

Frequency dependent operating mode of a coaxial thermoacoustic Stirling heater/cooler

We have constructed a travelling wave thermoacoustic refrigerator using a coaxial configuration with the regenerator positioned in the annulus. Tests were conducted using frequencies ranging from 100 Hz to 400 Hz. Within this range, a frequency dependent positional reversal of the cold section and hot section of the regenerator within the test range was discovered. Using an input electric power of 38 W, the largest temperature differences obtained were 39.0 C and -21.3 C, at frequencies 120 Hz and 380 Hz respectively, with the change in sign indicating a change in regenerator temperature gradient. Decomposition of the pressure wave within the annulus, obtained the positive (w_+) and negative (w_-) propagating travelling waves and SWR. A different sign of SWR and change of dominant travelling wave direction was observed between the operating frequencies of 120 Hz and 380 Hz indicating a correlation between the dominant travelling wave direction and the regenerator temperature gradient. As the temperature gradient reversal does not require moving parts, only a change in frequency, this feature in coaxial traveling wave devices has tremendous potential for applications which require both heating and cooling operation.