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(54) Title: BURNERS WITH FLAME CONTROL AND POSITIONING, AND RELATED METHODS

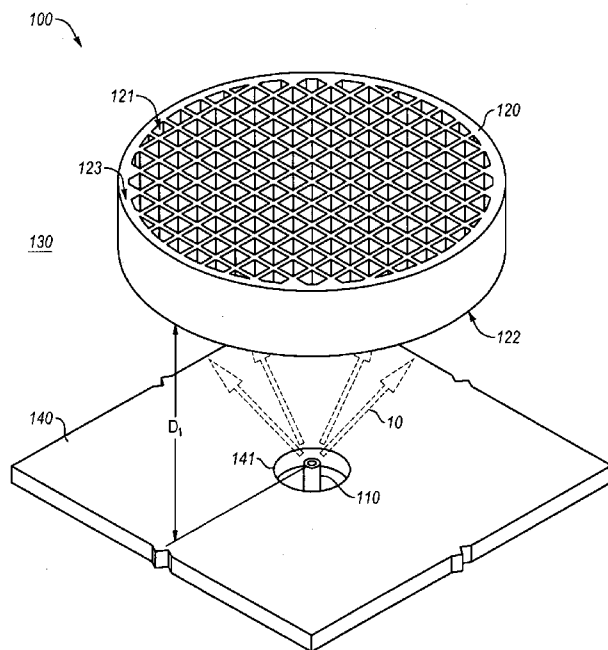


Fig. 1

(57) Abstract: Embodiments disclosed herein include flame positioning and stabilization devices, systems, and methods as well as burners and combustion systems (e.g., systems that include multiple burners), which incorporate such flame positioning and stabilization devices, systems, and methods.



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/15051

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F23D 17/00 (2015.01)

CPC - F23D 17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): F23D 17/00 (2015.01)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 IPC(8): F23D 14/62, F23D 14/82 (2015.01) CPC: F23D 14/62, F23D 14/82 USPC: 239/419.3, 239/419.5, 239/426, 239/427.5, 239/422, 431/354, 431/346, 431/353, 426/116

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 PatBase; ProQuest Dialog; Google Patents; Google Web; Google Scholar Search Terms: first, second, fuels, flame speed, different flame speeds, position, control%, adjust%, position%, first fuel, second fuel, flame, position%, stabil%, burner%, flame speed%, first flame speed, second flame speed, different flame speeds, regulat%, modif%,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---		1, 8 -----
Y ---	US 5,718,573 A (Knight et al.). 17 February 1998 (17.02.1998). Fig. 1; col 2, ln 31-45, 60-62; col 3, ln 1-52; col 4, ln 40-45.	2-5, 9-10 -----
A		6-7
Y	US 2007/0281253 A1 (Toqan). 06 December 2007 (06.12.2007). Fig. 1; para [0042]-[0043], [0047].	2-4
Y ---	US 2,407,973 A (Beckstrom). 24 September 1946 (24.09.1946). Fig. 2; col 2, ln 52-col 3, ln 1; col 3, ln 34-36.	5 -----
A		6-7
Y	US 5,685,708 A (Palmer-Jones). 11 November 1997 (11.11.1997). Fig. 3; col 3, ln 47-52; col 4, ln 6-10; col 5, ln 63-col 6, ln 7.	9-10

☐ Further documents are listed in the continuation of Box C.


* 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 application or patent 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

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/15051

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-10, directed to a method of controlling a downstream position of a flame relative to a primary fuel nozzle.

Group II: Claims 11-18, directed to a burner, including a first fuel source and a second fuel source.

Group III: Claims 19-21, directed to a burner, including a flame control mechanism configured to produce ignition of the first fuel at or near a perforated burner plate.

-*-See extra sheet-*-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-10

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 15/15051

.-Continuation of Box III-Observations where unity of invention is lacking-.-

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical feature(s) for the following reasons:

Group I requires the special technical feature of the steps of mixing at least a portion of a second fuel flow with at least a portion of a first fuel and controlling the relative proportion of the fuels or the position of the second fuel flow, not required by Groups II or III.

Group II requires the special technical feature(s) of a perforated flame holder, fuel nozzles spaced therefrom and facing generally toward the same, first and second fuel sources operably coupled to the fuel nozzles, and one or more control mechanisms configured to control one or more of a position of a flow of the second fuel relative to the first fuel or a relative proportion of the first and second fuels flowing toward the perforated flame holder, not required by Groups I or III.

Group III requires the special technical feature(s) of a flame control mechanism configured to produce ignition of the first fuel at or near a perforated burner plate, not required by Groups I or II.

The only shared technical feature(s) that would otherwise unify Groups I-III are a burner having at least one fuel nozzle. However, these shared technical feature(s) do not represent a contribution over the prior art, because the shared technical feature(s) are anticipated by US 5,718,573 A to Knight et al. (hereinafter 'Knight').

Knight teaches a burner (2 in Fig. 1; col 3, ln 14-15) comprising at least one fuel nozzle (4, 14 in Fig. 1; col 3, ln 15-17, 24-27).

As the common technical feature(s) were known at the time of the invention, they cannot be considered to be common technical feature(s) that would otherwise unify Groups I-III.

The only shared technical feature(s) that would otherwise unify Groups I and II are a burner configured to combust first and second, different, fuels, having different flame speeds, and first and second, different, fuel sources, wherein the fuels have different flame speeds, and a structure or method for controlling a relative proportion of a first fuel to a second fuel, or a position of a first fuel relative to a second fuel. However, these technical feature(s) do not represent a contribution over the prior art, because the shared technical feature(s) are obvious over Knight.

Knight teaches a burner (2 in Fig. 1; col 3, ln 14-15) configured to combust first and second, different, fuels (col 4, ln 41-45), and first and second, different, fuel sources (illustrated in Fig. 1; col 3, ln 15-37; col 4, ln 41-45); and a structure or method for controlling a relative proportion of a first fuel to a second fuel, or a position of a first fuel relative to a second fuel (as illustrated in Fig. 1; col 3, ln 14-37). Knight does not expressly teach that the first and second fuels have different flame speeds. However, inasmuch as an objective of the disclosure is to control the flame position so as to prevent flashback (col 3, ln 1-13), it would have been obvious to one having ordinary skill in the art that the burner and method taught by Knight could have been modified to selectively use first and second fuels having different flame speeds, to facilitate controlling flame position.

As the common technical feature(s) were known at the time of the invention, they cannot be considered to be common technical feature(s) that would otherwise unify Groups I and II.

The only shared technical feature(s) that would otherwise unify Groups I and III are a structure and/or method for igniting fuel in a burner, to produce a flame downstream of a nozzle. However, these technical feature(s) do not represent a contribution over the prior art, because the shared technical feature(s) are anticipated by US 4,078,587 A to Jackson (hereinafter 'Jackson').

Jackson teaches a structure and/or method for igniting fuel in a burner, to produce a flame downstream of a nozzle. Specifically, Jackson teaches a burner (10 in Fig. 1; col 3, ln 21-23) having an igniter (42 in Fig. 1; col 5, ln 12-16) to ignite a fuel to produce a flame downstream from a nozzle (inlet pipe 14 in Fig. 2; col 3, ln 32-34).

As the common technical feature(s) were known at the time of the invention, they cannot be considered to be common technical feature(s) that would otherwise unify Groups I and III.

The only shared technical feature(s) that would otherwise unify Groups II and III are a burner having a perforated flame holder. However, these technical feature(s) do not represent a contribution over the prior art, because the shared technical feature(s) are anticipated by Knight.

Knight teaches a perforated flame holder (22 in Fig. 1; col 3, ln 45-47).

As the common technical feature(s) were known at the time of the invention, they cannot be considered to be common technical feature(s) that would otherwise unify Groups II and III.

Therefore, Groups I-III lack unity under PCT Rule 13.