



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 0 902 237 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:  
**20.09.2000 Bulletin 2000/38**

(51) Int. Cl.<sup>7</sup>: **F23R 3/14**

(43) Date of publication A2:  
**17.03.1999 Bulletin 1999/11**

(21) Application number: **98116591.3**

(22) Date of filing: **02.09.1998**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**

Designated Extension States:  
**AL LT LV MK RO SI**

(30) Priority: **10.09.1997 JP 24547797**

(71) Applicant:  
**Mitsubishi Heavy Industries, Ltd.  
Tokyo 100-0005 (JP)**

(72) Inventors:  
• **Mandai, Shigemi,  
c/o Takasago R & D Center  
Arai-cho, Takasago-shi, Hyogo-ken (JP)**

• **Ohta, Masataka,  
c/o Takasago R & D Center  
Arai-cho, Takasago-shi, Hyogo-ken (JP)**  
• **Inada, Mitsuru,  
c/o Takasago Machinery Works  
Arai-cho, Takasago-shi, Hyogo-ken (JP)**  
• **Akamatsu, Shinji,  
c/o Takasago Machinery Works  
Arai-cho, Takasago-shi, Hyogo-ken (JP)**

(74) Representative:  
**Henkel, Feiler, Hänzel  
Möhlstrasse 37  
81675 München (DE)**

(54) **Combustor swirler with twisted vanes**

(57) Pre-mixture forming swirler in gas turbine pre-mixed flame type low NO<sub>x</sub> combustor is improved so as to accelerate mixing of fuel and air and to prevent occurrence of flame stagnation and burning of component.

Three-dimensional swirler is constructed such that swirler vane (101a) is twisted from hub side thereof to tip side so that fitting angle ( $\beta$ ) of the tip side relative to fuel nozzle (102) center axis (C) is larger than that ( $\alpha$ ) of the hub side. Thereby, while the angle ( $\alpha$ ) of the hub side is set smaller so that flame stagnation and burning of components resulted therefrom may be prevented from occurring, the angle ( $\beta$ ) of the tip side may be selected so that shearing flow necessary for appropriate mixing of fuel (F) and air (A) is obtained, thus favorable pre-mixing is done, life deterioration due to the burning etc. is prevented and combustion efficiency is enhanced.

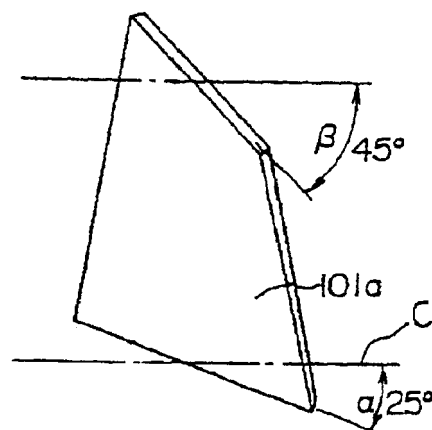


Fig. 1 (c)

EP 0 902 237 A3



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 98 11 6591

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 89 06307 A (SUNDSTRAND CORP) 13 July 1989 (1989-07-13) * page 6, line 8 - line 18 * * page 7, line 16 - line 28 * * figures 3-5 *	1	F23R3/14
X	US 2 798 661 A (WILLENBROCK) 9 July 1957 (1957-07-09) * column 2, line 69 - column 3, line 10 * * figures 6-9 *	1	
X	US 4 221 558 A (SANTISI HARRY C) 9 September 1980 (1980-09-09) * figure 1 *	1	
A	EP 0 397 046 A (MITSUBISHI HEAVY IND LTD) 14 November 1990 (1990-11-14) * column 2, line 51 - column 3, line 2 *	1,2	
A	US 5 186 607 A (CHEN LI-CHIANG ET AL) 16 February 1993 (1993-02-16) * figure 8 *	1,2	
A	US 1 931 692 A (GOOD) 24 October 1933 (1933-10-24) * column 2, line 43 - line 53 * * figures 5-9 *	1,2	
A	US 4 695 225 A (HELLAT JAAN ET AL) 22 September 1987 (1987-09-22)		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			F23R
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>25 July 2000</b>	Examiner <b>Steinhauser, U</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 11 6591

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-07-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 8906307 A	13-07-1989	EP 0371090 A US 4996837 A	06-06-1990 05-03-1991
US 2798661 A	09-07-1957	NONE	
US 4221558 A	09-09-1980	NONE	
EP 0397046 A	14-11-1990	DE 69010973 D DE 69010973 T US 5094610 A	01-09-1994 09-02-1995 10-03-1992
US 5186607 A	16-02-1993	US 5161946 A GB 2263763 A,B	10-11-1992 04-08-1993
US 1931692 A	24-10-1933	NONE	
US 4695225 A	22-09-1987	CH 660403 A	15-04-1987