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File Number: 88/90 - 3.2.5

Application No.: 83 104 804.6

Publication No.: 0 095 645

Title of invention: Method and apparatus for melting and casting metal

Classification: B22D 37/00

D E C I S I O N
of 17 March 1993

Applicant: COSWORTH RESEARCH AND DEVELOPMENT LIMITED

Opponent: Swedish Furnace AB

Headword:

EPC Art. 56, 123(2)

Keyword: "Inventive Step (yes)"



Case Number : T 88/90 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 17 March 1993

Appellant : COSWORTH RESEARCH AND DEVELOPMENT LIMITED
(Proprietor of the patent) Hylton Toad
GB - Worchester WR2 5JS (GB)

Representative : Leach, John Nigel
FORRESTER & BOEHMERT
Franz-Joseph-Straße 38
W - 8000 München 40 (DE)

Respondent : Swedish Furnace AB
(Opponent) Box 134
S - 734 01 Hallstahammar (SE)

Representative : Arwidi, Bengt
AHLPATENT AB
Hemstigen 21
S-552 66 Jönköping (SE)

Decision under appeal : Decision of the Opposition Division of the
European Patent Office dated 7 November 1989 with
written reasons posted on 5 December 1989 revoking
European patent No. 0 095 645 pursuant to
Article 102(1) EPC.

Composition of the Board :

Chairman : C.V. Payraudeau
Members : A. Burkhart
H.J. Seidenschwarz

Summary of Facts and Submissions

- I. The Appellant appealed against the decision of the Opposition Division, by which the European patent No. 0 095 645 had been revoked on the ground that its subject-matter was not patentable with respect to Article 56 EPC.
- II. The Appellant requested that the decision under appeal be set aside and that the patent be maintained in amended form with Claims 1 to 13, description, pages 1 to 16, and figures 1 to 3 filed on 18 December 1992 with letter of 14 December 1992 (main request), or on the basis of Claims 1 to 11 or Claims 1 to 6, filed on 7 January 1991 with letter of 3 January 1991 (first and second auxiliary requests).
- III. The Respondent requested that the appeal be dismissed.
- IV. Claims 1 and 9 of the main request read as follows:

"1. A method of melting and casting non-ferrous metal comprising the steps of melting the metal (M) in a melting vessel (10), intermittently transferring the metal (M) from the melting vessel (10) into a launder (17) and from there into a casting vessel (20) by flow of metal (M) under gravity and pumping the metal (M) against gravity from the casting vessel (20) into a mould (35) characterised by intermittently directing the metal (M) from the melting vessel (10) to fall freely into the launder (17) at an entry end thereof, directing the metal (M) from an exit end of the launder (17) to a filter box (24) disposed between the exit end of the launder (17) and the casting vessel (20), directing the metal (M) from the filter box (24) into the casting vessel (20), maintaining metal (M) in the launder with the top surface of the metal

(M) in the launder (17) at a first level (L_1) and the top surface of the metal (M) in the filter box (24) at a second level (L_3) which are at or above the level (L_2) of the top surface of the metal (M) in the casting vessel (20) whereby metal (M) flows upwardly through a replaceable porous refractory filter element disposed in the filter box, maintaining the lowest level which the top surface of the metal in the filter box (24) and the casting vessel (20) reaches during normal operation above the bottom of the launder (17) at the exit end, and maintaining the level of the top surface of the metal (M) as the metal (M) leaves the melting vessel (10) above the top surface of the metal (M) in the casting vessel (20) by not more than 200 mm."

"9. An apparatus for melting and casting non-ferrous metal comprising a melting vessel (10), a casting vessel (20), a pump (32) to pump metal (M) against gravity from the casting vessel (20) into a mould (35), a launder (17) to transfer metal (M) from the melting vessel (10) into the casting vessel (20) by flow of metal under gravity characterised in that the launder (17) has an entry end located so that metal (M) leaving the melting vessel (10) intermittently falls freely to enter the launder (17) thereat and an exit end whereby the metal (M) may flow from the launder (17) to a filter box (24), having a replaceable porous refractory filter element (30) therein, positioned between the exit end of the launder (17) and the casting vessel (20), means to direct metal (M) from the filter box (24) into the casting vessel (20), the launder (17) being disposed to maintain metal in the launder with the top surface of the metal (M) in the launder (17) at a first level (L_1) and the top surface of the metal in the filter box (24) at a second level (L_3) which are below the level of the top surface of the metal (M) as it leaves the melting vessel (10) and are at or

above the level (L₂) of the top surface of the metal (M) in the casting vessel (20), for upward flow of metal through the filter element (30) from the launder to the casting vessel (20), the launder (17) and the casting vessel (20) being disposed so that the bottom (18) of the launder at the exit end is below the lowest level which the top surface of the metal in the casting vessel (20) reaches during normal operation and the level of the top surface of the metal (M) as the metal (M) leaves the melting vessel (10) being maintained above the top surface of the metal (M) in the casting vessel (20) by not more than 200 mm."

V. The following prior art documents were referred to during the appeal proceedings:

D1: GB-A-1 439 875

D4: "Engineering", Volume 221, No. 3, March 1981,
pages 185 to 188

D5: GB-A-2 046 707.

VI. The Appellant's (Patentee's) submissions can be summarised as follows:

The combination of the features according to the characterising portion of Claims 1 or 9 of the main request is not suggested by the teachings of documents D1 or D4. The documents D1 and D4 are only concerned with avoiding problems due to oxide entrainment during transfer. They do not recognise the problem of impurities already present in the melting vessel, nor do they address a solution to this problem. Document D1 does not permit metal treatment to be satisfactorily carried out in the melting vessel and suffers from temperature control problems. A reader of document D1 would be given no guidance to suggest that satisfactory castings could be

attained whilst permitting free fall of metal into the launder. Document D1 could only teach that no fall at all should be permitted. For that reason alone, document D1 would not be considered of assistance by a person skilled in the art since intermittent fall of metal freely into the launder is the essence of the present invention. In addition, documents D1 and D4 do not teach providing a filter in the metal melt feed system. Neither do the documents D1 and D4 recognise the need to maintain the launder full of metal despite intermittent feed and the need to filter upwardly through a replaceable porous refractory filter element to achieve quiescent flow.

Therefore, the method according to Claim 1 and the apparatus according to Claim 9 are both new and involve an inventive step.

The late-filed document D5 should be disregarded by the Board.

VII. The Respondent's (Opponent's) submissions can be summarised as follows:

The new claims are rather inconsistent with the claims of the granted patent and with the invention as presented in the patent specification. In these new claims, the patentee has underlined features, like "free fall of the metal into the launder" and "intermittent transfer of the metal to the launder", that have not been given patentable weight in the original specification, but have been selected now only with regard to what can be, and cannot be, respectively, found in the cited documents D1 and D4.

The subject-matter of the claims according to both the main request and the auxiliary requests seems to lack an

inventive step having regard to the teachings of documents D4 and D1.

Document D5 was only introduced because of the patentee's counter-arguments that a combination of the teachings of documents D1 and D4 would not be obvious to the person skilled in the art.

Reasons for the Decision

1. Amendments

The independent Claims 1 and 9 according to the main request have been amended by adding the following features to the respective claims of the granted patent:

- (i) the metal is intermittently directed from the melting vessel to fall freely into a launder at an entry end thereof,
- (ii) the metal is directed from an exit end of the launder to a filter box disposed between the exit end of the launder and the casting vessel,
- (iii) the metal is maintained in the launder with the top surface of the metal in the launder at a first level L_1 and the top surface of the metal in the filter box at a second level L_3 which are at or above the level L_2 of the top surface of the metal in the casting vessel whereby metal flows upwardly through a replaceable porous refractory filter element disposed in the filter box,
- (iv) the lowest level which the top surface of the metal in the filter box and the casting vessel reaches

during normal operation is maintained above the bottom of the launder at the exit end.

These additional features are disclosed in the originally filed application documents as follows:

Feature (i): Claims 3 and 6; page 4, lines 20-26; page 5, lines 3-9; page 11, lines 5-10 and 18-24; Figure 1.

Feature (ii): Claim 13, page 4, lines 29 and 30; page 10, lines 8-13; Figure 1.

Feature (iii): page 10, lines 18-36; Figures 1, 4 and 6.

Feature (iv): Claim 7; page 12, lines 15-19.

The Respondent objected that the aforementioned additional features (i) to (iv) "have not been given patentable weight in the original specification", which objection appears to have been raised under Article 123(2) EPC.

This objection of the Respondent is not justified. The features (i) to (iv) are disclosed in the above-mentioned passages of the originally filed application documents as forming part of the invention as originally filed. When considering conformity of the amendments with Article 123(2) EPC, it does not matter whether or not the features in question are presented as essential in the originally filed application documents, or whether or not these features are defined in the granted patent as essential features supporting the patentability of the subject-matter of the independent claims, but it is sufficient that these features be disclosed in the originally filed application documents in combination with the other features.

The subject-matter of the dependent claims according to the main request is disclosed in the originally filed application documents as follows:

Claim 2: see page 4, lines 3-9; page 5, line 5; figures 5 and 6.

Claim 3: see page 3, lines 16 and 17.

Claim 4: see page 5, line 3.

Claim 5: see Claim 14.

Claim 6: see Claim 15.

Claim 7: see Claim 16.

Claim 8: see Claim 17.

Claim 10: see Claim 11.

Claim 11: see page 3, lines 16 and 17.

Claim 12: see page 5, line 3.

Claim 13: see Claim 12.

In conclusion, no features have been introduced in the claims which were not already contained in the application documents as filed. Moreover, the addition of the aforementioned new features to the independent claims restricts the scope of protection of these claims. Therefore, the claims on file do not contravene Article 123(2) and (3) EPC.

2. Novelty

Document D4 discloses a method and apparatus for melting and casting non-ferrous metal comprising the features of the preamble of Claims 1 and 9, respectively, according to the main request, namely that the metal is melted in a melting vessel, that the metal is intermittently transferred from the melting vessel into a launder and from there into a casting vessel by flow under gravity and that the metal is pumped against gravity from the casting vessel into a mould.

The method and apparatus according to Claims 1 and 9, respectively, differ from this prior art by the features of the characterising portions of Claims 1 and 9, respectively.

Document D1 discloses a method and apparatus for controlling the distribution of molten metal from a furnace, wherein molten metal is passed under gravity from the furnace through at least one substantially horizontal passage to a plurality of stations, the level of molten metal in the furnace is monitored and fresh metal is supplied to the furnace at substantially the same rate at which metal is used at the stations so as to maintain a predetermined level of molten metal in the furnace and thereby in the passage or passages.

The method and apparatus according to Claims 1 and 9, respectively, differ from this prior art in that the metal is intermittently directed from the melting vessel to fall freely into the launder, that the metal is pumped against gravity from the casting vessel into a mould and that a filter box is disposed between the exit end of the launder and the casting vessel, whereby the metal flows upwardly through a replaceable porous refractory filter element disposed in the filter box.

Document D5 does not disclose any of the features of the characterising portions of Claim 1 or Claim 9 of the main request.

Therefore, the subject-matter of Claims 1 and 9 according to the main request is novel.

3. Inventive step

3.1 In the method known from document D4, which represents the closest prior art, the level of the top surface of the metal, as the metal leaves the melting vessel and enters the steeply inclined launder, is considerably higher than the level of the top surface of the metal in the casting vessel so that the transfer flow of the metal into the casting vessel is not sufficiently smooth to avoid turbulences within the metal and to prevent particulate impurities to be entrained into the casting vessel, so that the casting quality is not high enough.

Therefore, the problem underlying the invention consists in providing a method wherein the metal is transferred from the melting vessel into the casting vessel in such a manner that turbulences in the liquid metal are avoided and a minimum of particulate impurities is entrained into the casting vessel, so that high quality castings can be produced (see page 2, lines 45 and 46 and lines 52 and 53; page 2, lines 1 and 2 and lines 44 and 45 of the granted patent).

3.2 This problem is solved by modifying the method known from document D4 by the combination of the following features:

- (a) intermittently directing the metal from the melting vessel to fall freely into the launder at an entry end thereof,
- (b) directing the metal from an exit end of the launder to a filter box disposed between the exit end of the launder and the casting vessel and from the filter box into the casting vessel,
- (c) maintaining the metal in the launder with the top surface of the metal in the launder at a first level L_1 and the top surface of the metal in the filter box at a second level L_3 which are at or above the level L_2 of the top surface of the metal in the casting vessel whereby metal flows upwardly through a replaceable porous reflectory filter element disposed in the filter box,
- (d) maintaining the lowest level which the top surface of the metal in the filter box and the casting vessel reaches during normal operation above the bottom of the launder at the exit end, and
- (e) maintaining the level of the top surface of the metal as the metal leaves the melting vessel above the top surface of the metal in the casting vessel by not more than 200 mm.

The feature (a) avoids a constant communication between the melting vessel and the melt distribution system, and therefore, prevents that particulate impurities present within the metal in the melting vessel are transferred to the launder, since the rate of metal discharged from the melting vessel can be easily controlled at such a desired rate to limit discharge of particulate impurities from the melting vessel.

Due to the combination of the feature (a) with the measures for maintaining the metal surface levels within certain narrow limits according to the features (c), (d) and (e) a non-turbulent and smooth flow of the metal from the melting vessel to the casting vessel is achieved, so that oxide entrainment is minimised.

The features (b), (c) and (d) have the effect that residual particulate impurities, either those present in the melting vessel or any introduced into the melt during transfer are removed, that the filter is wholly submerged at all times and is not therefore subject to oxide build-up at the surface or blinding of part of its area as levels change, that due to the upward movement of metal contaminants remain entrapped in the filter and are not able to break away and float freely and that the filter is easily changeable.

All features (a) to (e) act together in the sense that oxide contamination and content of particulate impurities within the melt to be cast is minimised so that a high casting quality is achieved.

- 3.3 Document D1 teaches that the surface of the metal in the melting vessel and in the distribution passage system should be maintained essentially at the same level, in order to achieve very slow speeds and thus to avoid undue oxide formation (see page 2, lines 21-28 and lines 83-87).

Thus, document D1 teaches implicitly that no free fall of melt should be permitted during transfer from the melting furnace to the distribution system.

Since in the device according to document D1 the melting vessel is in constant and direct communication with the distribution passageways, it has the drawback that impurities of the melt present in the melting vessel can easily be transferred into the distribution system and that it is not possible to carry out treatments such as de-gasing, fluxing, grain refining, alloying and the like in the melting vessel because the necessary high temperature and turbulence would cause even more particles to be transferred into the passageways and hence into the castings.

Moreover, in the device according to document D1 no filter is present in the distribution system.

Therefore, the teaching of document D1 cannot incite the person skilled in the art to improve in the method known from document D4 the casting quality by intermittently directing the metal from the melting vessel to fall freely into the launder and by disposing a filter box between the exit end of the launder and the casting vessel, whereby the metal flows upwardly through a replaceable porous refractory filter element disposed in the filter box.

- 3.4 In the method according to document D5 there can be found no teaching that the transfer from the holding furnace to the apparatus in which the metal is used should be quiescent.

As stated on page 6, lines 16 to 21 of document D5, "a portion of melt can be supplied from the receiving station 18 to a sand mould, gravity die casting mould etc., alternatively, the portion can be supplied to the filing hole in the pressure chamber of the die casting machine. In the absence of any explicit teaching that such supply is quiescent, a skilled reader would understand that the

metal would be allowed to fall under gravity from the receiving station 18, i.e. from the upper end of the outlet canal 17 into a sand mould or into a gravity-die casting mould or into the filling hole in the pressure chamber of a die casting machine. Such transfer is turbulent.

Thus, the teaching of document D5 leads away from the problem and solution of the invention of the patent in suit.

- 3.5 In conclusion, none of documents D4, D1 or D5 suggests to provide in a method of melting and casting non-ferrous metal the combination of the features according to Claim 1 of the main request. Therefore, the subject-matter of Claim 1 of the main request involves an inventive step within the meaning of Article 56 EPC.

The same applies to the apparatus of Claim 9 of the main request, which comprises all the method features of Claim 1 in terms of apparatus features.

4. For the foregoing reasons, the subject-matter of Claims 1 and 9 of the main request complies with Article 52(1) EPC.

Claims 2 to 8 and 10 to 13 of the main request, which are dependent on Claims 1 and 9, respectively, and relate to specific embodiments of the subject-matter of the independent claims, are also patentable.

5. The patent can thus be maintained as amended according to the main request of the Appellant.

Order

For these reasons, it is decided that:

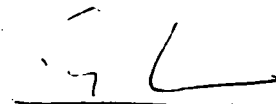
1. The decision under appeal is set aside.
2. The case is remitted to the first instance for maintenance of the patent on the basis of the new documents according to the main request of the Appellant filed on 18 December 1992 with the letter of 14 December 1992.

The Registrar:



R. Townend

The Chairman:



C. Payraudeau