International Journal on Recent and Innovation Trends in Computing and Communication
Volume: 4 Issue: 4
ISSN: 2321-8169
166 - 169

Mechanism of Stirling Engine

Ajay Utekar,Anirudha Shinde
Department of Mechanical Engineering,
University of Mumbai
Vishwatmak Om Gurudev College Of Engineering
Maharashtra State Highway 79, Mohili, Maharashtra 421601,
India
Ajaydhondiba37@gmail.com

Siddhesh Kstoori,Siddhesh Pawar
Department of Mechanical Engineering,
University of Mumbai
Vishwatmak Om Gurudev College Of Engineering
Maharashtra State Highway 79, Mohili, Maharashtra 421601,
India
Siddhesh.kastoori@gmail.com

Abstract— fuel energy is one of the more attractive renewable energy sources; the conversion of the latter per thermal way into electricity is a major energy stake. The current systems are primarily based on technology known as 'solar dish/Stirling', which uses Stirling engines placed at the focal plan of a parabolic concentrator. The Stirling engine presents an excellent theoretical output equivalent to the output of Carnot one. It is with external combustion, less pollutant, silencer and request little maintenance. Thanks to these advantages which the Stirling engine is very interesting to study. The dish Stirling system studies consist on three parts; the thermal modeling of Stirling engine, optical study of parabolic concentrator and finally the thermal study of the receiver. The present study is dedicated only to a thermal modeling of the Stirling engine based on the decoupled method. We evaluate, starting from an ideal adiabatic analysis, the thermal and mechanical powers exchanged, that we correct then by calculating the various losses within the machine. This model led to the writing of important set of equations algebra - differentials. The calculation program worked out under Fortran to solve this system, makes allow to calculate the performances of any types of the Stirling engines, according to the kinematics used, the types of regenerators, the exchangers, as well as the various working liquids used.

Keywords—Heat Engine,Solar Engine

*****

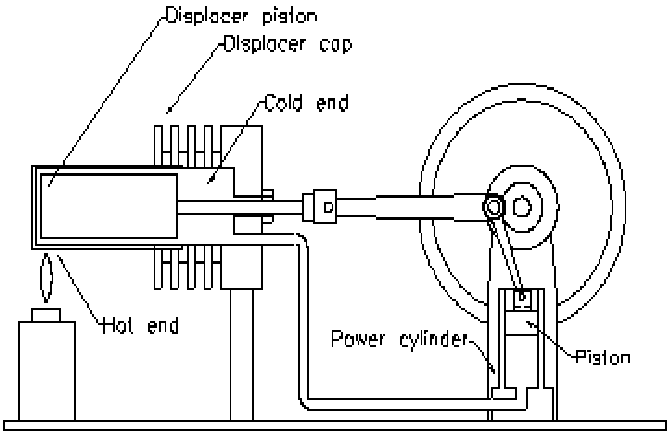
I. INTRODUCTION

- The Stirling Motor Is A Warmth Motor Of The Outer Burning Cylinder Motor Sort. It Was Designed And Created By Reverend Dr Robert Stirling In 1816.

- A very much composed Stirling motor can accomplish half to 80% of the perfect proficiency in the transformation of warmth into mechanical work, restricted just by grating and material properties. The motors can hypothetically keep running on any warmth wellspring of adequate temperature, including sun powered vitality, compound and atomic fills.

- While the Stirling motor is more costly than an inner ignition motor of the same force rating, its numerous novel favorable circumstances make it favored for an assortment of corner applications. Contrasted with inward burning motors, Stirling motors can be made exceptionally vitality productive, calm, solid, durable and low-upkeep.

- In late years, these favorable circumstances have turned out to be progressively huge given the general ascent in vitality costs and the natural worries of environmental change. This developing enthusiasm for Stirling innovation has prompted the progressing advancement of Stirling gadgets for some applications, including renewable force era and Astronautics.



II. LITERATURE REVIEW

A. Stirling Engines Operate / Work :-

A fixed volume of air is heated. As it gets warmer, its pressure increases. By allowing the air to act on the underside of a piston, the engine can do work. Having pushed the piston to the top of its stroke, the air is then cooled, reducing its pressure and allowing atmospheric pressure to push the piston back down. Repeat rapidly and you have a hot air engine!

Turning the idea into reality has involved many engineers over a long period of time. The Frenchman Carnot proposed the first theoretical work, which was developed into a practical machine by the Englishman Thomas Mead and, in Scotland, Dr Robert Stirling. Such was Stirling's contribution that "hot air engine" and "Stirling cycle engine" now get used almost interchangeably. There are several design considerations.

Firstly, the air must be heated from an external source (yes - this is an external combustion engine!). Having heated the air, it must then be cooled effectively and some way found of preventing heat "leaking" from one end of the engine to the other. Finally, some mechanical means must be contrived to make the preceding things happen in an appropriate order. The engine starts with the displacer at the hot end of its cylinder - conversely, the air is displaced to the cold end. As the air cools, the pressure drops. This in turn acts on the piston. The piston descends, moving the displacer piston back along its cylinder.

B. PROBLEM STATEMENT :-

The greater part of the motors make utilization of ordinary powers that are expensive and in addition dirtying in nature, yet the stirling motor makes utilization of air as the working liquid which is spotless of any contaminating operators. Likewise, the Stirling motor is noted for its high productivity contrasted with steam motors, calm operation, and the straightforwardness with which it can utilize any warmth source. In actuality, stirling motors run utilizing an outer wellspring of warmth, for example, a burner or gas cutter, however for our task we are making utilization of a spotless, renewable and effectively accessible wellspring of vitality i.e. sun based vitality. When contrasted with burner or whatever other warmth source, sun based vitality is promptly accessible. Hence our point was to outline and manufacture a model of sun powered stirling motor.

C. PROPOSED SOLUTION :-

Normally when designing an engine we decide the power output that we need, and then proceed further. However we were unable to follow this procedure while designing our stirling engine model, because a 100 Watt model could have been of the size of about a small sized car. The reason for this is that stirling engines have very high volume to power ratio. Hence we began our design with dimensions assumed from previous studies on beta type stirling engine for a small mode The next step, was to select a suitable mechanism that would create a phase difference of 90° between the connecting rods of both power and displacer piston.

Then we went on to fabricate the different parts of the engine, according to its dimensions, and at last assembled it in the workshop.Now our next step was to provide an appropriate heat source to run the engine which was solar energy in our case. Thus, we now had to design the solar parabolic collector which would provide us the required heat.

III. WORKING PROCESS

Cylinder is mounted horizontally & machined with highly A honed bore in which a precision lapped piston works to & fro with a definite stroke travel the cylinder has fines. For effective release of heat to the atmosphere there by keeping its other end cool the cylinder is side faced which is lapped & polished for free leak proof slide of the valve. A pan for inlet of hot air is cut from the solar energy by reflector & exhaust of cool air is cut on the cross face on the lower dead center this side of the cylinder is plugged. The piston reciprocates in the cylinder from its upstroke to the down stroke. The piston rod engages in a crank pin, which is rigidly mounted on the crankshaft through a crank web. This reciprocating motion of the piston is converted into rotary motion of the crankshaft. The crankshaft is supported in journal bearing fitted. On the vertical support mount a flywheel is mounted at the output side of the crank shaft. The sharpical reflector is mounted on the fabricated foundation & the engine is so adjusted that the focal point of reflector is concentrated on the expansion cylinder & this focal is drop on the expansion cylinder & heat is generated by this heat the engine of operated. The engine is rigidly mounted on a fabricated foundation base the solar energy by the reflector provides the required heat to the cylinder. The speed of the engine is in the range of 350 to 400 rpm. This type of Sterling engine, known as the *beta configuration* features just one cylinder with a hot end and a cool end. The working gas is transferred from one end of the cylinder to the other by a device called a displacer (here illustrated in blue). The displacer resembles a large piston, except that it has a smaller diameter than the cylinder, thus its motion does not change the *volume* of gas in the cylinder - it merely *transfers* the gas around within the cylinder.

D. ENGINE CONFIGURATIONS

The Beta and Gamma type Stirling engines use a displacer piston to move the working gas back and forth between hot and cold heat exchangers. The alpha type engine relies on interconnecting the power pistons of multiple cylinders to move the working gas, with the cylinders held at different temperatures. The ideal Stirling engine cycle has the same theoretical efficiency as a Carnot heat engine (for the same input and output temperatures). The thermodynamic efficiency varies, but can be higher than steam engines and many modern internal combustion engines (Diesel or Gasoline).

E. ANALYSIS

DESIGN CONSIDERATION

To first order, two properties of a drive mechanism influence the performance of Stirling engines, the volume amplitude ratio and the phase lag between expansion and compression space. The volume amplitude ratio, VAR , is defined as the change of the volume of the compression space divided by the change in volume of the expansion space during a complete revolution. VAR = 1 is suggested by many researchers for this quantity.

The volumetric phase lag , VPL , refers to the angular offset between the volume of the compression space as function of crank angle and that of the expansion space. VPL = 90° is an often cited optimal value with the compression space lagging behind the expansions space. For strictly sinusoidal function this definition of phase lag is unique for others one might look at the phase lag of the maxima and the minima of compression and expansion space.

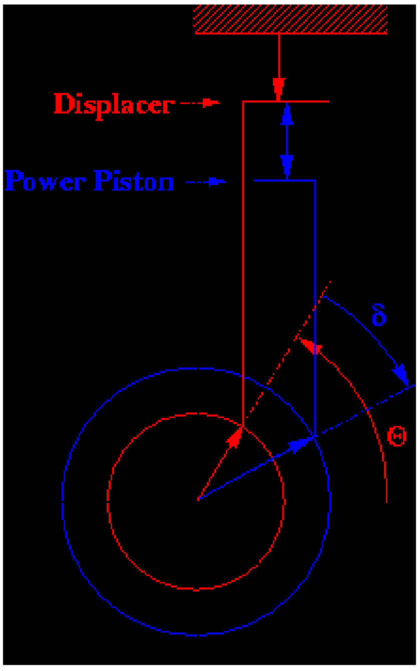


Fig 6. VAR & VPL

IV. THE STIRLING CYCLE

The ideal stirling cycle consists of four thermodynamic processes acting on the working fluid:

1. Isothermal Compression

2. Constant-Volume (or isometric) heat-addition

3. Isothermal Expansion

4. Constant-Volume (or isometric) heat-removal

This ideal stirling cycle is commonly known as a "squared-cycle", because the transitions between the processes are discontinuous; so when the cycle is graphed on a Pressure-Volume plot, the shape of the cycle contains corners. A real stirling cycle in a stirling engine, requires relatively smooth motion which is commonly sinusoidal or quasi-sinusoidal. In this case the shape of the PV-plot is elliptical. Also in a real engine cycle, the heat transfer performance of the heat exchangers ranges from 100% effectiveness in an isothermal process, to 0% effectiveness in an adiabatic process (no heat transfer). The compression and expansion processes can be modeled as a polytropic processes ,

$$PV^n = k$$

where **k** is constant, and **n** is bounded by:

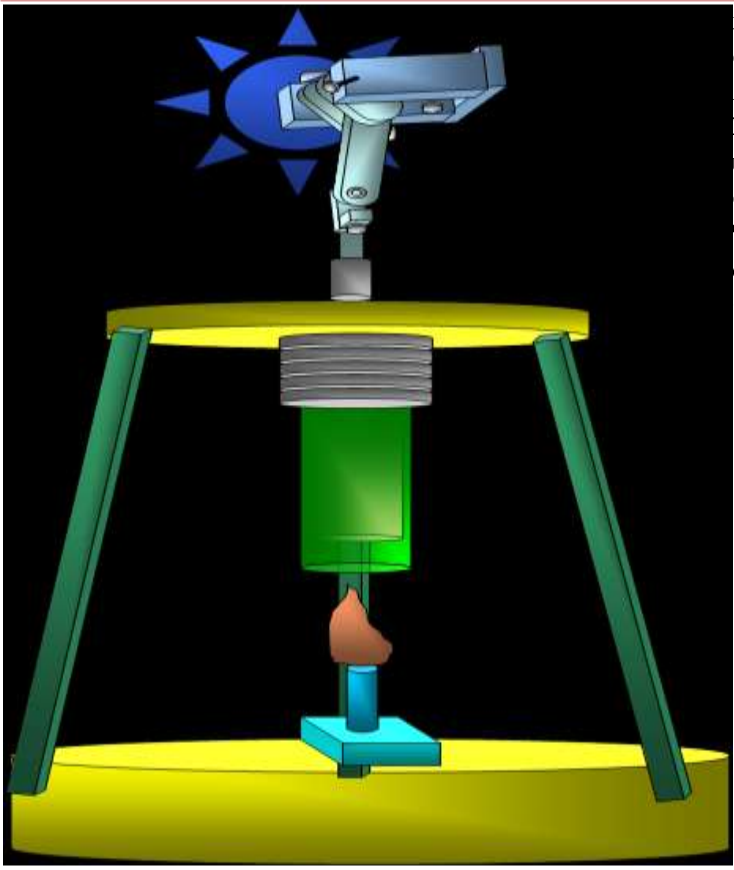
$$1 \leq n \leq \frac{c_p}{c_V} \leq 2$$

. where *cV* is the specific heat capacity at constant volume (J/kgK) and *cp* is the specific heat capacity at constant pressure (J/kgK) Compared to the ideal cycle, the efficiency of a real engine is reduced by irreversibilities, friction, and the loss of *short-circuit* conducted heat, so that the overall efficiency is often only about half of the ideal (Carnot) efficiency.

V. CONCLUSION AND FUTURE SCOPE

With every one of our endeavors entirely centered around outline counts and particular parameters we figured out how to accomplish our objective of planning and manufacturing our engine.With the help of our school we even figured out how to plan our own explanatory reflector.The achievement of a task fundamentally relies on upon the hardwork, devotion and the fruithful results that is normal. Remembering this we initially began to test our venture independently as in we independently tried the motor first and afterward the reflector.Our motor figured out how to function admirably under the utilization of an outer warmth source to be exact a gas cutter.We got the required force which was roughly same as the force got from our calculations.Simlarly if there should arise an occurrence of our parabola we effectively got our results.Although at first we had a few blunders which we at long last figured out how to revise them.As both the autonomous frameworks were delivering wanted results, our next target was to coordinate them.Hence we then went ahead with our plan.So then we mounted our motor on the sunlight based explanatory reflector according to our design.Now our fundamental center was the's sun powered energy.As per our counts the sun oriented radiations ought to create a temperature of around 375 degree Celsius so that would energize the motor cylinder so that he motor may start.But due numerous sudden circumstances we couldn't get the required temperature for beginning the engine.We attempted different strategies like making a round dark range so greatest measure of vitality might be absorbed.Inspite of every one of our endeavors we were not ready to accomplish our objective of beginning our motor through sun based radiations.All our experimentation techniques were coming up short. Because of lack of time further joining work has been halted and at this stage separately both of our frameworks are demonstrating their best execution .

2) Inspite of not accomplishing our objective of beginning the motor by sun powered vitality despite everything we have our significant figurings and plans and our different techniques that we have attempted . With further info our computations and investigation of the motor and reflector might be helpful to the future understudies and we could expect a joined sun powered stirling motor to run.



a.

Fig. 1. **A TYPICAL COLOUR VIEW OF "STIRLING ENGINE**

Acknowledgment

We express esteemed gratitude and sincere thanks to our worthy lecturer guide, Prof. More Sir, Our vocabulary does not have suitable words befitting to the high standard of nowledge, extreme sincerity, devotion and affection which ur professors have. They have regularly encouraged us to put eart and soul in this project of manufacturing of Solar Stirling ngine also thank all workshop Assistants and work shop uperintendent who helped a. We lot, for completion of this roject. We convey our great thanks to our H.O.D. rof.S.V.Rao Sir and honorable Principal, Prof.Radake Sir vho made all the facilities available to us and helped a lot for ompletion of this project

REFERENCES

[1] Engine Design---- P.M.Held

[2] Engine Design --- Petrovasky

[3] Rotary Stirling Engines This site is intended to assist and support all enthusiasts who work to advance the cause of the Stirling Cycle engine. Accessed October 2006

a. Non-conventional Energy Sources- G.D.Rai
b. Solar Energy – Fundamentals and Applications – H.P. Garg J. Prakash
c. Solar Thermal Experiments - H.P. Garg T.C.Kandpal
d. Books from solar – Sukhatme

[4] •http://en.wikipedia.org/wiki/Solar_Powered_Stirling_Engines

[5] •http://auto.howstuffworks.com/stirling-engine.htm 46