BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS | BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE | CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 31/89 - 3.2.2

Application No.: 84 101 117.4

Publication No.: 0 115 863

Title of invention: Process for melting glass

Classification: C03B 5/235, C03B 5/20

D E C I S I O N
of 21 March 1991

Applicant: Union Carbide Benelux N.V.

Opponent: AGA AB

Headword:

EPC Art. 56

Keyword: "Inventive step (yes)"

Headnote

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 31/89 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal
of 21 March 1991

Appellant : (Proprietor of the patent)
Union Carbide Benelux N.V.
Noorderlaan 147
Antwerp (BE)

Representative :
Schwan, Gerhard, Dipl.-Ing.
Elfenstrasse 32
8000 München 83 (DE)

Respondent : (Opponent)
AGA Aktiebolag
S-181 81 Lidingö (SE)

Representative :
Wiedemann, Bernd
Patent department
AGA Aktiebolag
S-181 81 Lidingö (SE)

Decision under appeal :
Decision of Opposition Division of the European Patent Office dated 12 October 1988 revoking European patent No. 0 115 863 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : G. Szabo
Members : M. Noel
L. Mancini

Summary of Facts and Submissions

I. European patent No. 0 115 863 comprising four claims was granted on 26 November 1986 on the basis of European patent application No. 84 101 117.4 filed on 3 February 1984.

Claim 1 as granted reads as follows:

"1. Process for melting glass in a furnace (1) adapted therefor, said furnace having an upstream melting zone (4) and downstream fining zone (7), wherein the molten glass travels along a path from the melting zone to the fining zone comprising:

(a) introducing solid glass batch into the melting zone (4);
(b) heating the batch whereby an upper layer of batch and a lower layer of molten glass are formed in the melting zone (4);
(c) providing sufficient heat to maintain the molten glass in the molten state through the fining zone (7);
(d) providing at least a part of the process heat through at least one oxygen/fuel flame (6) located at each side of the path of the molten glass, said flames being fueled by an oxygen containing gas/fuel mixture wherein the oxygen containing gas contains about 50 percent to about 100 percent oxygen by volume, and the tip of each flame being directed towards the interface of the solid glass batch and the molten glass; and
(e) withdrawing the molten glass from the fining zone, characterized by
(i) providing the oxygen/fuel flames (6) at a velocity of about 30 to about 100 meters per second of such a size that they meet the interface of the solid glass batch and the molten glass; and

(ii) covering substantially all of the width of the furnace with the flames in a narrow band about perpendicular to the path of the molten glass, said narrow band straddling the point at which the tips of the flames meet said interface of the solid glass batch and the molten glass."

II. The Opposition Division revoked the European patent by a decision dated 12 October 1988 on the ground that the subject-matter of the claims did not involve an inventive step with respect to the combination of documents

(1) WO 82/04246, and
(2) DE-A-2 015 597

in the light of the general knowledge of a person skilled in the art.

III. The Appellant (Proprietor of the patent) lodged an appeal against this decision on 12 December 1988 with the payment of the appropriate fee and submitted a statement of grounds on 13 February 1989.

In the statement of grounds, in a later reply received on 29 June 1990 and during oral proceedings held on 21 March 1991, the Appellant made essentially the following points:

(i) Document (2) represents the closest prior art, as mentioned in the introductory part of the patent. In this document, however, the burners are located at a distance from the solid batch and the flames are more or less directed opposite to the direction of flow of the molten glass. Moreover the oxygen/fuel flames are stiff high-speed flames, of which only the combustion products downstream of

the flames meet the interface of the solid and molten glass.

(ii) Although an increase of the production rate was sought in document (1), as in the present invention, the process described therein used a totally different principle since no specifically defined melting barrier area was to be maintained according to this document. Further, a high energy flame impinged directly upon the surface of the molten glass so as to cover a maximum area, which the invention seeks precisely to avoid.

(iii) Neither document (1) nor document (2) taken separately or in combination gives any hint of causing the tip of low velocity flames to meet the interface of the solid glass batch and the molten glass, according to the specific features of Claim 1.

IV. These arguments were contested by the Respondent (Opponent) in a reply dated 6 July 1989 and during oral proceedings. He made essentially the following submissions:

(i) Document (1) is in itself sufficient to suggest the basic idea of the invention. By locating the burners in opposition and perpendicularly to the direction of the molten bath the same operative conditions and consequently the same results are necessarily achieved.

(ii) Since the borderline between the flame and exhaust gas is arbitrary and not defined in the patent, this aspect should not be considered when assessing inventive step of Claim 1.

V. The Appellant requested that the decision under appeal be set aside and that the patent be maintained as granted.

The Respondent requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. Closest prior art

The Board cannot agree with the Opposition Division which regarded document (1) as the starting point of the invention, since it was established (point 3.1 of the Decision) that document (1) failed to disclose the pre-characterising feature of Claim 1 according to which the flame is directed towards the interface of the solid glass batch and the molten glass. This results from the fact that, as exposed below, there is actually in document (1) no distinction between a melting zone and a fining zone in the sense of the patent.

In view of the structural similarities, the Board therefore considers the document (2) as the state of the art closest to the invention.

As a matter of fact, document (2) discloses a process for melting glass in a furnace having an upstream melting zone and a downstream fining zone, including all the features of the pre-characterising portion of Claim 1. Besides, this document is itself mentioned and discussed in column 1 of the patent specification.

3. Problem and solution

The main object of the process according to document (2) is, as in the patent, to create and maintain a melting barrier between the solid glass batch and the molten glass and thus to control the movement of the raw materials from the melting zone towards the fining zone, so as to cause the production rate to increase by bettering thermal efficiency and enhancing the purity of the product.

However, the oxygen/fuel flames which emanate from the burners of document (2) have to cover a considerable distance through the furnace, which implies the use of specific operating conditions having a plurality of disadvantages (cf. point 6.1 below).

Hence, in accordance with the introductory part of the patent (column 1) the problem underlying the present invention resides at improving the efficiency of the glass melting process disclosed in document (2). This is achieved by the features stated in the characterising part of Claim 1.

Principally, by causing the tip of the oxygen/fuel flames to meet directly the interface of solid and molten glass, a reduced amount of heat is efficiently and selectively applied to the interface while at the same time minimising the amount of heat which is deflected to the furnace walls and which otherwise would accelerate refractory wear.

4. Inventive step

4.1 Figures 1 and 3 of document (2) show that the flame and its combustion products are directed approximately towards the interface of the molten bath and the raw material, so as to force it backwards. But the fact that the burners

are located far away from the melting front involve a number of distinctions.

- In document (2) a pair of burners is inserted at opposite locations through the side walls, i.e. the flames are directed obliquely and far with respect to the side walls or to the longitudinal axis 51, whereas the burners according to the patent are mounted about perpendicularly to the side walls and/or to the centre line 10 and immediately adjacent to the melting front.

  The result is that, in document (2), the region covered by the flames and their combustion products is confined to a narrow band about the centre area of the hot spot 60 (Fig. 1) whereas, according to the patent, the narrow band of the flame extends substantially through all the width of the furnace, which avoids, even at high pull rates, the breakthrough of most of the unmelted solid particles into the fining zone (column 6, lines 35-40).

- As rightly observed by the Appellant (III(i)) the burners of document (2) provide high speed flames having a velocity of preferably about 900 to 1000 m/s (page 10, third paragraph), i.e. the flames are of turbulent nature. As a consequence, the products of combustion which emanate from the high energy flames strikes the unmelted raw batch material (page 15, first paragraph) with the risks of projecting solid particles onto the walls of the furnace.

  The subject-matter of Claim 1 differs from this in that low velocity flames in the range of 30 to 100 m/s, i.e. having laminar characteristics, are sufficient to cover all the width of the furnace. Having low speed and moreover being directed about tangentially to the

melting front these flames are likely to minimise the dusting of the solid particles, which, if projected onto the walls, would otherwise decrease their refractory life (column 6, lines 26-30).

- In document (2) only the combustion products downstream of the flame contact the interface at the location of the hot spot 60 or upstream thereof (page 14, first paragraph). As an important feature, it is specified that the tip of the flame should not directly contact the point of impact (page 14, second paragraph and page 15, first paragraph).

  In the Board's view, such facts clearly diverge from those characteristic of the present invention according to which the tip of the flame is required to precisely strike the coldest point of the interface. This is particularly advantageous to improve the degassing, i.e. the releasing of occluded gases and thereby to increase the melting rate of the furnace (column 4, lines 14-22 and column 6, lines 7-17).

4.2 The question now arises whether the subject-matter of the other prior art document (1) and the common knowledge of the skilled person would provide any indication as to how the process according to document (2) should be modified to solve the given technical problem and to arrive at the subject-matter of the present Claim 1.

Document (1) describes a part of the characterising feature (ii) according to which of a pair of oxygen/fuel burners 11, located in opposite furnace side walls and directed perpendicularly to the path of the molten glass, are used so that high energy flames cover substantially all the width of the furnace (Claims 3 and 17). Appellant agreed to said interpretation at the oral proceedings.

In the Board's opinion, however, the remaining characterising features of Claim 1 are not disclosed in document (1) for the following reasons:

- Document (1) describes that the furnace is provided at opposite side walls or at the rear end with a plurality of batch feeders (not shown, page 4, second paragraph) so that exposed raw and molten material can be found in many regions of a unique melting chamber, all over the surface of the furnace. As a result, no defined demarcation line between a melting zone and a fining zone, i.e. no interface in the sense of the patent is present in document (1). Since the problem of retaining a melting front upstream of a transverse barrier is not dealt with in this document, the skilled person would not have, in the first place, reasonably envisaged an interface for the process in the document, which operates according to a basic principle different from that of the patent.

- Furthermore, in document (1) the opposite burners are positioned in alignment with a row of orifices (bubblers 18, page 4, fourth paragraph) arranged transversely of the chamber. Although the flames are directed preferably to one of the regions where batch charging takes place, the target of the flames is not some sort of interface but first of all these orifices (page 6, third paragraph). The flames are provided to strike directly the surface of the molten glass and the burners are adjusted so as to maximise the area of molten glass covered by the flames (page 1, last paragraph and page 2, first paragraph), which the present invention precisely seeks to avoid. Consequently the Respondent's assertion made under IV(i) cannot be followed. The Board is of the opinion that the transverse arrangement of oppositely placed

burners is not in itself sufficient to lead the skilled person to the claimed feature (ii), which further specifies that the flames shall meet the interface in a narrow band straddling the point contacted by the flame tips.

- In document (1) the velocity of the flame plays no role and is not even specified. Only the temperature of the flame is important for increasing the production rate (page 1, last paragraph and page 5, second paragraph). This is attained by impinging a high energy heat flame directly upon a surface area of the molten glass which is made as large as possible. The skilled person, therefore, would not find in document (1) an indication to adjust the flame velocity to the low value as set in feature (i) of Claim 1.

For the foregoing reasons, the Board is satisfied that document (1) does not give any suggestion how the process according to document (2) could be modified to arrive at the process as claimed in the patent.

4.3 The revocation of the patent by the Opposition Division was based in particular on the assertion that the adjustment of the flame length by regulating the flame velocity was considered to be within the normal competence of the skilled person. This assertion is, according to the Board's view, not convincing. Even if such an adjustment were not to exceed necessarily the normal capabilities of a person skilled in the art, it would remain a basic fact that none of the cited documents suggests to locate the burners immediately adjacent the demarcation line of the melting front so that a flame of low velocity can be readily controlled in such a manner that the tip of the flames accurately reach the specific point as defined in Claim 1. In the Board's view, such considerations support

the assumption of an inventive step, which enables the invention to be efficient and superior over the conventional process, with the advantages set out in the patent (column 6, lines 49-58).

4.4 As to the Respondent's argument under IV(ii) the Board observes that on the one hand only the flame is concerned in Claim 1, the concept of flame being well known and perfectly clear to any person skilled in the field of combustion, as pointed out in the Appellant's reply of 29 June 1990 and, on the other hand, document (2) distinguishes between the flame and its products of combustion. Consequently the difference had to be considered when comparing this document with the subject-matter of Claim 1, as made in point 6.1 above.

5. Summing up, the Board comes to the conclusion that the subject-matter of the patent cannot be derived in an obvious manner from the cited prior art and accordingly involves an inventive step under Article 56 EPC.

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 maintain the patent as granted.

The Registrar: The Chairman:

S. Fabiani G. Szabo

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