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An inter-phasing Stirling pulse tube cryocooler without reservoirs

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A substantial fraction of the volume of a traditional pulse tube cryocooler is occupied by a reservoir, which greatly reduces the specific power of the cryocooler. This is undesirable for applications that require a small size and weight. This paper presents an inter-phasing pulse tube cryocooler conjoining two or more cold fingers via their inertance tubes. Because the volume flow in the cold fingers are elaborately adjusted to make the total volume flow into the junction of the inertance tubes zero, the reservoirs are allowed to be removed. Experiments demonstrated that, with a 1 kW electric power input, the cooling power at 77 K reached 59.8 W, corresponding to a relative Carnot efficiency of 16.8%. Compared with a traditional pulse tube cryocooler, this cryocooler can achieve the same cooling performance.

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