Supercritical CO2 propulsion concept as a revolutionary replacement for traditional jet engines

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Infinity Turbine's new supercritical CO2 propulsion concept as a revolutionary replacement for traditional jet engines. It highlights the benefits of the system, such as higher efficiency, environmental friendliness, and potential for a wide range of applications in the future of aviation, from eVTOL air taxis to long-range drones and regional airliners.

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CMPG Supercritical CO2 Aviation Power and Propulsion Applications

The Cluster Mesh Power Generation concept can be utilized innovatively for propulsion in the new line of electric vertical takeoff and landing (eVTOL) aircraft or drones, offering advantages in terms of energy efficiency, range, and power management. Here’s how this concept can be adapted for such applications:

1. Efficient Onboard Power Generation
The Cluster Mesh Power Generation system, which utilizes multiple turbines to convert waste heat into energy, could be implemented in electric aircraft or drones to enhance their onboard power supply. Here's how:

• Waste Heat Recovery from Battery and Motor Systems: Electric aircraft and drones generate waste heat from battery packs, electric motors, and power electronics. This heat can be captured and fed into a cluster of small turbines to generate additional power, effectively increasing the available energy for propulsion. This extends flight duration and improves overall efficiency.

• Supplementary Power for Boost Mode: During takeoff, climb, or other high-power demands, the additional power generated by the cluster turbines could be used to supplement the primary electric propulsion, providing an efficient boost mode that reduces the drain on the batteries and helps to manage thermal stress.

2. Hybrid Thermal-Electric Propulsion System
A hybrid propulsion approach could be used where the Cluster Mesh Power Generation system complements the electric powertrain:

• Internal Heat Sources: In addition to battery systems, an auxiliary onboard heat source could be utilized. This source (such as a compact gas turbine or fuel cell) would generate heat, which is then fed into the cluster mesh turbines for additional power generation. This setup would create a hybrid thermal-electric propulsion system that offers increased range compared to purely battery-powered aircraft.

• Reduced Weight and Extended Range: Utilizing waste heat for power generation reduces the dependency on oversized battery packs, allowing for reduced weight and improved energy density. This enables the design of lighter aircraft or drones with extended range capabilities, which is crucial for both urban air mobility and long-range applications.

3. Enhanced Cooling System for Propulsion Components
Electric propulsion systems require effective cooling, especially in demanding aerial applications where power density is high. The Cluster Mesh Power Generation concept can significantly enhance the cooling of propulsion components:

• Heat Pump Cooling for Motors and Electronics: The system could use waste heat to drive a heat pump cycle that provides efficient cooling for motors, power electronics, and battery packs. By maintaining optimal temperatures, the system not only increases the efficiency of the propulsion system but also extends the lifespan of critical components.

• Cooling Duct Integration: The turbines could be integrated with cooling ducts in the aircraft or drone structure, enhancing air circulation for thermal management without adding extra weight. This improved thermal management allows for higher continuous power output from motors, especially beneficial for vertical takeoff and landing phases.

4. Distributed Propulsion Design
The Cluster Mesh Power Generation concept aligns well with distributed propulsion systems, which are becoming popular in eVTOL and drone design:

• Multiple Turbines for Thrust Generation: The mesh of turbines can be used to directly contribute to propulsion by powering distributed ducted fans or propellers. By strategically placing small turbines across the aircraft’s frame, thrust can be distributed evenly, improving maneuverability and redundancy.

• Variable Thrust Control: Each turbine in the cluster mesh can be independently controlled, enabling precise control over the thrust produced at different points of the aircraft. This can help in

CO2 Propulsion

The concept of using a supercritical CO2 (sCO2) turbine with a common shaft-mounted compressor in a closed-loop CO2 Brayton cycle to replace a traditional jet turbine system is an intriguing one, especially given the unique thermodynamic properties of supercritical CO2. This system could potentially provide a more efficient and environmentally friendly alternative to conventional jet engines while retaining the high power density needed for aviation propulsion. Here is an assessment of how this concept could be implemented, the challenges involved, and the potential benefits:

1. Overview of the Supercritical CO2 Brayton Cycle for Propulsion
The proposed concept involves replacing a conventional jet engine with a closed-loop supercritical CO2 Brayton cycle to drive a ducted fan, propeller, or fan jet for propulsion. In a closed-loop sCO2 Brayton cycle, the working fluid (CO2) remains within the system, circulating through the turbine, compressor, and heat exchanger. The cycle includes the following key components:

• sCO2 Turbine: Converts thermal energy from a heat source into mechanical work, which is used to drive a fan or propeller.
• Compressor: Mounted on a common shaft with the turbine, compresses the CO2 before it enters the heat exchanger.
• Heat Exchanger: Recovers waste heat from other onboard systems or an external heat source to heat the CO2, increasing its pressure and temperature for expansion through the turbine.
• Ducted Fan or Propeller: The turbine provides mechanical power to the ducted fan or propeller, which produces thrust.

2. Advantages of Using a Supercritical CO2 Brayton Cycle for Propulsion
• High Efficiency: Supercritical CO2 cycles are known for their high thermal efficiency, especially in moderate-temperature ranges, due to the favorable properties of CO2 in the supercritical state. This makes it a highly efficient system for converting thermal energy into mechanical work, which could lead to reduced fuel consumption compared to traditional jet engines.

• Compact and High Power Density: sCO2 cycles operate at high pressures, allowing for smaller and more compact turbomachinery compared to conventional steam or gas turbines. This high power density is advantageous in aviation, where weight and space are critical constraints.

• Closed-Loop Design: The closed-loop nature of the sCO2 cycle ensures minimal environmental impact, as the CO2 remains contained within the system. This also avoids emissions typically associated with jet engines, making it a cleaner alternative.

• Versatile Heat Sources: The heat required for the cycle could be sourced from various fuels or even hybrid systems. For instance, a combustor could burn a fuel like hydrogen, or heat could be provided from a nuclear source or a waste heat recovery system, providing flexibility in the choice of fuel.

• Reduced NOx Emissions: Traditional jet engines produce nitrogen oxides (NOx) due to the high-temperature combustion of air and fuel. The closed-loop sCO2 cycle could operate with external heat sources, reducing the generation of NOx emissions.

3. Key Components and Their Roles
• Turbine-Compressor Assembly: The common shaft design between the turbine and the compressor helps in

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3. Key Components and Their Roles
• Turbine-Compressor Assembly: The common shaft design between the turbine and the compressor helps in maintaining efficiency across the system. As the turbine expands the hot CO2, it provides enough energy to drive both the compressor and the propeller or fan. The integrated assembly allows better control over the thermodynamic cycle, ensuring optimal operation and efficient energy transfer.

• Ducted Fan or Propeller: The mechanical power generated by the turbine is used to drive a ducted fan or propeller, similar to how turbofans work in modern jet engines. The fan creates thrust by accelerating the airflow, providing propulsion for the aircraft.

4. Potential Challenges
• Thermal Management: One major challenge in implementing a supercritical CO2 Brayton cycle for propulsion is managing the heat rejection and recuperation. In a traditional jet engine, ambient air provides cooling; however, with a closed-loop sCO2 cycle, a dedicated heat exchanger is required to reject excess heat from the CO2 before it is recompressed. Efficient heat exchangers with high

Revolutionizing Aviation Propulsion: How Supercritical CO2 Turbines Could Replace Jet Engines for Efficient, Sustainable Flight

The aviation industry is constantly in search of new technologies to improve efficiency, reduce emissions, and meet the growing demand for sustainable travel. One promising approach involves replacing conventional jet engines with a supercritical CO_2 (sCO_2) turbine in a closed-loop Brayton cycle to power the propulsion of aircraft and drones. This innovative concept holds the potential to transform the way we think about aviation propulsion by offering a cleaner, more efficient, and quieter alternative. Let's explore how this system works, the potential benefits, and its applications in aviation.

The Concept: A New Take on Jet Propulsion

The proposed system replaces the traditional jet turbine with an sCO_2 turbine, driven by a closed-loop Brayton cycle. Unlike a traditional jet engine, which uses atmospheric air for combustion and propulsion, this system uses supercritical CO_2 as the working fluid within a sealed loop, converting thermal energy into mechanical power. This power is then used to drive a ducted fan, propeller, or fan jet, providing thrust for aircraft.

The key components of this system include:

• sCO_2 Turbine: Converts thermal energy into mechanical power.
• Compressor: Mounted on a common shaft with the turbine, compresses the CO_2 to maintain the thermodynamic cycle.
• Heat Exchanger: Uses an external heat source to heat the CO_2 before expansion through the turbine, ensuring efficient energy transfer.
• Ducted Fan or Propeller: Driven by the turbine to produce the necessary thrust for aircraft propulsion.

How the Supercritical CO2 Brayton Cycle Works for Propulsion

In this system, supercritical CO_2 is used as the working fluid, operating at high pressures and temperatures, which makes it highly efficient for energy conversion. The closed-loop nature means that the CO_2 remains within the system, circulating through the compressor, heat exchanger, and turbine without being released into the atmosphere. Here's how the process works:

1. Compression: CO_2 is compressed by a compressor, increasing its pressure before entering the heat exchanger.
2. Heat Addition: An external heat source is used to heat the CO_2 in the heat exchanger, raising its temperature to a supercritical state.
3. Expansion: The hot, high-pressure CO_2 expands through the turbine, producing mechanical power. This power is used to drive a propeller, ducted fan, or jet fan, generating thrust for the aircraft.
4. Cooling and Recirculation: The expanded CO_2 is cooled in a heat exchanger and then recirculated back to the compressor, continuing the cycle.

This system can use various heat sources, including combustion of cleaner fuels like hydrogen, waste heat recovery from onboard systems, or even a compact nuclear source, offering flexibility in fuel choices and operating environments.

Advantages of Using Supercritical CO2 for Aircraft Propulsion

1. High Efficiency and Fuel Savings
Supercritical CO_2 cycles are known for their high thermal efficiency, particularly at moderate temperatures. This efficiency could translate to reduced fuel consumption compared to traditional jet engines. With the ability to recover and reuse waste heat, the system effectively maximizes energy use, leading to substantial fuel savings.

2. Compact and High Power Density
The sCO_2 cycle operates at high pressures, which allows for smaller and more compact turbine components compared to traditional jet engines. This high power density is ideal for aviation, where

Aircraft Propulsion Alternative to Common Shaft Drive

Innovative approach to aircraft propulsion which utilizes multiple supercritical CO2 (sCO2) turbines arranged in a circle, paired with a magnetic gear reduction system to drive a propulsor fan or propeller. The use of magnetic coupling to transfer power without physical contact is particularly intriguing and has potential advantages in terms of efficiency, reduced wear and tear, and operational flexibility. Below, I will assess this concept compared to conventional jet turbine or engine-driven propulsion systems in terms of efficiency, complexity, weight, and feasibility.

1. Overview of the Concept
In this concept, multiple sCO2 turbines are arranged in a circular configuration around a propulsor fan or propeller. The power generated by these turbines is transmitted to the fan using magnetic gear reduction, which means there is no physical connection between the turbines and the propeller. Instead, magnets are used to couple the rotational energy of the turbines to the propeller, converting this magnetic interaction into mechanical power and thereby producing thrust.

Key components include:
• Multiple sCO2 Turbines: Each turbine is powered by a supercritical CO2 Brayton cycle, operating in a closed loop.
• Magnetic Gear Reduction System: The sCO2 turbines have magnets that interact with corresponding magnets on the propulsor, allowing for non-contact power transfer.
• Circular Arrangement: The turbines are positioned in a circular configuration to evenly distribute power to the propulsor.

2. Comparison to Conventional Jet Turbine or Engine-Driven Propulsion

Efficiency and Power Transfer

Reimagining Aircraft Propulsion: How Supercritical CO2 Turbines and Magnetic Coupling Could Transform Aviation

The aviation industry is in the midst of a transformative shift, seeking innovative solutions that improve efficiency, reduce environmental impact, and enable quieter, more flexible flight. One such futuristic concept involves replacing the traditional shaft-driven jet engine with multiple supercritical CO_2 (sCO_2) turbines and a magnetic gear reduction system for powering a propulsor fan or propeller. By leveraging the unique properties of sCO_2, combined with magnetic coupling, this propulsion system aims to revolutionize aircraft technology, offering a cleaner and more efficient alternative to conventional engines. Let's explore how this concept works, its potential advantages, and the challenges it faces compared to traditional jet propulsion.

The Concept: Supercritical CO2 Turbines with Magnetic Gear Reduction

The proposed propulsion system utilizes multiple supercritical CO2 turbines, arranged in a circular configuration, to drive a ducted fan or propeller. Rather than relying on a traditional mechanical shaft, the power generated by the turbines is transmitted through magnetic gear reduction. Magnets on the turbines and the propulsor couple the rotational energy without any direct physical contact, transforming the magnetic interaction into mechanical power that generates thrust.

Key Components Include:
• Supercritical CO2 Turbines: Multiple turbines, each operating using a supercritical CO2 Brayton cycle, convert thermal energy into mechanical work.
• Magnetic Gear Reduction System: Magnets on the turbines and the fan create a coupling system that transfers rotational energy without physical contact, reducing mechanical losses.
• Circular Turbine Arrangement: The turbines are positioned in a circle around the propulsor, ensuring even power distribution and creating a distributed propulsion system.