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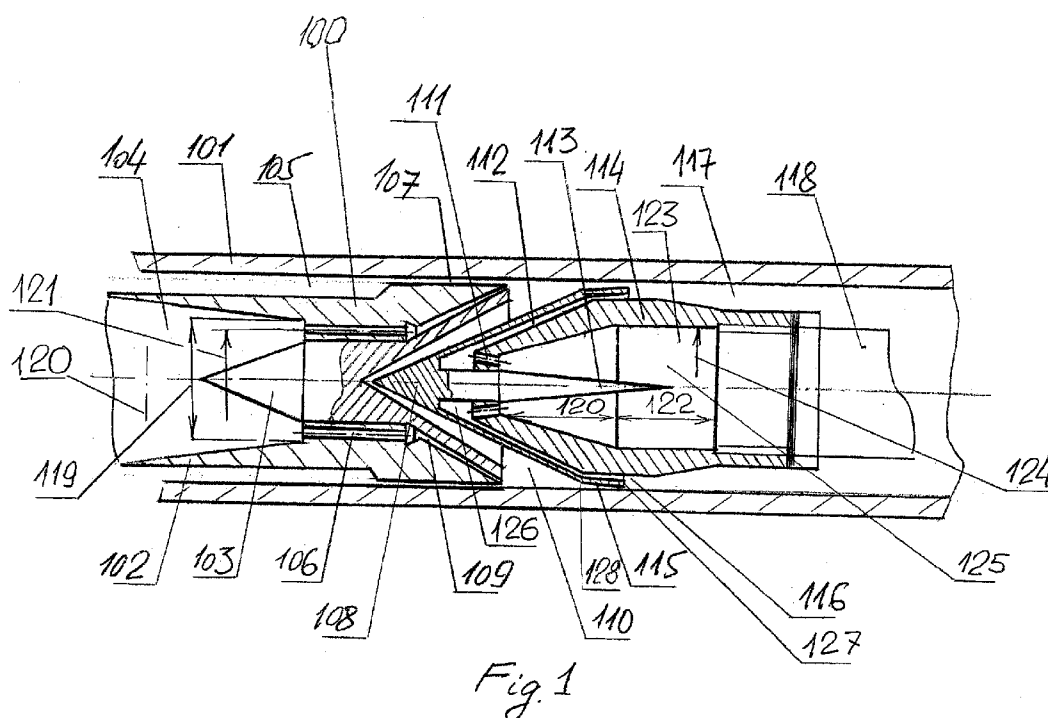
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[Continued on next page]

(54) Title: DYNAMIC MIXING OF FLUIDS



(57) Abstract: Methods, systems, and devices for preparation and activation of liquids and gaseous fuels are disclosed. Method of vortex cooling of compressed gas stream and water removing from air are disclosed.

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Published:

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- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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14 May 2009

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 08/75374

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B01F 5/04 (2009.01)

USPC - 239/399

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)
239/399Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
60/215, 217, 748; 239/399, 403, 404, 406, 463

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST(USPT,PGPB,EPAB,JPAB); Google Scholar; Google Patents

Search Terms Used: fuel; spheres; shell; core; compressed; low; pressure; turbulent; stream; cone; truncated; capillary

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 6,432,148 B1 (GANAN_CALVO) 13 Aug 2002 (13.08.2002), entire document especially col 4 ln 63-67, col 5 ln 1-11, col 16 ln 26-39, and col 17 ln 26-51	1-3 8-10, 62, 64, 76-78, 80-81 ----- 4-7, 19, 21-32, 63, 65-69, 75, 79
Y	US 4,553,504 A (DUGGAL et al.) 19 November 1985 (19.11.1995), col 1 ln 27-36	4, 66
Y	US 5,174,247 A (TOSA et al.) 29 December 1992 (29.12.1992), col 5 ln 7-20 and abstract	5-6, 67, 68-69, 79
Y	US 5,865,158 A (CLEVELAND et al.) 02 February 1992 (02.02.1992), col 2 ln 63-67 and abstract	7, 63, 65, 68
Y	US 3,980,233 A (SIMMONS et al.) 14 September 1976 (14.09.1976), entire document especially Fig. 2, Fig. 3, col 2 ln 60-68, col 3 ln 1-10, and col 3 ln 43-67	19, 21-32, 75

☐ 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

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 08/75374

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, 19, 21-32, 62-69, and 75-81: directed to liquid fuel/air droplet compositions and related methods and devices.
Group II) claims 11-18, 20, 33-61, 70-74, 82-91, 97, 102, and 103: directed to methods and devices for preparation of fuel mixtures.
Group III) claims 92-96, 98-101, 104, and 105: directed to fuel injectors and related methods.

-----continued on supplemental 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, 19, 21-32, 62-69, and 75-81

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 08/75374

The inventions listed in Group I relate to a general inventive concept of liquid fuel/air compositions that include mixtures having air cores; the inventions listed in Group II relate to the preparation of fuel mixtures that includes the step of mixing fuel and other gaseous stream; and the inventions listed in Group III relate fuel injection device having vortex chambers; however, the inventions listed as Groups I, II, and 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 features for the following reasons:

Groups II and III do not include the inventive concept of air cores, as required by Group I.

Groups I and III do not include the inventive concept of methods having a step of mixing fuel and gas, as required by Group II.

Groups I and III do not include the inventive concept of methods having a step of mixing fuel and gas, as required by Group II.

Groups I and II do not include the inventive concept of a vortex chamber, as required by Group III.

Further, while Groups I, II and/or III are drawn to inventions that include known elements such as elements and related steps for receiving and transmitting gas and liquid streams; various mixture chambers or stages; centrifugal atomizer nozzle, and so forth (see Simmons, et al. at col 2, ln 35 to col 3, ln 13; and FIG. 2; US 3,980,233 titled Air-atomizing fuel nozzle).

Groups I, II, and III therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature