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Design and Testing of a Travelling-wave Looped-tube Engine for low-cost electricity generators in remote and rural areas

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This paper describes the construction and preliminary testing of a low-cost thermoacoustic electricity generator. A travelling-wave thermoacoustic engine with a configuration of a looped-tube resonator is designed and constructed to convert heat to acoustic power. A commercially available, low-cost loudspeaker is adopted to convert the engine's acoustic power to electricity. Preliminary experimental results are presented and discussed in detail. The results show that it is feasible to use commercially available, low-cost loudspeakers as alternators to develop low-cost thermoacoustic generators.

Nomenclature

Bl	=	force factor of the alternator
F	=	force
F_s	=	resonance frequency
I_1	=	current
K_m	=	mechanical stiffness
L_e	=	inductance of coil
M_m	=	total mass of the diaphragm and the coil
p	=	pressure oscillation
P_a	=	acoustic power
P_e	=	electrical power
Δp	=	pressure drop through the diaphragm of the alternator
Q_{es}	=	electrical quality factor
Q_{ms}	=	mechanical quality factor
R_e	=	resistance of coil
R_L	=	load resistor
R_m	=	mechanical resistance
S	=	effective area of the alternator
U_1	=	volumetric velocity
u_1	=	velocity of the diaphragm
V_L	=	voltage on the resistor

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