

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:
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INVITATION TO PAY ADDITIONAL FEES
 AND, WHERE APPLICABLE, PROTEST FEE
 (PCT Article 17(3)(a) and Rule 40.1 and 40.2(e))

	Date of mailing (day/month/year) 27 November 2018 (27-11-2018)
Applicant's or agent's file reference JZ-17-P-4-WO	PAYMENT DUE within ONE MONTH from the above date of mailing
International application No. PCT/IB2018/056780	International filing date (day/month/year) 5 September 2018 (05-09-2018)
Applicant JOHN ZINK COMPANY, LLC	

1. This International Searching Authority

(i) considers that there are 2 (number of) inventions claimed in the international application covered by the claims indicated on an extra sheet:

(ii) therefore considers that **the international application does not comply with the requirements of unity of invention** (Rules 13.1, 13.2 and 13.3) for the reasons indicated on an extra sheet:

(iii) has carried out a partial international search (see Annex) will establish the international search report on those parts of the international application which relate to the invention first mentioned in claims Nos.:
see extra sheet

(iv) will establish the international search report on the other parts of the international application only if, and to the extent to which, additional fees are paid.

2. Consequently, the applicant is hereby **invited to pay**, within the time limit indicated above, the amount indicated below:

<u>EUR 1.775,00</u>	x	<u>1</u>	=	<u>EUR 1.775,00</u>
Fee per additional invention		number of additional inventions		currency/total amount of additional fees

3. The applicant is informed that, according to Rule 40.2(c), **the payment of any additional fee may be made under protest**, i.e., a reasoned statement to the effect that the international application complies with the requirement of unity of invention or that the amount of the required additional fee is excessive, where applicable, subject to the payment of a protest fee.
 Where the applicant pays additional fees under protest, the applicant is hereby invited, within the time limit indicated above, to pay a protest fee (Rule 40.2(e)) in the amount of EUR 875,00 (currency/amount)

Where the applicant has not, within the time limit indicated above, paid the required protest fee, the protest will be considered not to have been made and the International Searching Authority will so declare.

4. Claim(s) Nos. _____ have been found to be unsearchable under Article 17(2)(b) because of defects under Article 17(2)(a) and therefore have not been included with any invention.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	Authorized officer VIZZINI, Damiano Tel: +49 (0)89 2399-7821
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This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-24

Method of low NOx combustion and corresponding burner; a burner tile is surrounded by a furnace environment and a primary combustion zone is defined within the burner tile for a lean, low NOx first combustion step

2. claims: 25-39

Method of controlling low NOx combustion and corresponding burner system, e.g. within a furnace; a primary combustion zone is defined by a burner tile for a lean, low NOx first combustion step; flow rates are adjusted based on fuel composition and/or adiabatic flame temperature and/or measured NOx values in the furnace.

This Authority considers that the application does not meet the requirements of unity of invention and that there are two inventions. The reasons, for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

The common matter linking together the independent claims 1, 9, 25 and 32 is the following:

- primary combustion zone / chamber, implicitly defining also a following secondary combustion (zone)

This common matter does not comprise a single general inventive concept, based on same or corresponding special technical features within the meaning of Rule 13.2 PCT, because low NOx burner apparatuses and their method of operation having a primary combustion chamber / zone and a secondary combustion zone are disclosed in D1 (US 5,407,345).

D1 discloses a low NOx burner apparatus (column 1, lines 5, 6). Air is added through an input 25 into a plenum 20 and is mixed in mixing section 40 with fuel entering through fuel input 21 (see figure 1; column 1, line 67 to column 2, line 8). The lean premix enters primary burner section (= chamber) 60, where it is burned (figure 1; column 5, lines 63-65).

Secondary fuel gas jets 101 surround the outlet of the primary burner section thus forming a secondary flame section / secondary burning (= secondary combustion zone) (figure 1; column 8, lines 1-11).

Hence, the following separate inventions or groups of inventions are not so linked as to form a single general inventive concept:

claims: 1-24

Method of low NOx combustion and corresponding burner; a burner tile is surrounded by a furnace environment and a primary combustion zone is defined within the burner tile for a lean, low NOx first combustion step

claims: 25-39

Method of controlling low NOx combustion and corresponding burner system, e.g. within a furnace; a primary combustion zone is defined by a burner tile for a lean, low NOx first combustion step; flow rates are adjusted based on fuel composition and/or adiabatic flame temperature and/or

measured NOx values in the furnace.

Independent claim 1 comprises the non-common feature "furnace environment surrounding the burner tile". Independent claim 9 comprises the equivalent feature "tile wall extending into the furnace", thereby linking claims 1 and 9 to form one single invention.

This non-obvious feature provides the technical effect of superior premixing the secondary fuel with the flue gases in the furnace (due to the long mixing distance caused by the extending wall) and solves the objective technical problem of avoiding fuel rich zones in the secondary combustion zone.

Independent claim 25 comprises the non-common features "determining the composition of the primary and secondary fuel, determining the adiabatic flame temperatures and determining the required excess air quality required to produce a certain NOx amount". Independent claim 32 comprises the "overlapping" non-common features "computer processing system to adjust fuel flow rates .. based on the fuel composition and/or the adiabatic flame temperature and/or the measured NOx emissions from the furnace, thereby linking claims 25 and 32 to form one single invention. This non-obvious feature provides the technical effect of superior flame(s) temperature(s) control and solves the objective technical problem of reducing NOx emissions.

Hence, the claims comprise neither the same, nor corresponding special technical features, so the technical relationship between the subject matter of the claims required by Rule 13.2 PCT is lacking and the claims are not so linked as to form a single general inventive concept as required by Rule 13.1 PCT.

Consequently the application does not meet the requirement for unity of invention.

The application relates to a plurality of inventions, or groups of inventions, in the sense of Rule 13.1 PCT. They have been divided as defined above. If the applicant pays additional fees for one (or more) not yet searched group(s) of invention(s), then the further search(es) may reveal further prior art that gives evidence of a further lack of unity 'a posteriori' within one (or more) of the not yet searched group(s). In such a case only the first invention in this (each of these) group(s) of inventions, which is considered to lack unity of invention, will be the subject of a search. No further invitation to pay further additional fees will be issued. This is because Article 17(3)(a) PCT stipulates that the ISA shall establish the International Search Report on those parts of the international application which relate to the invention first mentioned in the claims ('main invention') and for those parts which relate to inventions in respect of which the additional fees were paid. Neither the PCT nor the PCT guidelines provide a legal basis for further invitations to pay further additional search fees (W17/00, point 11 and W1/97, points 11-16). In such a case the non-searched claims may be the subject of one or more divisional applications after the application has entered the regional phase before the EPO (see W18/07, point 26).

**Annex to Form PCT/ISA/206
COMMUNICATION RELATING TO THE RESULTS
OF THE PARTIAL INTERNATIONAL SEARCH**

International Application No
PCT/IB2018/056780

1. The present communication is an Annex to the invitation to pay additional fees (Form PCT/ISA/206). It shows the results of the international search established on the parts of the international application which relate to the invention first mentioned in claims Nos.:
- see 'Invitation to pay additional fees'
2. This communication is not the international search report which will be established according to Article 18 and Rule 43.
3. If the applicant does not pay any additional search fees, the information appearing in this communication will be considered as the result of the international search and will be included as such in the international search report.
4. If the applicant pays additional fees, the international search report will contain both the information appearing in this communication and the results of the international search on other parts of the international application for which such fees will have been paid.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 407 345 A (ROBERTSON THOMAS [US] ET AL) 18 April 1995 (1995-04-18) column 1, lines 5,6; figures 1-3, 4A-4C column 1, line 52 - column 2, line 13 column 2, line 20 - line 35 column 3, line 58 - column 4, line 13 column 4, line 25 - column 5, line 27 column 5, line 63 - column 7, line 14 column 7, line 42 - column 8, line 16 column 8, line 32 - line 42 -----	1-24
A	EP 0 562 710 A2 (ZINK CO JOHN [US]) 29 September 1993 (1993-09-29) column 1, line 1 - line 4; figures 1-4 column 2, line 4 - line 25 column 2, line 44 - column 4, line 53 column 5, line 7 - line 45 -----	1-24
A	US 2005/175945 A1 (CHUNG I-PING [US] ET AL) 11 August 2005 (2005-08-11) paragraph [0003]; figures 1-4 paragraph [0021] - paragraph [0024] paragraph [0027] - paragraph [0032] -----	1,9
A	CN 201 903 058 U (LUOYANG RUICHANG PETROCHEMICAL EQUIPMENT CO LTD) 20 July 2011 (2011-07-20) the whole document -----	1,9

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Patent Family Annex

Information on patent family members

International Application No

PCT/IB2018/056780

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5407345	A	US 5407345 A	18-04-1995
		US 5554021 A	10-09-1996

EP 0562710	A2	CA 2076705 A1	28-09-1993
		EP 0562710 A2	29-09-1993
		JP 2633452 B2	23-07-1997
		JP H0618011 A	25-01-1994
		TW 227037 B	21-07-1994
		US 5195884 A	23-03-1993

US 2005175945	A1	NONE	

CN 201903058	U	NONE	

Application no:
Demande n°: PCT/IB2018/056780
Anmelde-Nr:

DISCLAIMER

The attached provisional opinion on the patentability of the first invention searched serves only as information.
A reply addressing the points raised in the opinion is **not** required and will **not** be taken into account when issuing the final search report and opinion on patentability.

AVERTISSEMENT

L'avis provisoire ci-joint sur la brevetabilité de la première invention recherchée ne sert qu'à titre d'information.
Une réponse abordant les points soulevés dans l'avis n'est **pas** nécessaire et ne sera **pas** prise en compte lors de l'établissement du rapport final de la recherche et de l'avis sur la brevetabilité.

DISCLAIMER

Die beigefügte vorläufige Stellungnahme zur Patentierbarkeit der ersten geprüften Erfindung dient lediglich zur Information.
Eine Antwort auf die erhobenen Punkte in der Stellungnahme ist **nicht** erforderlich und bleibt bei der Erstellung des endgültigen Recherchenberichts und der Stellungnahme zur Patentierbarkeit **unberücksichtigt**.

Re Item IV

Lack of unity of invention

This Authority considers that the application does not meet the requirements of unity of invention and that there are two inventions.

The reasons, for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

The common matter linking together the independent claims 1, 9, 25 and 32 is the following:

- primary combustion zone / chamber, implicitly defining also a following secondary combustion (zone)

This common matter does not comprise a single general inventive concept, based on same or corresponding special technical features within the meaning of Rule 13.2 PCT, because low NO_x burner apparatuses and their method of operation having a primary combustion chamber / zone and a secondary combustion zone are disclosed in D1 (US 5,407,345).

D1 discloses a low NO_x burner apparatus (column 1, lines 5, 6). Air is added through an input 25 into a plenum 20 and is mixed in mixing section 40 with fuel entering through fuel input 21 (see figure 1; column 1, line 67 to column 2, line 8). The lean premix enters primary burner section (= chamber) 60, where it is burned (figure 1; column 5, lines 63-65). Secondary fuel gas jets 101 surround the outlet of the primary burner section thus forming a secondary flame section / secondary burning (= secondary combustion zone) (figure 1; column 8, lines 1-11).

Hence, the following separate inventions or groups of inventions are not so linked as to form a single general inventive concept:

claims: 1-24

Method of low NO_x combustion and corresponding burner; a burner tile is surrounded by a furnace environment and a primary combustion zone is defined within the burner tile for a lean, low NO_x first combustion step

claims: 25-39

Method of controlling low NO_x combustion and corresponding burner system, e.g. within a furnace; a primary combustion zone is defined by a burner tile for a lean, low NO_x first combustion step; flow rates are adjusted based on fuel composition and/or adiabatic flame temperature and/or measured NO_x values in the furnace.

Independent claim 1 comprises the non-common feature "furnace environment surrounding the burner tile". Independent claim 9 comprises the equivalent feature "tile wall extending into the furnace", thereby linking claims 1 and 9 to form one single invention.

This non-obvious feature provides the technical effect of superior premixing the secondary fuel with the flue gases in the furnace (due to the long mixing distance caused by the extending wall) and solves the objective technical problem of avoiding fuel rich zones in the secondary combustion zone.

Independent claim 25 comprises the non-common features "determining the composition of the primary and secondary fuel, determining the adiabatic flame temperatures and determining the required excess air quality required to produce a certain NOx amount". Independent claim 32 comprises the "overlapping" non-common features "computer processing system to adjust fuel flow rates .. based on the fuel composition and/or the adiabatic flame temperature and/or the measured NOx emissions from the furnace, thereby linking claims 25 and 32 to form one single invention. This non-obvious feature provides the technical effect of superior flame(s) temperature(s) control and solves the objective technical problem of reducing NOx emissions.

Hence, the claims comprise neither the same, nor corresponding special technical features, so the technical relationship between the subject matter of the claims required by Rule 13.2 PCT is lacking and the claims are not so linked as to form a single general inventive concept as required by Rule 13.1 PCT.

Consequently the application does not meet the requirement for unity of invention.

The application relates to a plurality of inventions, or groups of inventions, in the sense of Rule 13.1 PCT. They have been divided as defined above. If the applicant pays additional fees for one (or more) not yet searched group(s) of invention(s), then the further search(es) may reveal further prior art that gives evidence of a further lack of unity 'a posteriori' within one (or more) of the not yet searched group(s). In such a case only the first invention in this (each of these) group(s) of inventions, which is considered to lack unity of invention, will be the subject of a search. No further invitation to pay further additional fees will be issued. This is because Article 17(3)(a) PCT stipulates that the ISA shall establish the International Search Report on those parts of the international application which relate to the invention first mentioned in the claims ('main invention') and for those parts which relate to inventions in respect of which the additional fees were paid. Neither the PCT nor the PCT guidelines provide a legal basis for further invitations to pay further additional search fees (W17/00, point

11 and W1/97, points 11-16). In such a case the non-searched claims may be the subject of one or more divisional applications after the application has entered the regional phase before the EPO (see W18/07, point 26).

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

- D1 US 5 407 345 A (ROBERTSON THOMAS [US] ET AL) 18 April 1995
(1995-04-18)
- D2 EP 0 562 710 A2 (ZINK CO JOHN [US]) 29 September 1993
(1993-09-29)

1 Independent Claim 1

- 1.1 D1 is regarded as being the prior art closest to the subject-matter of claim 1, and discloses a method of discharging fuel and an amount of air into a furnace space wherein fuel is burned such that flue gases having low NO_x content and low CO content are formed therefrom, namely:

A method of discharging fuel and an amount of air into a furnace space (column 1, lines 5, 6; figure 1; column 8, lines 7-9 for furnace) wherein the fuel is burned such that flue gases having low NO_x content (see above) and low CO content (implicitly disclosed through lines 12-15 in combination with the high oxygen content in the primary combustion zone, see e.g. column 1, lines 54-58) are formed therefrom, the method comprises:

mixing a first portion of the fuel and substantially all of the air to form a lean primary fuel-air mixture (figure 1: sole air input 25; primary fuel input 21, mixing section 40);

discharging the lean primary fuel-air mixture into the furnace space within a primary combustion zone (figure 1: primary burner section 60; column 4, lines 59, 60) defined by a burner tile (figure 1, item 91; column 7, lines 58, 59);

burning the primary fuel-air mixture in the primary combustion zone to produce a flame and thus generated flue gases, wherein the primary combustion zone has a first end and a second end (figure 1), and the lean primary fuel-air mixture is introduced so that the flame is anchored adjacent

the first end (column 4, line 59 to column 5, line 9) and the generated flue gases are discharged into the furnace environment at the second end (figure 1; column 5, lines 63-65).

- 1.2 The subject-matter of claim 1 therefore differs from this known method in that there is a furnace environment surrounding the burner tile and is therefore new (Article 33(2) PCT).
- 1.3 The problem to be solved by the present invention may be regarded as how to avoiding fuel rich zones in the secondary combustion zone.
- 1.4 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
- 1.4.1 D1 discloses the secondary fuel being injected through the burner tile at the outlet of the primary combustion zone.
The mounting of the tile protruding into the furnace would NOT solve the technical problem.
- 1.4.2 D1 features a massive tile and teaches the advantages of heat storage; the figures seem to show a mounting flange. The skilled man - knowing that high temperature furnaces employing tile type burners typically have a refractory insulation - would provide a flush mounting in order to embed the burner tile in the refractory (thereby using additional heat storage) rather than exposing the tile to the changing temperatures (e.g. short interruptions of operation) of the furnace space.
- 1.4.3 Although D2 teaches a burner with an extending tile wall (see figures 1, 2) the skilled man is not prompted to expose the massive tile of D1, because
- exposing the tile of D1 would not solve the problem (see 1.4.1)
 - exposing the tile of D1 counteracts the teaching of D1 (see 1.4.2)
 - the tile of D2 is directed to anchoring the flame, whereas D1 teaches to complete the primary combustion within the primary combustion zone.
- problem (see 1.4.1)

2 **Dependent Claims 2-8**

- 2.1 Claims 2-8 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

3 **Independent Claim 9**

- 3.1 Furthermore, the below-mentioned lack of clarity notwithstanding, the subject-matter of claim 9 is new and does involve an inventive step in the sense of Article 33(3) PCT.

- 3.2 D1, which is considered to represent the most relevant state of the art, discloses a fuel gas burner (see figure 1; cited passages; 1.1) from which the subject-matter of claim 9 differs in that
- A: a burner tile wall extends into the furnace
 - B: a plurality of flame holders are located within the (primary) combustion chamber
 - C: a primary tube is an ignition unit
 - D: the secondary fuel tips are operably associated with the burner apparatus, such that the secondary fuel gas is injected from outside of the burner tile.
- 3.3 The problem to be solved by the present invention may be regarded as how to avoiding fuel rich zones in the secondary combustion zone.
- 3.4 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: see 1.4.1 to 1.4.3
- 4 **Dependent Claims 10-24**
- 4.1 Claims 10-24 are dependent on claim 9 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Re Item VIII

Certain observations on the international application

The application does not meet the requirements of Article 6 PCT, because claim 9 is not clear.

Line 3 defines that the first end of the plenum is attached to a furnace. This wording leaves the reader in doubt, if the furnace as such is a feature of the claim and therefore establishes a lack of clarity. Similarly, line 12 "extending into **the** furnace" refers back to the feature.