Designing and Testing a Novel 25% Degree of Reaction Steam Turbine

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There are two types of steam turbines - impulse (with 0% degree of reaction, which means the pressure drop entirely takes place in the stationary blades) and reaction (with 50% degree of reaction, which means the stationary and rotating blades equally expand the steam). Reaction turbines are the most efficient type of turbine. However, because steam expands the most in reaction turbines, they are large and expensive. A full reaction turbine would be inconceivably large. Since the whole steam turbine cannot be reaction, impulse turbines are used in the earlier stages. Impulse turbines are smaller and compact; however, they are much less efficient than reaction. A steam turbine can never be optimized for both efficiency and size/cost. Or can it? In this project, a novel 25% degree of reaction turbine (the novel turbine), which is a hybrid of impulse and reaction, was designed. The novel turbine was tested against the turbine that it can replace- the impulse turbine. Both turbines were 3D modeled and printed. The novel turbine produced a mean of 0.1003 watts, which is more than 5 times as much power as the impulse turbines' output of 0.0187 watts. This, coupled with being much more compact than the reaction turbine, proves the novel turbine's effectiveness. The novel turbine can not only be used in the intermediate pressure section of steam turbines, but it also has vast applications outside of steam turbines, such as in jet engines, where size and weight are important considerations, and in gas turbines.

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