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

Datasheet for the decision of 8 December 2009

Case Number: T 1028/07 - 3.2.07

Application Number: 98963946.3

Publication Number: 1077901

IPC: C03B 5/00

Language of the proceedings: EN

Title of invention:
Glass melting process using roof-mounted oxygen-fuel burner

Patentees:
OWENS CORNING, et al

Opponent:
L'AIR LIQUIDE, S.A. pour l'étude et l'exploitation des procédés GEORGES CLAUDE

Headword:
-

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (all requests): no"

Decisions cited:
-

Catchword:
-

Case Number: T 1028/07 - 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 8 December 2009

Appellant: (Opponent)	L'AIR LIQUIDE, S.A. pour l'étude et l'exploitation des procédés Georges Claude 75, quai d'Orsay F-75321 Paris (FR)
Representative:	Ducreux, Marie L'AIR LIQUIDE, S.A. Direction de la Propriété Intellectuelle 75, quai d'Orsay F-75321 Paris Cedex 07 (FR)
Respondents: (Patent Proprietors)	OWENS CORNING One Owens Corning Parkway Toledo Ohio 43659 (US) and THE BOC GROUP, INC. 575 Mountain Avenue Murray Hill New Jersey 07974 (US)
Representative:	Jacob, Reuben Ellis R.G.C. Jenkins & Co 26 Caxton Street London SW1H 0RJ (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted 10 April 2007 rejecting the opposition filed against European patent No. 1077901 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman:	H. Meinders
Members:	P. O'Reilly
	I. Beckedorf

Summary of Facts and Submissions

I. Opposition was filed against European patent No. 1 077 901 as a whole based on Article 100(a) EPC (lack of inventive step).

The opposition division decided to reject the opposition.

II. The appellant (opponent) filed an appeal against that decision.

III. The appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondents (patent proprietors) requested that the appeal be dismissed or, alternatively, in setting aside the decision under appeal the patent be maintained in amended form on the basis of one of the sets of claims filed as first and second auxiliary requests with letter of 9 November 2009 or as third auxiliary request with letter of 6 February 2007.

IV. Claim 1 of the **main request** (patent as granted) reads as follows:

"A process for producing refined glass from raw glass-forming material (30) in a refractory lined glass melter (10) without the use of regenerators or recuperators, the glass melter having a roof (22) connected to a bottom (20) by side walls (18) and defining therebetween an elongated channel having a melting zone (26) and a downstream fining zone (28), the process comprising the steps of:

charging raw glass-forming material (30) to the melting zone (26) of the glass melter (10);
providing at least one oxygen-fuel burner (34) recessed within a burner block (38) in the roof of the glass melter and arranged to fire perpendicular or substantially perpendicular to the surface of the raw glass-forming material, the oxygen-fuel burner having an inner central cylindrical gaseous fuel conduit (40) for providing gaseous fuel and an outer cylindrical oxygen conduit (42) concentric with the central fuel conduit for providing oxygen; and
controlling the velocities of the gaseous fuel and of the oxygen from the oxygen-fuel burner such that the velocities of the gaseous fuel and of the oxygen are substantially equivalent to provide a generally laminar gaseous fuel flow and generally laminar oxygen flow to combust proximate a top surface of the raw glass-forming material (30) and thereby produce a flame which impinges the surface of the raw glass-forming material and which has middle portion (54) of an approximately columnar shape;
melting raw glass-forming material within the melting zone by means of the flame coverage from the oxygen-fuel burner without the use of regenerators or recuperators; and
withdrawing the refined glass from the fining zone."

Claim 1 of the **first auxiliary request** reads as follows (amendments when compared to claim 1 of the **main request** are depicted in bold):

"A process for producing refined glass from raw glass-forming material (30) in a refractory lined glass melter (10) without the use of regenerators or recuperators, the glass melter having a roof (22) connected to a bottom (20) by side walls (18) and defining therebetween an elongated channel having a melting zone (26) and a downstream fining zone (28), the process comprising the steps of:

charging raw glass-forming material (30) to the melting zone (26) of the glass melter (10);
providing at least one oxygen-fuel burner (34) recessed within a burner block (38) in the roof of the glass melter and arranged to fire perpendicular or substantially perpendicular to the surface of the raw glass-forming material, the oxygen-fuel burner having an inner central cylindrical gaseous fuel conduit (40) for providing gaseous fuel and an outer cylindrical oxygen conduit (42) concentric with the central fuel conduit for providing oxygen; and
controlling the velocities of the gaseous fuel and of the oxygen from the oxygen-fuel burner such that the velocities of the gaseous fuel and of the oxygen are substantially equivalent to provide a generally laminar gaseous fuel flow and generally laminar oxygen flow to combust proximate a top surface of the raw glass-forming material (30) and thereby produce a flame which impinges the surface of the raw glass-forming material and which has middle portion (54) of an approximately columnar shape;
melting raw glass-forming material within the melting zone by means of the flame coverage from the oxygen-fuel burner without the use of regenerators or recuperators; and
withdrawing the refined glass from the fining zone,

wherein the maximum velocities of the gaseous fuel and of the oxygen from the oxygen-fuel burner at the exit of the burner block are controlled within an operating zone defined by upper and lower operating curves derived by plotting H/id against V_{Bb},
wherein
i_d = inside diameter of the opening of the burner block,
H = distance from the end of the burner block to a top surface of the raw glass-forming material, and
V_{Bb} is the maximum flame velocity at the tip of the burner block;

the upper operating curve being derived from the following fourth order linear polynomial:

$$V_{Bb} = a + b(H/i_d) + c(H/i_d)^2 + d(H/i_d)^3 + e(H/i_d)^4 \quad (I)$$

in which

H/id = about 6 - 20,
VBb = 58 to 168 m/s (190 - 550 feet per second),
a = 571.0801,
b = -187.2957,
c = 30.1164,
d = -1.8198 and
e = 0.04

and a lower operating curve being derived from the following fourth order linear polynomial:

$$V_{Bb} = a + b(H/i_d) + c(H/i_d)^2 + d(H/i_d)^3 + e(H/i_d)^4 \quad (I)$$

in which,

H/id = about 6 - 30,

VBb = 15 to 91 m/s (50 - 300 feet per second),

a = -103.6111,

b = 38.9939,

c = -2.8772,

d = 0.1033 and

e = -0.00125."

Claim 1 of the **second auxiliary request** contains the following extra feature at the end of the claim (compared to claim 1 of the **first auxiliary request**):

"**wherein at least one oxygen-fuel burner (34) is located over the downstream fining zone (28)**."

Claim 1 of the **third auxiliary request** reads as follows (amendments when compared to claim 1 of the **second auxiliary request** are depicted in bold or struck through):

"A process for producing refined glass from raw glass-forming material (30) in a refractory lined glass melter (10) without the use of regenerators or recuperators, the glass melter having a roof (22) connected to a bottom (20) by side walls (18) and defining therebetween an elongated channel having a melting zone (26) and a downstream fining zone (28), the process comprising the steps of:

charging raw glass-forming material (30) to the melting zone (26) of the glass melter (10);
providing at least one oxygen-fuel burner (34) recessed within a burner block (38) in the roof of the glass melter and arranged to fire perpendicular or

substantially perpendicular to the surface of the raw glass-forming material, the oxygen-fuel burner having an inner central cylindrical gaseous fuel conduit (40) for providing gaseous fuel and an outer cylindrical oxygen conduit (42) concentric with the central fuel conduit for providing oxygen; and
controlling the velocities of the gaseous fuel and of the oxygen from the oxygen-fuel burner such that the velocities of the gaseous fuel and of the oxygen are substantially equivalent to provide a generally laminar gaseous fuel flow and generally laminar oxygen flow to combust proximate a top surface of the raw glass-forming material (30) and thereby produce a flame which impinges the surface of the raw glass-forming material and which has middle portion (54) of an approximately columnar shape;
melting raw glass-forming material within the melting zone by means of the flame coverage from the oxygen-fuel burner without the use of regenerators or recuperators; and
withdrawing the refined glass from the fining zone,

wherein the maximum velocities of the gaseous fuel and of the oxygen from the oxygen-fuel burner at the exit of the burner block are controlled within an operating zone defined by upper and lower operating curves derived by plotting H/id against V_{Bb}~~, wherein i_d = inside diameter of the opening of the burner block, H = distance from the end of the burner block to a top surface of the raw glass-forming material, and V_{Bb} is the maximum flame velocity at the tip of the burner block;~~ **(in which H and id have the meanings specified in Claim 5 and V_{Bb} is the maximum flame velocity at the tip of the burner block),** the upper operating curve being derived from the following fourth order linear polynomial:

$$V_{Bb} = a + b(H/i_d) + c(H/i_d)^2 + d(H/i_d)^3 + e(H/i_d)^4 \quad (I)$$

in which

H/id = about 6 - 20,
VBb = 58 to 168 m/s (190 - 550 feet per second),
a = 571.0801,
b = -187.2957,
c = 30.1164,
d = -1.8198 and
e = 0.04

and a lower operating curve being derived from the following fourth order linear polynomial:

$$V_{Bb} = a + b(H/i_d) + c(H/i_d)^2 + d(H/i_d)^3 + e(H/i_d)^4 \quad (I)$$

in which,

H/id = about 6 - 30,
VBb = 15 to 91 m/s (50 - 300 feet per second),
a = -103.6111,
b = 38.9939,
c = -2.8772,
d = 0.1033 and
e = -0.00125,

wherein at least one oxygen-fuel burner (34) is located over the downstream fining zone (28)**, and**
wherein the oxygen-fuel burner over the downstream fining zone (28) operates under the same control

parameters as the oxygen fuel burner over the melting zone (26)."

V. The documents cited in the present decision are the following:

D1: US-A-3 337 324
D2: US-A-4 531 960

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

(i) The subject-matter of claim 1 of the main request does not involve an inventive step.

The closest prior art document is D1. The respondents have argued that there are two features of claim 1 which are not disclosed in D1. These features, however, are disclosed in D2. Taking as the problem to be solved the one proposed by the respondents, i.e. to control the gas velocities to improve convective heat transfer, it would have been obvious for the skilled person to consider that teaching of D2 and to apply it to the furnace known from D1 and thus he would arrive at the process according to claim 1.

In D2 it is indicated that there is a central conduit for the fuel surrounded by orifices for the oxygen, see column 3, lines 34 to 39. In column 4, lines 1 to 7 it is stated that the fuel gas and oxygen are injected at the same velocity to prevent rapid mixing thereof, which means that the flow must be laminar. This laminar flow will result in a columnar shape as specified in claim 1. The flame is implicitly disclosed as producing convective heat transfer since according to column 2, lines 9 to 15, it may be directed onto the clods and hence will impinge upon them producing convective heat transfer. The skilled person would consider mounting this burner in the furnace roof as used in the process of D1 since it is not disclosed in D2 that it is essential that the burner is side mounted. This is shown by the fact that it is only in a dependent claim that it is specified that the burner is side mounted. Also, in D1 it is indicated that the burners may be suitable for mounting in either the roof or the walls, see column 8, lines 16 to 31. The flame disclosed in D1 already has a columnar shape as is visible in figure 3 so that this feature is in any case not a distinguishing feature of the claim.

(ii) The subject-matter of claim 1 of the first auxiliary request does not involve an inventive step.

The upper and lower operating curves specified in this claim correspond to those which are shown in figure 6 of the patent drawings.

The ranges of the velocities of the gases exiting from the burner block disclosed in D2 are given in column 3, line 65 to column 4, line 7. These velocity ranges cover the majority of the operating zone set out in figure 6 of the patent in suit between the upper and lower operating curves as illustrated in the annotated copy of figure 6 of the patent filed during the oral proceedings before the Board. The skilled person when applying the teaching of D2 to the process known from D1 will also select these velocities for the burner gases. In any case the upper and lower operating curves merely eliminate operating zones which are either unsafe or thermally inefficient as is explained in the patent specification (see page 5, lines 31 to 32). The skilled person will steer clear from these zones as a matter of course when deciding upon the operating parameters for the burner.

(iii) The subject-matter of claim 1 of the second auxiliary request does not involve an inventive step.

It is already known from D1 to provide a second burner mounted in the furnace roof over the downstream fining zone which is an air-fuel burner. Therefore, the only feature which this claim adds that further distinguishes its process over the disclosure of D1 is that this burner is an oxygen-fuel burner. There is no indication in the patent of any technical effect being achieved by this burner being an oxygen-fuel burner as opposed to an air-fuel burner. The passage on page 7, lines 19 to 30 of the patent explains the effects of the presence of a downstream burner over the fining zone. These effects, however, would also be the effects of the downstream burner provided in the furnace of D1 since there is nothing in this passage which specifically indicates any effect due to the burner being an oxygen-fuel burner. Since there is no technical effect from the oxygen-fuel burner it must be seen as a known alternative to an air-fuel burner.

(iv) The subject-matter of claim 1 of the third auxiliary request does not involve an inventive step.

It has already been explained with respect to claim 1 of the first auxiliary request that the upper and lower operating curves for the flame velocity at the tip of the burner block merely exclude those operating zones where the skilled person would know that the process should not be operated for safety reasons or for thermal efficiency reasons. The skilled person will apply the same considerations when a second burner is provided over the fining zone. No effect has been demonstrated as resulting from operating the second downstream burner in this manner.

VII. The arguments of the respondents may be summarised as follows:

(i) The subject-matter of claim 1 of the main request involves an inventive step.

D1 is the closest prior art document. The subject-matter of claim 1 is distinguished over the process disclosed in D1 by the features that:
the inner central cylindrical conduit is for providing the gaseous fuel and the outer cylindrical conduit concentric with the central conduit is for providing oxygen; and
the velocities of the gaseous fuel and of the oxygen are substantially equivalent to provide a generally laminar gaseous fuel flow and generally laminar oxygen flow to combust proximate a top surface of the raw glass forming material and thereby produce a flame which impinges the surface of the raw glass-forming material and which has a middle portion of an approximately columnar shape.

The problem to be solved is to control the gas velocities to improve convective heat transfer.

D2 is directed towards a furnace having side burners. These burners function chiefly by radiation heat transfer, not convective heat transfer. The relevance of the disclosed features is not to be determined by only the independent claims. The absence of a reference to side burners in the independent claims does not mean that the document is not principally directed to furnaces with side burners. There is no indication in D2 how to improve convective heat transfer. Indeed, it is indicated in column 2, lines 9 to 15, that it should be avoided that the flame touches the glass surface. The flame described in D2, see column 4, lines 5 to 6, is long which teaches away from a columnar flow since a long flame will bend upwards due to lofting. D2 has references to the burner being directed "onto the clods" which indicates a direction and does not indicate that it will impinge on the clods. With such a direction the effect of lofting will be such that the flame will pass over the clods without impinging on them.

If the skilled person were to consider arranging the burner known from D2 in the furnace known from D1 then he would arrange it as a side burner in this furnace, since side burners are mentioned as an alternative in D1, see column 8, lines 16 to 20.

(ii) The subject-matter of claim 1 of the first auxiliary request involves an inventive step.

In this claim upper and lower operating curves for the maximum flame velocity at the burner block are defined in terms of the height of the furnace as well as the inside diameter of the opening in the burner block. Although D2 mentions some velocities for the gases there is no indication therein that the height of the furnace and the said diameter should be taken into account. In any case D2 does not explain how to improve convective heat transfer so that the skilled person would not take it into account.

(iii) The subject-matter of claim 1 of the second auxiliary request involves an inventive step.

Although a downstream burner is disclosed in D1 it is an air-fuel burner. The claim, however, specifies an oxygen-fuel burner which normally will have 90% or more oxygen as oxidant. It is, however, correct to say that an oxygen-fuel burner does not always have as much as 90% oxygen. The positive effects of the provision of such a second burner are set out on page 7, lines 19 to 30 of the patent and furthermore an oxygen-fuel burner will reduce the NO_X emissions, as indicated in lines 36 to 38.

(iv) The subject-matter of claim 1 of the third auxiliary request involves an inventive step.

The extra feature of claim 1 of this request is to be interpreted that the parameters for the downstream burner over the fining zone are subject to the same operating curve limits as are set out with respect to the upstream burner over the melting zone, though the actual values for the operating parameters for the downstream burner may be different to those of the upstream burner. By operating also this burner in the same operating zone as the burner over the melting zone the operating conditions are further improved and the NO_X emissions reduced still further.

Reasons for the Decision

Main request

1. *Inventive step*

1.1 The parties and the Board agree that the closest prior art document is D1.

1.2 According to the respondents the process of claim 1 is distinguished over the process disclosed in this document by the features that:

a) the inner central cylindrical conduit is for providing the gaseous fuel and the outer cylindrical conduit concentric with the central conduit is for providing the oxygen; and

b) the velocities of the gaseous fuel and of the oxygen are substantially equivalent to provide a generally laminar gaseous fuel flow and generally laminar oxygen flow to combust proximate a top surface of the raw glass forming material and thereby produce a flame which impinges the surface of the raw glass-forming material and which has a middle portion of an approximately columnar shape.

1.3 The problem to be solved by the distinguishing feature b) of claim 1 is to optimise the convective heat transfer from the combusting gas to the glass. The respondents considered that this was the problem to be solved and the appellant indicated that it was prepared to argue on the basis of this problem. Also the Board considers that this is a plausible problem to be solved.

1.4 Convective heat transfer occurs when hot gas flows along the surface of the glass, transferring heat thereto by direct contact. In the furnace disclosed in D1 there is an oxygen-fuel burner that is preferably positioned in the roof, though it may be positioned in a side wall (see column 8, lines 16 to 20). The burner is positioned to produce a flame which directly impinges upon the batch, i.e. the unmelted glass at the melting zone (see column 8, lines 27 to 31). It is this impinging action which causes the convective heat transfer, which the skilled person will seek to optimise.

1.5 When seeking to optimise the convective heat transfer the skilled person will consider prior art where this type of heat transfer occurs.

D2 is concerned with convective heat transfer. In column 3, lines 58 to 60 of D2 it is explained that oxygen-fuel burners are "directed onto" the clods of glass in the bath. This is repeated in claim 1 of the document, which specifies that the flame of fuel and oxygen is "directed onto clods" of the unmelted glass. The Board understands this to mean that the flame comes into contact with the clods so that convective heat transfer ensues. This view is supported by the passage in column 2, lines 9 to 15 of the document which describes the effects of a flame with an excessive velocity touching the glass surface, i.e. the production of waves.

The respondents suggested that the expression "directed onto clods" did not mean that the flame impinged on the clods, but rather that it indicated the initial direction of the flame and that subsequent lofting would deflect the flame upwards and over the clods. The respondents further suggested that the passage in column 2, lines 9 to 15 of the document implied that impinging of the flame on the surface of the glass is not desired.

The Board cannot agree with the respondents in this respect. The indication of "onto" clearly indicates that contact is envisaged and not merely that a direction is meant, i.e. "towards". Also the passage in column 2, lines 9 to 15 merely indicates that the creation of waves on the glass surface is not desired. It does not indicate that touching of the surface by the flame is not desirable; rather it indicates that waves are not desired **when** the surface is touched.

The Board concludes therefore that D2 is concerned with convective heat transfer.

1.6 When the fuel for the oxygen-fuel burner disclosed in D2 is a gas it is injected at a velocity substantially equal to that of the oxygen so as to avoid an excessively rapid mixture of the two gases (see column 4, lines 1 to 7). Although it is not expressly stated in D2 that the flow is laminar the Board considers that this must be the case since according to the patent in suit it is the equivalence in the velocities which produces the laminar flows of the fuel and oxygen. Both claim 1 and page 5, lines 2 to 11 of the patent in suit make it clear that the equivalent velocities ensure laminar flows which then prevent premature mixing. Since in the burner disclosed in D2 the velocities are substantially equal and rapid mixing is avoided this must result from the flow being laminar. When these flows impinge on the clods, i.e. the top surface of the glass-forming material, the flame will transfer its heat.

1.7 The respondents have argued that the shape of the flame from the oxygen-fuel burner shown in figures 3 and 4 of D1 is not columnar which expression they, as well as the appellant, interpret as meaning that it is long and thin. The appellant, however, did not agree with the respondents that the shape shown is not columnar and pointed out that the columnar shape resulted from the laminar flow which also applied to the flow from the burner disclosed in D2. The Board agrees with the appellant for this reason.

The respondents further argued that the flame from the burner disclosed in D2 is not columnar because of the lofting effects due to its horizontal orientation. However, as pointed out by the appellant, when the teachings of D2 are applied to modify the roof-mounted burner disclosed in D1 this will result in a vertical flame so that this argument will not apply.

1.8 With regard to the distinguishing feature a) the appellant pointed out that this feature is present in the burner disclosed in D2 so that when applying the teaching of D2 to the process disclosed in D1 the skilled person would also apply this part of the teaching of D2. The Board agrees with the appellant also for this reason.

1.9 The Board concludes therefore that it was obvious for the skilled person to apply the teachings of D2 to the process known from D1 and that in doing so would arrive at a process having features a) and b) and hence at the subject-matter of claim 1 of this request.

1.10 Therefore, the subject-matter of claim 1 of the main request does not involve an inventive step in the sense of Article 56 EPC.

First auxiliary request

2. *Inventive step*

2.1 The extra features of claim 1 of this request compared to claim 1 according to the main request are derived from claim 6 as granted and are concerned with the chart shown in figure 6 of the patent. In that figure the flame velocity at the exit of the burner block is charted against the distance from the burner block to the surface of the glass divided by the inside diameter of the opening in the burner block. Two operating curves are drawn on this chart, which divide it into three zones. According to the description of the patent on page 5, lines 31 to 32, the zone above the upper operating curve represents an excessive high velocity or an unsafe operating zone, and the zone below the lower operating curve represents a thermally inefficient operation. According to the claim the operating curves are derived from fourth order polynomials and the maximum flame velocity is controlled to be within the operating zone defined between the upper and lower operating curves.

The description of the patent gives no information as to the basis for drawing these operating curves. With regard to the upper curve there is no indication as to the criteria applied to arrive at what is "excessive velocity" or "unsafe". With regard to the lower curve there is no indication as to the criteria applied to arrive at what is "thermally inefficient".

In accordance with the claim these curves are represented by fourth order polynomials. A polynomial, however, is no more than a standard mathematical device used to represent a curve, whereby its order is chosen depending upon the degree of accuracy desired. The choice of a fourth order polynomial is thus simply a choice for the accuracy of representing the curve. The patent description gives no explanation as to why in particular fourth order polynomials were selected.

2.2 The appellant has argued that the skilled person would as a matter of course not work in the zone where the flame is thermally inefficient, nor would the skilled person employ a flame that has too high a velocity or is unsafe. In this respect the appellant noted that D2 already indicates (see column 2, lines 9 to 15) that too high a velocity should be avoided. During the oral proceedings before the Board the appellant filed a copy of figure 6 of the patent to which it had applied the burner velocities disclosed in D2 (see column 3, line 65 to column 4, line 1). This annotated copy demonstrated that these velocities fell towards the centre of the operating zone specified in the claim, though the other parameter of the chart is not disclosed in D2.

2.3 The Board agrees with the appellant in this respect. It is normal that a skilled person will select an operating zone and that this selection will avoid operating the furnace in ways which are for instance not safe or inefficient. The respondents have provided no evidence to suggest that the operating zone between the upper and lower operating curves defined in the claim is anything other than what the skilled person would arrive at as a matter of course, or at least by trial and error.

2.4 The respondents argued that the process according to the claim defined not just a selection but also a process of how to determine the operating zone. However, that process, as already explained above, is one which the skilled person would normally adopt.

The respondents pointed out that D2 made no reference to the height of the furnace. It is clear, however, that the skilled person would have to take this height into consideration since the relationship of the height to the velocity determines the time taken for the flame to reach the glass surface and hence the state of mixing of the gases when impinging on the glass.

Also, the skilled person would take the inside diameter of the burner block opening into account. This diameter will affect the rate of mixing of the gases, i.e. inversely to how long the laminar flow can be upheld, and in D2 in column 2, lines 12 to 15 reference is made to the flame width as being a relevant parameter for the skilled person to take into consideration.

The respondents have provided no evidence that the parameters specified in the claim were ones which the skilled person would not normally take into consideration when deciding upon the operating conditions of the furnace.

2.5 Therefore, the subject-matter of claim 1 of the first auxiliary request does not involve an inventive step in the sense of Article 56 EPC.

Second auxiliary request

3. *Inventive step*

3.1 Claim 1 of this request includes the additional feature (compared to claim 1 of the first auxiliary request) that there is an oxygen-fuel burner provided over the downstream fining zone. This feature was contained in claim 7 as granted.

3.2 D1 already discloses an air-fuel burner located over the downstream fining zone (see column 7, lines 62 to 66 and figure 3) so that the extra feature of this claim over the disclosure of D1 is that this downstream burner is an oxygen-fuel burner.

3.3 The description on page 7, lines 12 to 30, of the patent explains the purpose of the downstream burner. In this respect the appellant argued that these effects were just those to be expected when an additional roof-mounted burner is located over the fining zone.

The Board agrees with the appellant in this respect. There is nothing in that part of the description which indicates that the stated effects are due to the burner being an oxygen-fuel burner as opposed to being effects achieved by providing any suitable burner at that location, e.g. an air-fuel burner.

3.4 Even if it were considered that the said part of the description related specifically to the use of an oxygen-fuel burner the Board notes that there is nothing to suggest that the effects are other than those to be expected from the use of an oxygen-fuel burner whereby the higher flame temperature of such a burner was already well known (see D1, column 5, lines 56 to 58).

Furthermore, neither the claim nor the patent description indicates the percentage of oxygen in the oxidant of the oxygen-fuel burner. The respondents suggested that this is commonly 90% though they agreed that it was known in the art to be as low as 30%. In this respect the Board notes that in the patent on page 4, lines 24 to 25 it is indicated that the oxygen-fuel burner is "designed to use a higher percentage of oxygen than is present in air". It is further indicated on page 4, lines 30 to 32 that the fuel to oxygen ratio can varied "to produce a range of operating condition in the glass melting furnace".

It is thus clear that the expression "oxygen-fuel burner" must be understood in the context of the patent in suit to have a broad meaning with respect to the percentage of oxygen that may be present in the oxidant including having only a relatively small additional amount of oxygen compared to the content of oxygen in the air. The respondents have not demonstrated any effect due to the employment of oxygen-fuel burners which is present over the full possible range of the amount of additional oxygen.

3.5 Therefore, the subject-matter of claim 1 of the second auxiliary request does not involve an inventive step in the sense of Article 56 EPC.

Third auxiliary request

4. *Inventive step*

4.1 Claim 1 of this request contains the extra feature (compared to claim 1 of the second auxiliary request) that the oxygen-fuel burners over the melting and fining zones are operated under the same control parameters. This feature was contained in claim 10 as granted.

According to the respondents this feature means that the burner over the fining zone operates in the same operating zone as that defined for the upstream burner though it may have differing values for the parameters, e.g. differing diameters for the openings in the burner block.

It is not necessary for the Board to come to a conclusion as to whether this is the correct interpretation of the claim since also when applying this interpretation the Board concludes that the subject-matter of the claim lacks an inventive step.

4.2 As already explained above with respect to claim 1 of the first auxiliary request the Board considers that the operating zone defined for the oxygen-fuel burner over the melting zone was one which the skilled person would have arrived at by applying normal (trial-and-error) principles avoiding operating conditions that are unsuitable, e.g. thermally inefficient.

In the view of the Board the same applies to the burner over the downstream fining zone, i.e. the unsuitable operating conditions would be avoided leaving only the suitable ones. The respondents have provided no evidence of any effect achieved by operating the downstream burner with these parameters that goes beyond what is to be expected.

4.3 Therefore, the subject-matter of claim 1 of the third auxiliary request does not involve an inventive step in the sense of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

G. Nachtigall H. Meinders