

### AN AIR SWIRLER FUEL ATOMIZER ASSEMBLY WITH VARIABLE HUB TO TIP ASPECT RATIO

#### IITM Technology Available for Licensing

#### Problem Statement

- Current gas turbine combustors suffer from inadequate fuel-air mixing and atomization due to limited control over radial velocity components in existing swirler designs.
- A novel swirler is needed to introduce variable radial velocity components, addressing the shortcomings of conventional designs and meeting the demand for finer atomization and improved droplet dispersion in diverse combustion systems.

#### Technology Category/ Market

**Category-** Combustion Technology

**Applications** – Gas turbine engines, liquid rocket engines, marine combustors, burners, and any combustor requiring improved fuel-air mixing and atomization.

**Industry** – Aerospace and Energy

**Market** -The global internal combustion engine market demand size reached 181,836 thousand units in 2022 and is anticipated to expand at a (CAGR) of 9.2% from 2023 to 2030.

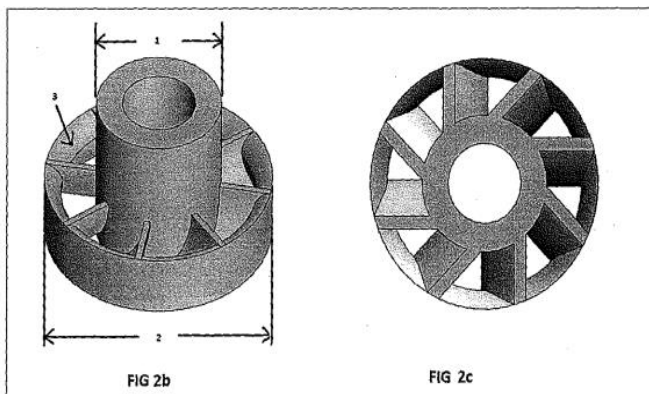


Fig 2a illustrates Varying AR on the hub side

#### Intellectual Property

- IITM IDF Ref. 1666
- IN 396359 (PATENT GRANTED)

#### Technology

##### Variable Aspect Ratio Design:

The invention introduces a swirler with a varying aspect ratio from entry to exit, allowing control over axial, tangential, and crucially, radial velocity components, enhancing fuel-air mixing.

##### Sheet Cutter:

The design incorporates sheet breakers at the swirler exit, disrupting liquid sheets into ligaments and droplets, facilitating finer atomization even at lower injection pressures.

##### Improved Flow Guidance:

The swirler's smooth nozzle shape with a variable flow area guides the flow effectively, resulting in higher exit velocity components, contributing to enhanced combustion efficiency.

##### Enhanced Spray Characteristics:

Flexibility to adapt trust computation to specific security requirements.

##### Adaptability in Design:

The invention allows for flexibility in implementing the variable aspect ratio design on either the hub or tip side of the swirler, providing versatility to suit specific combustor requirements.

#### TRL (Technology Readiness Level)

TRL- 4, Technology validated in Lab.

#### Research Lab

Prof. Sundararajan T

Dept. of Mechanical Engineering

#### CONTACT US

Dr. Dara Ajay, Head  
Technology Transfer Office,  
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:  
<https://ipm.icsr.in/ipm/>

Email: [smipm-icsr@icsrpis.iitm.ac.in](mailto:smipm-icsr@icsrpis.iitm.ac.in)

[sm-marketing@imail.iitm.ac.in](mailto:sm-marketing@imail.iitm.ac.in)

Phone: +91-44-2257 9756/ 9719

### Key Features / Value Proposition

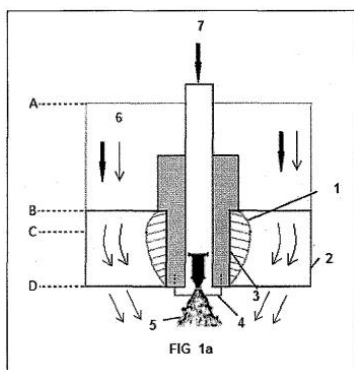
#### User Perspective:

- Provides combustor engineers with a swirler design enhancing fuel-air mixing and atomization, improving combustion efficiency in applications like gas turbine engines.

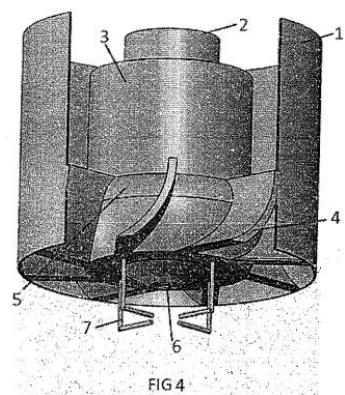
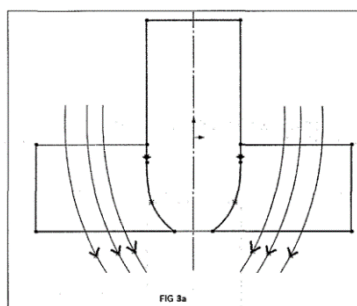
#### Technical Perspective:

- Introduces a novel swirler with variable aspect ratio, enabling control over axial, tangential, and radial velocities, addressing limitations in current combustor designs.

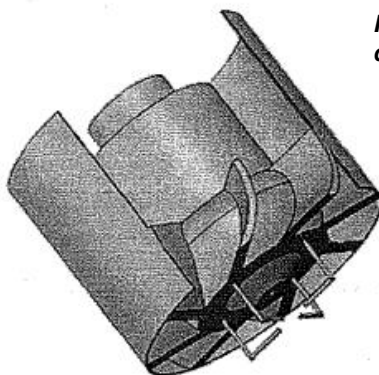
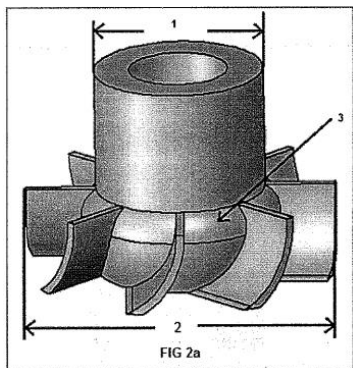
### Image



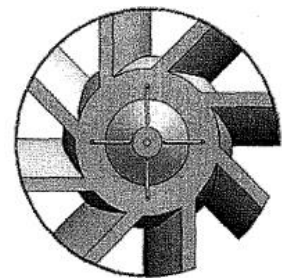
**FIG 1a illustrates Varying Aspect ratio on the hub side**



**Fig 4 illustrates partially cut view of new swirler design**



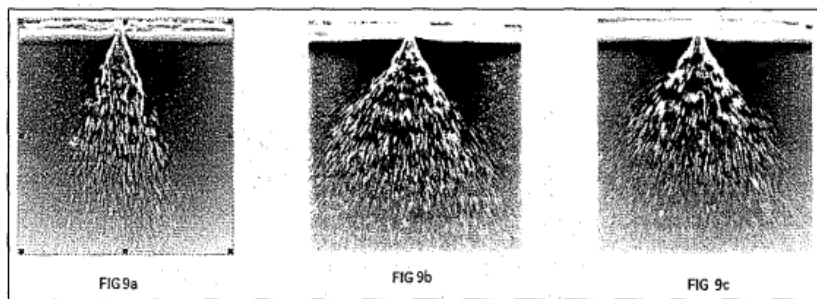
**FIG 5**



**Fig 6**

**Figures 5 and 6 show the different views of the partially cut design**

**Fig 9a illustrates Spray cone angle variation of conventional 60o swirler. Fig 9b illustrates Spray cone angle variation of 60o swirler with varying aspect ratio on hub side. Fig 9c illustrates Spray cone angle variation of 60o swirler with varying aspect ratio on tip side.**



### CONTACT US

**Dr. Dara Ajay, Head**  
Technology Transfer Office,  
IPM Cell- IC&SR, IIT Madras

**IITM TTO Website:**  
<https://ipm.icsr.in/ipm/>

**Email:** [smipm-icsr@icsrpis.iitm.ac.in](mailto:smipm-icsr@icsrpis.iitm.ac.in)

[sm-marketing@imail.iitm.ac.in](mailto:sm-marketing@imail.iitm.ac.in)

**Phone:** +91-44-2257 9756/ 9719