
Different Methods of Gas Turbine Engine Efficiency

Samir Osman

Aerospace institute, National Aviation University, Kyiv, Ukraine

Abstract

In this research, we arise the various methods along with a new concept in order to enhance convention turbofan engine efficiency therefore less fuel consumption, less engine exhausts moreover low operating noise level.

Keywords: turbofan, twin fan, engine, gas, turbine, efficiency, fuel, consumption

Introduction

Initially gas turbine engines have been improved by their manufacturers for decades, some due to the inflation of crude oil prices¹ and oil crisis which took place last century², for saving fuel from economic perspective or for a way to improve the way people fly, we briefly arise a specific type of gas turbine engine, it is turbofan engine which is widely used for economical airlines here are some various methods consequently lead towards less fuel consumption therefore greater engine efficiency.

Proposals for gas turbine engine development

Bypass ratio(β): The ratio between the mass flow rate of the bypass stream to the mass flow rate in engine entering the core³, technically increasing engine axial bypass flow in a duct around the engine core leads to less thrust-specific fuel consumption, the wider inlet fan diameter, the less exhaust and operating noise obtained, the great role bypassed air plays to cool engine combustion chamber where gas temperature reaches gradually up to 2500° then mixture of cold air flow and hot gas flow dropped to 900°⁴ due to some thermal energy transferred into kinematic energy to push low pressure turbine “two shafts engine” to maintain spinning which is associated with the same shaft of fan and booster.

Accessory gearbox: In a geared turbofan engine, a planetary reduction gearbox between the fan and the LP shaft allows the latter to run at a higher rotational speed thus enabling fewer stages to be used in both the LP turbine and the LP compressor, increasing efficiency and reducing weight⁵, reduction gearbox can maintain, decrease or even speed up spinning of engine shafts according to complex gears mechanism, utilizing accessory gearbox as a reduction factor to lessen fan revolutions, less revolutions per minute, more air mass flow rate, avoid shock waves thanks to fan high speed tips which in turn generates enormous drag⁶, eventually

leads to high bypass ratio, less exhausts and low noise level, based on this concept hence came out the expression of geared turbofan engine, for instance PW1000G “7”

Composite substances: Essentially engine weight and power can assign cruising altitude and speed, engine materials characteristics in charge of reducing engine overall weight by hybrid composite substances combine between durability and light weight, these substances of combustion chamber directly affect the weight of gas turbine engine, the case is the outer shell of the combustor, and is a fairly simple structure, the casing generally requires little maintenance“8”, the chamber is made from titanium which is heavy material, and good corrosion resistance, high strength, stiffness and toughness to endure gas high temperature during combustion process“9”, in order to decrease engine’s weight there are various composite substances which may include titanium, aluminum alloy and ceramic matrix composite“10”.

“Twinfan turbofan engine”: from the above, new concept based on our perspective of compressor functionality, increasing air inlet stages from a single fan stage in convention gas turbine engine to next level which is twin fan stage; front fan and rear fan which in turn increasing air flow once there is a reduction gearbox controlling over rear fan rotation speed, it can even play multiple roles which tend to be compressor rotors and stators to compress air leads dramatically to high pressure ratio.

Conclusion

By all counts, we have proposed some ideas and brought a new concept of twinfan turbofan engine and flexible rear fan based on our perspective of modifying gas turbine engine’s components.

References

- [1] <https://www.macrotrends.net/1369/crude-oil-price-history-chart>
- [2] *“International Crude Oil Market Handbook”, Energy Intelligence Group, 2011*
- [3] <https://www.britannica.com/technology/bypass-ratio>
- [4] <https://aviation.stackexchange.com/questions/29279/what-is-the-absolute-velocity-change-through-compressorburner>
- [5] https://en.wikipedia.org/wiki/Geared_turbofan
- [6] <https://www.grc.nasa.gov/www/k-12/airplane/inlet.html>
- [7] *Connors, Jack (2010). The Engines of Pratt & Whitney: A Technical History. Reston. Virginia: American Institute of Aeronautics and Astronautics. ISBN 978-1-60086-711-8.*
- [8] Henderson and Blazowski, pp. 119–20.

- [9] <https://www.totalmateria.com/page.aspx?ID=titaniumproperties&LN=EN>
- [10] <https://www.ge.com/reports/post/112705004705/ge-develops-jet-engines-made-from-ceramic-matrix/>