Auxetic Diameter Regulator

Reference No: Y21003

CHALLENGE

Gas turbines are high-precision machines and first choice for aircraft engines or electrical power generators. To ensure their safe and efficient operation, the gap between the casing and the rotor blades is highly critical. This gap needs to be as small as possible, to reduce losses by the leakage flow through the tip clearance (efficiency), but big enough to ensure contactless sealing and allow for manufacturing and/or assembly tolerances and thermal expansion of the different components (safety).

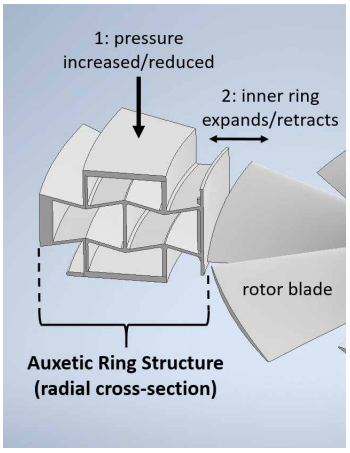
Typical solutions involve labyrinth seals, abradable seals or brush seals. However, these seals cannot actively adapt. Active clearance control systems have also been developed, based on the thermal expansion of a sealing ring. Such systems are rather slow though, improving the gap control, but not optimizing it.

INNOVATION

Scientists from the Universität der Bundeswehr München have developed a novel mechanical structure to actively or passively adjust the clearance of a rotationally symmetric gap. In its simplest form, the structure consists of a rigid outer ring and a deformable inner ring with an auxetic structure in between. (An object is auxetic if when compressed, it contracts perpendicularly to the applied force.) Here, when a force is applied on the auxetic structure along the axis of rotation of the rotor, the diameter of the inner ring is increased. This helps to correct gap deviations from manufacturing and assembly tolerances as well as compensate material degradation from wear. The simple axial force application constitutes a significant advantage over existing more complicated active clearance control systems.

Due to its compact design, the invention is particularly well applied in jet engines, where space and weight restrictions are key. It can also be applied in the upcoming field of electric aircraft engines, e.g. to reduce the gap between the fan and the housing to increase the pressure ratio.

Another use case of the present invention is in the field of traditional mechanical engineering, e.g. new assembly methods for frictionally engaged shaft-hub connections with undercuts.



COMMERCIAL OPPORTUNITIES

- active gap-control mechanism with a simple and space-saving design.
- increased gas-turbine efficiency due to reduced secondary air flow.

DEVELOPMENT STATUS

Prototype structures available.

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Universität der Bundeswehr München

Technology from UNIVERSITÄT DER BUNDESWEHR MÜNCHEN

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