice portion, it is evident that its subject-matter is novel over D1. Claim 1 of the eighth subsidiary request therefore meets the requirement of Article 54 EPC.

2. *Admissibility of amendments (Articles 84 and 123(2) EPC)*

Eighth subsidiary request

2.1 Claim 1 of the eighth subsidiary request is based on claim 1 of the application as originally filed. The further features are taken from or can be derived from page 9, lines 18 to 20; page 12, lines 24 to 28; page 14, lines 4 to 15; and figures 2 to 7 of the application as originally filed.

Hence claim 1 of the eighth subsidiary request is considered to meet the requirement of Article 123(2) EPC.

2.2 Claim 1 is additionally considered to meet the requirements of Article 84 EPC since it comprises all the essential features.

3. *Inventive step (Article 54 EPC)*

3.1 The electroslag refinement process according to D1, particularly the one according to the embodiment of figure 11, is considered to represent the closest prior art for the method of claim 1 of the eighth subsidiary request (compare the paragraphs 1.1.1, 1.1.3, and 1.1.5 above).

3.2 The method of claim 1 differs from the process according to D1 by the features recited in point 1.3 above.

3.3 The appellant argued that the objective problem to be solved by claim 1 would be to provide a further control of the flow of the molten metal in the central orifice. This would be achieved by a magnetic effect caused by the electromagnetic flux at high power in the constriction portion of the central orifice (see E-mail of Mr Carter). This argument firstly cannot be accepted since claim 1 of the eighth subsidiary request does not contain any corresponding limiting features (compare paragraph 1.1.8 above) and secondly for the following further reasons.

3.3.1 Even accepting the fact that according to present claim 1, the gap exists between the induction coils on the one hand and the extension of the base plate on the other, permitting vertical movement of the coil(s),

only the embodiment according to figure 6 of the present application would allow to position the vertically movable primary coil 38a over the constriction portion 133 of the central orifice 32 in order to obtain such a magnetic effect as alleged by the appellant. According to the remaining specific embodiments of figures 5 and 7 the primary coil 38a is positioned directly below the base plate 28 or 128 so that it either surrounds only the downstream end of said constriction portion 133 in the extension 29 (figure 5) or the constriction portion 233 is not surrounded by the primary coil 38a at all (figure 7).

3.3.2 Furthermore, taking account of these two embodiments which are also stated to be suitable for controlling the flow of the molten metal, it is evident that the possibility of vertically moving the induction heater system 38 relative to the extension 29 according to claim 1 is actually not critical for controlling the flow of the molten metal. Consequently, no combinatorial effect obtained by moving the primary coil 38a vertically over the constriction portion 133 is credible for claim 1.

3.3.3 The appellant did not argue with respect to any other effect which would be related to the second ramp portion at the exit side of the central orifice.

In this context the Board points out that it is evident from the embodiment of figure 7 of the application that such a second inclined ramp portion at the exit side is not necessary for controlling the flow through the central orifice 32 which fact is admitted in the

description of the application (see page 17, third paragraph).

3.4 The Board therefore considers that the objective technical problem to be solved by the method of claim 1 is a less demanding one, namely simply the provision of an alternative process.

The solution to this problem proposed by the application is the method of claim 1 of the eighth subsidiary request. It is also credible that this problem has been solved.

3.5 The solution according to claim 1 is, however, considered to be obvious in view of D1 and the common general knowledge of the skilled person.

3.6 As already considered in point 1.1.5 above the induction coils 38a of D1 are arranged in the region of the reduced diameter orifice portion of the drain 32, i.e. the constriction portion, so that by applying a current to said coils 38a by necessity an electromagnetic flux is induced in the constriction portion 32b which allows to control the flow of the molten metal through the drain 32 by either increasing or decreasing the heat which results from said flux and the electromagnetic field induced by said current.

3.6.1 A vertically movable induction heating system which can be moved relative to the extension of the melt guide belongs to the state of the art as is acknowledged in the present application (see page 3, second paragraph).

Thus the skilled person would have included such an apparatus design feature into the process of D1. In any case, as considered in point 3.3.2 above, this feature of claim 1 is actually not critical for carrying out the claimed method for controlling the flow of the molten metal through the central orifice and is therefore considered to be arbitrarily chosen.

3.6.2 Likewise, as already mentioned in point 3.3.3 above, the second ramp portion at the exit side of the central orifice is considered not to be critical either, taking account of the statement in the application that "The stepped and angled profile of the central orifice 232 can be formed by an inclined central orifice ramp portion 230 that extends from a surface 128' of the base plate 128 to a constriction 233 in the central orifice 232. The constriction 233 may comprise a single constriction 235 (solid lines in Fig. 7) that extends over the entire central orifice 232 length and may terminate at the wall 151" (see page 17, third paragraph).

As no effect has been made credible by the appellant which could be attributed to the second ramp portion at the exit side of the central orifice this feature is likewise considered to be arbitrarily chosen.

3.6.3 The appellant argued that the apparatus according to D1 would not be suitable for inducing an electromagnetic flux in its drain. This argument cannot be accepted since the claimed arrangement of the apparatus elements in question (e.g. the primary coils, the melt guide, the central orifice, etc.) is the same as in D1 so that the use thereof is considered to result in the same

known effects of generating an electromagnetic field which induces an electromagnetic flux and heat, particularly as the primary coil 38a according to D1 is placed over the constriction portion of said drain 32. Thus the arrangement according to figure 11 of D1 actually must achieve the same effect as is obtainable with a movable primary coil and the constriction according to the present application.

3.7 The subject-matter of claim 1 of the eighth subsidiary request is therefore considered to lack an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Nachtigall H. Meinders