LOAD TEST ON STIRLING ENGINE AND OPTIMIZATION OF IT'S PARAMETERS

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Abstract *Stirling engine is an external combustion engine which lost out in the race for supremacy to Internal Combustion engines. Invented before steam engine and IC Engines in 1816, lack of manufacturing accuracy of those times led to its being superseded by other prime movers. Today it is coming back as an attractive option since it can burn any fuel and work on any source of heat thereby being environmental friendly. The four processes taking place in Stirling engine are Isothermal heat rejection and Compression, Isochoric heat addition, Isothermal heat addition and expansion, Isochoric heat rejection. The main parts of Stirling engine are Power piston, Displacer, and Regenerator.*

In a Stirling, connecting pipes, and volumes of compression and displacer cylinders unwept engine, the dead volume is the volume of regenerator by pistons. We propose to experimentally change this volume by combinations of different power and displacer cylinders to find the optimum using software which calculates the power output given the dead volume ratio and temperature ratios

1. INTRODUCTION

A. stirling engines are interesting and often misunderstood devices. These engines provide a renewable and clean source of power that no other engine can match this is due to the fact that working gas is a closed system with no exhaust. all that is required for these engines to run is an initial starting force and a temperature differential. The ideal stifling working cycle has the maximum obtainable efficiency defined passes by carnot efficiency and highly efficient stirling engines can therefore be built, if designed properly.

B. in order to find optimum values of design variables, numerical optimisation techniques can be used to describe the engine realistically, it is necessary *to* consider several tens of design variables this project intends to optimise the stirling engine with help of a working prototype of a stirling engine that will operate indefinitely with a small temperature difference as possible

1.1 WORKING PRINCIPLE

A stirling engine is a heat engine that operates by cycle compression and expansion of air and other gas at deferent temperatures, such that there is a net conversion of heat to mechanical work. It involves for mainly for thermodynamic cycle process.

A. Isothermal expansion: the expansion space and associated heat exchanger are maintained at a constant high temperature and the gas undergoes isothermal expansion absorbing heat from hot source

B. Isochoric process(heat addition):the gas back through the regenerator where it recovers much of the heat transferred in process 2, heating up on its way to the expansion space

C. Isothermal compression: it is maintained at low temperature so the gas undergoes isothermal compression rejecting heat to cold sink.

D. Isochoric process(Heat removal): the gas is passed through the regenerator where cools, transferring heat to the expansion space

fig.1: customized stirling engine

1.2 OPERATION (EXPERIMENTAL SETUP)

A. Purchase a gamma Stirling engine of 20×15×15 cm size.

B. Take out the LED bulb connected to the generator by default.

C. Connect a multi meter at the end of the generator.

D. Keeping all other parameters constant, change dead space volume from a lower value to higher value in order to get 4 readings

E. Note the reading which gave maximum power output.

F. Keep the first parameter (ie. dead space volume) in the above noted value and run the engine.

G. Continue this procedure for all the parameters except REGENERATOR MATERIAL.

H. Run the engine at above noted values for the 4 parameters which gave maximum power output.

I. Use Air, copper shavings, steel shavings as regenerator materials and note the material which gave maximum output.

2. KEY PARTS OF THE PROJECT

A. Assume half of the input heat is dissipate into atmosphere

B. And also heat flow through convection, radiation is neglected

C. So we consider only conduction

D. Input power= v *i*.5

E. Output power =v*I

F. Efficiency= output power/input power

Observation Table

Volume, V=25cc Length =72mm							
I/P	Inlet Temp	Outlet Temp	I/P with 59% loss	V	I	O/P	eff
219	308	32	89.79	2.32	0	0	0
219	309	32	89.79	1.98	0.212	0.42	0.004678
219	309	32	89.79	1.75	0.371	0.65	0.007239
219	311	32	89.79	1.29	0.624	0.805	0.008965
219	311	32	89.79	0.97	1.41	1.376	0.015325
219	311	32	89.79	0.59	3.31	1.956	0.021784

Volume, V=25cc Length =72mm							
I/P	Inlet Temp	Outlet Temp	I/P with 59% loss	V	I	O/P	eff
263	387	32	107.83	2.71	0	0	0
263	387	32	107.83	2.33	0.283	0.66	0.00251
263	387	32	107.83	2.04	1.063	2.17	0.008251
263	389	32	107.83	1.82	1.72	3.14	0.011939
263	389	32	107.83	1.61	2.1	3.39	0.01289
263	390	32	107.83	0.96	4.81	4.69	0.017833

Volume, V=25cc Length =72mm							
I/P	Inlet Temp	Outlet Temp	I/P with 59% loss	V	I	O/P	eff
310.5	571	32	127.31	2.8	0	0	0
310.5	571	32	127.305	2.37	0.286	0.68	0.005342
310.5	574	32	127.305	2.13	0.633	1.35	0.010604
310.5	575	32	127.305	1.86	0.854	1.59	0.01249
310.5	575	32	127.305	1.39	2.07	2.89	0.022701
310.5	575	32	127.305	0.99	3.414	3.68	0.028907

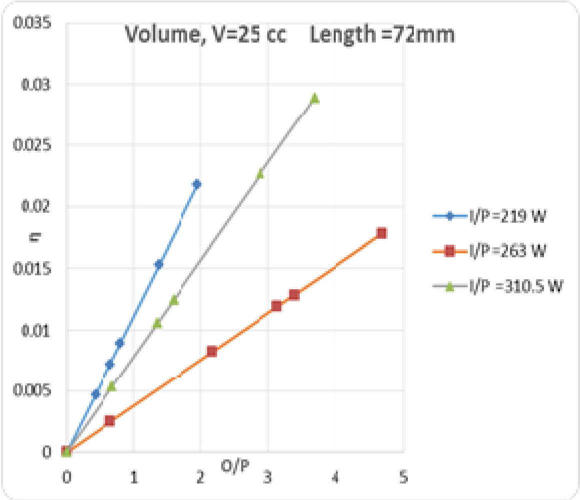

Fig.3;output VS efficiency

3 CONCLUSION

Stirling engines have a higher efficiency compared to internal combustion engines, being able to reach 50% efficiency. They are also capable of quiet operation and can use almost any heat source. The heat energy source is generated external to the Stirling engine rather than by internal combustion as with the Otto cycle or diesel cycle engine. Because the Stirling engine is compatible with alternative and renewable energy sources it could become increasingly significant as the price of conventional fuels rises and also in light of concerns such as depletion of oil supplies and climate change. This type of engine is currently generating interest as the core component of micro combined heat and power units in which it is more efficient and safer than a comparable steam engine.

ACKNOWLEDGEMENT

We thank our Assistant professor Abdul Azeez P.A, IES College of Engineering for his valuable guidance and taking us on the right path throughout our project work.

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