National Aeronautics and Space Administration

Mechanical and Fluid Systems

Periodic Wave Disc Brake Rotor

Lightweight brake rotor design with high heat dissipation using novel surface cooling technology

Developed by innovators at the NASA Marshall Space Flight Center, the Periodic Wave Disc Brake Rotor offers improved performance for potential applications in racings cars, motorcycles, and in particular for electric vehicles (EVs) equipped with regenerative braking systems. NASA's periodic wave rotor technology is a suite of rotor designs that provides dramatic weight reduction along with high heat dissipation, two of the primary challenges associated with high performance braking systems. Increasing any vehicle's racing performance involves decreasing the rotational moment of inertia and brake-system weight, which allow the vehicle to accelerate faster, change direction better, and require less energy when doing all of the above. For racing cars, reducing braking system weight is all about achieving better lap times. For any popular EVs, however, decreased electrical energy expenditure provides increased travel range. NASA's Periodic Wave Disc Brake Rotor can be easily implemented into any existing vehicles with either hub-mounted or wheel rim-mounted brake systems.

BENEFITS

- *Lightweight and low-profile:* The Periodic Wave Disc Brake Rotor is ~3x lighter and ~2-3x thinner than traditional rotors
- *High-performance, efficient design:* NASA's new rotor offers performance comparable to high-end carbon rotors with costs similar to steel rotors currently on the market by cutting mass and reducing the potential for damage from stress and distortion when the rotor is under high thermal load
- *Adaptable design:* Design elements can be adapted for a variety of applications, including front and rear rotors for a variety of motor vehicles

technology solution

THE TECHNOLOGY

The NASA Periodic Wave Disc Brake Rotor is novel yet elegantly simple and cost-effective design to maximize weight reduction and heat dissipations. This is accomplished through NASA's proprietary concept of combining the forced convection, radiation, and conduction of air flow over the brake rotor's surface. Depending upon the application, a dramatic reduction of the rotor material itself can be selected from either steel, oxygen-diffused titanium, or an aluminum forging alloy.

A two-piece floating rotor assembly is designed to further reduce the weight of the rotor's mounting hub and its rotational moment of inertia, while simultaneously minimizing the rotor's thermal expansion, stress, warping, or distortion experience during extreme frictional heating generated from repeated hard braking actions under high speed racing conditions.

APPLICATIONS

The technology has several potential applications:

- *Automotive:* high-efficiency, lightweight brake rotors for motor vehicles including cars, motorcycles, off-road vehicles, and trucks
- *Electric vehicles:* lightweight brake rotors for regenerative braking systems
- *Auto racing:* high-performance brakes for racing cars or motorcycles

PUBLICATIONS

Patent Pending

More Information

National Aeronautics and Space Administration

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MFS-33878-1
MFS-TOPS-106