Air-Breathing Plasma Thruster With a Variable Spacing Cathode

This technology offers a platform for indefinite space flight using high-altitude air-breathing plasma thrusters and does not require on-board propellant. This system can accommodate varying air densities and be mechanically tuned between the thruster's anode and cathodes.

What is the Problem?

Since the launch of the first commercial communication satellite in 1962, satellites have changed the landscape of telecommunications and remote sensing/monitoring, becoming progressively specialized in numerous applications. Even with tremendous technological advancement over the years, typical satellites still have some significant challenges. The main drawbacks are found in cost, including the expense of launching them into orbit, repairing/maintaining them while in operation, and developing payloads that can withstand the harshness of space. To overcome some of these limitations, recent work has produced "atmospheric satellites." These aircraft typically have wings and fly at twice the height of commercial airliners, and they can maintain flight for years by using solar energy. These crafts have the benefit of being closer to the ground, ensuring less susceptibility to signal degradation, and can be slow-moving to operate in one local area, unlike low-orbiting satellites that move much too quickly across the sky. In spite of the promise from atmospheric satellites, there is much development necessary to perfect this platform. One significant consideration is the variability of pressure in the atmosphere; depending on the operational altitude, the density of air changes affecting the vehicle's efficiency. In this innovation, a novel design for air-breathing plasma thrusters proposes adaptable electrode spacing to ensure thruster efficiency over a range of atmospheric pressures, while achieving unprecedented thrust.

What is the Solution?

This innovation proposes a platform for indefinite space flight using high-altitude air-breathing plasma thrusters, which does not require on-board propellant. Solar power backed by energy storing batteries will drive the craft's thrusters. The system expects to operate between 40,000 and 90,000 feet, with a stable flight altitude between 60,000 and 80,000 feet. Through thin-air superheating, the thruster will produce a weakly ionized plasma to achieve a pioneering thrust level. At the center of this technology is a unique variable electrode spacing system that allows its adaptability to a wide range of air pressures. A series of gear bars and an inner gear (driven by a servo motor) adjust the relative spacing between 12 copper cathode bars configured radially around a central anode. This adaptable spacing can accommodate varying air densities in the main discharge section of the thruster.

Technology ID

BDP 7947

Category

Hardware/Other

Selection of Available Technologies

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What Differentiates it from Solutions Available Today?

Current solutions suffer from variability of pressure in the atmosphere; depending on the operational altitude, the density of air changes affecting the vehicle's efficiency. The innovation describes an air-breathing plasma thruster that boasts a wide atmospheric operation range due to its novel variable electrode spacing. By mechanically tuning the spacing between the thruster's anode and cathodes, the thruster can function in various air-densities, with the potential for indefinite flight.

Patent Information:

US11143171B2

References

1. Robert M. Winglee(43678) , https://www.researchgate.net/publication/335212330_Theoretical_and_Experimental_Analysis_for_an_Air-Breathing_Pulsed_Plasma_Thruster, Conference: AIAA Propulsion and Energy 2019 Forum