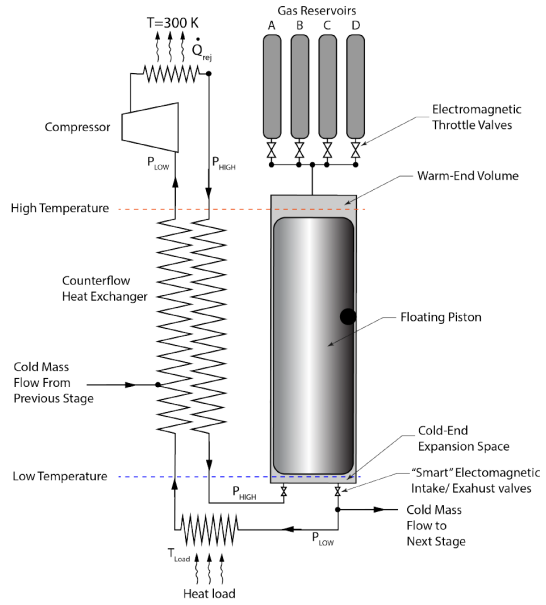
Development of Technologies for the Modified Collins Cryocooler

PI: JG Brisson, MIT

Co-I: Charles Hannon, Triton Systems Corporation

Research Objectives

- Development of light pistons that remain dimensionally stable in a varying-temperature, oscillating pressure environment
  - -TRL 2 (concept) to TRL 3 (tested apparatus)
  - -Innovation: the use of additive manufacturing technologies
- Development and demonstration of a control system appropriate to a Collins machine that will eliminate deliterious secondary flows in that cooler.
  - -preliminary calculations suggest feasability (TRL 2)
  - -experimental demonstration of the system with performance measurements (TRL 3)
  - -Innovation: a sealed, efficient all fluidic expander



Modified Collins Cryocooler Stage

Approach

Pistons

Using 3D printing, piston will be manufactured and tested. Internal structures will support the piston wall.

All-metal and hybrid structures will be investigated.

Hybrid manufacturing techniques (additive and subtractive) will be investigated.

Control System

Fluid and thermal models of the expansion process will be developed.

An algorithm will be developed and implemented on an instumented apparatus.

A full model based on the measurements taken on the system will be implemented.

Potential Impact

If the technology is adopted into the current modified Collins Cryocooler design,

More Efficient and lighter coolers capable of cooling to temperature from 4 K to 90+ K

More stable operation of the Collins Stage

A new generation of cryocoolers capable of delivering cooling from the small to the medium-large scale

The impact for NASA would primarily be a system that can efficiently provide cooling at 4 K (detector technology) or large scale cooling (for cooling fuels or oxidants.)

A side benefit is with the reliability of the control system fully established, commercial systems are likely to be attractive.