

PIEZO-ELECTRIC, ULTRASONIC, ANNULAR SURFACE INJECTION FOR EMISSION REDUCTION AND BETTER CONTROL IN ENGINES

IITM Technology Available for Licensing

Problem Statement

- Current ultrasonic and micro-nozzle fuel injectors often struggle with precise control over droplet size and spray penetration, especially at low pressures.
- Existing **ultrasonic fuel injectors are often too large to be effectively integrated into small engines**, limiting their application.
- There is a need for a more cost-effective and easily manufacturable injection system that can deliver precise atomization for diverse engine types and sizes.

Intellectual Property

- IITM IDF Ref. **969**
- IN 326643 - Patent Granted**

Technology

The invention employs piezoelectric ultrasonic multi-hole nozzles to achieve fine fuel droplet sizes (<10 microns), ensuring rapid vaporization and reducing wall film formation, leading to lower emissions and improved transient response.

The system is electronically controlled, allowing precise fuel metering based on engine conditions, and eliminates the need for high-pressure fuel pumps, making it more efficient and suitable for small engines.

The invention allows for both homogeneous and stratified combustion by strategically activating injectors around the air inlet pipe, optimizing fuel-air mixing for various engine loads and improving fuel economy.

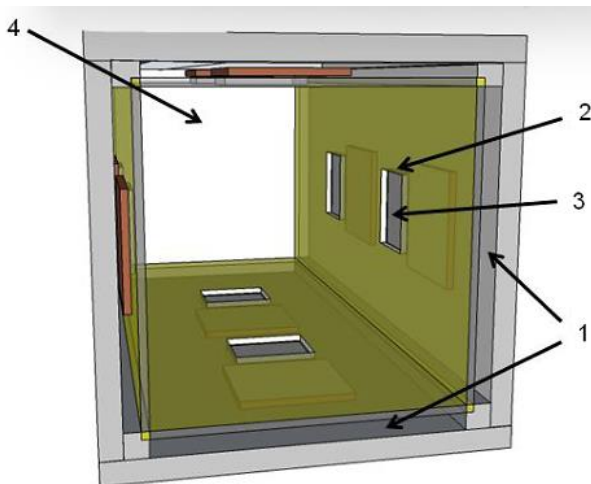
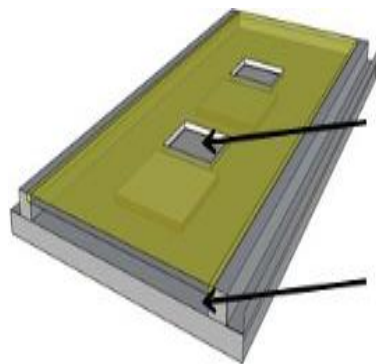


FIG. 1. Assembled view of the manifold containing the ultrasonic microinjectors.



Part Name	Part No
Fuel passage	1
Slot for atomizer	2
Atomizer surface	3
Air passage	4
Fuel	5
Piezo-electric crystal	6

FIG. 2. View showing one side of the manifold with the cut out for the atomizers, and the annular passage in which fuel is present.

TRL (Technology Readiness Level)

TRL - 5: Technology validated in relevant environment.

Research Lab

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Technology Category/ Market

Category - Advanced Fuel Injection Systems, Automobile & Transportation

Applications- Passenger Vehicles, Commercial Vehicles, Motorcycles and Scooters

Industry- Automotive, Engine Component Two-Wheeler Sector: Motorcycles, Scooters, Mopeds

Market - Automotive Fuel Injector Market is expected to reach an estimated \$15.4 billion by 2030 with a **CAGR of 5.8%** from 2024 to 2030.

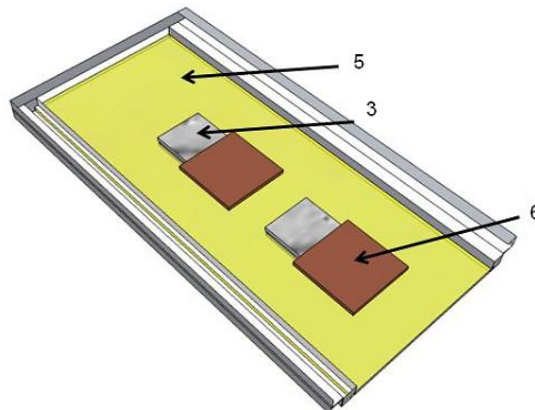


FIG. 3. Top view of one of the side walls of the manifold with the top plate removed. The piezoelectric ultrasonic injector is shown.

Key Features / Value Proposition

1. Precise Fuel Metering:

- Electronic control of fuel injection based on engine conditions ensures accurate and efficient fuel usage.

2. Superior Atomization:

- Piezoelectric ultrasonic multi-hole nozzles produce fine droplets (<10 microns) for rapid vaporization and reduced emissions.

3. Enhanced Transient Response

- Close-proximity injection minimizes wall film formation, leading to quicker engine response and lower hydrocarbon emissions.

4. Pump-Free Operation:

- Gravity-fed fuel delivery eliminates the need for high-pressure pumps, reducing system complexity and power consumption.

5. Versatile Combustion Modes:

- Capability to switch between homogeneous and stratified combustion improves fuel economy and engine performance across various loads.

6. Compact and Adaptable Design:

- Surface injectors with large injecting surfaces are easily integrated into small engines, offering a practical solution for diverse applications.

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