ANALYSIS OF WORKING OF NOVEL PUMPS

Sunny Narayan[1],

Faculty of Mechanical engineering ,Indus International University , India [1]

1. Introduction

Engines are common sources of power for many devices. many of these engines are very complex and need high levels of technological support for operation[1-6]. This paper focuses on the design, construction and operation of a simple device which can pump water and can be easily made without need for complex tools. these devices can be powered from simple combustion or directly from solar energy. The liquid piston fluidyne device which is simple form of a stirling engine uses the fluctuating pressure is to pump fluid . A simple proto type of this pump has been made and tested. basic theory of the device is also discussed and future recommendations made to improve current design.

2. Problem discussion

A liquid piston engine is a novel engine working on Stirling engine cycle.[7] A gas confined in a closed space expands when heated and contracts on cooling. This expansion and contraction can be used generate pressure Fluctuations which can be used to do useful mechanical work. The working of this pump is reviewed in next section of this work. Initially piston is at central and gauge is neutral indicating equal pressures on both sides. When gas present in hot end of arrangement expands, it pushes piston towards extreme left and moves towards cold end by means of connecting tube increasing pressure at cold end as indicated by gauge. As the gas comes in contact with cold end, it contracts and pressure falls hence pushing piston towards extreme leftend. Figures 1-3 indicate this operation.

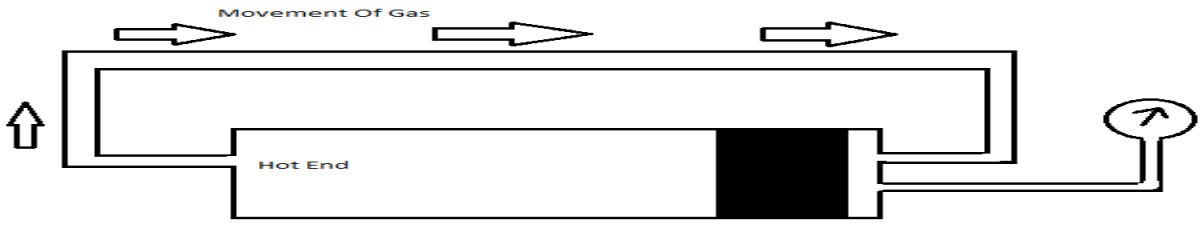

Figure 1-Neutral phase

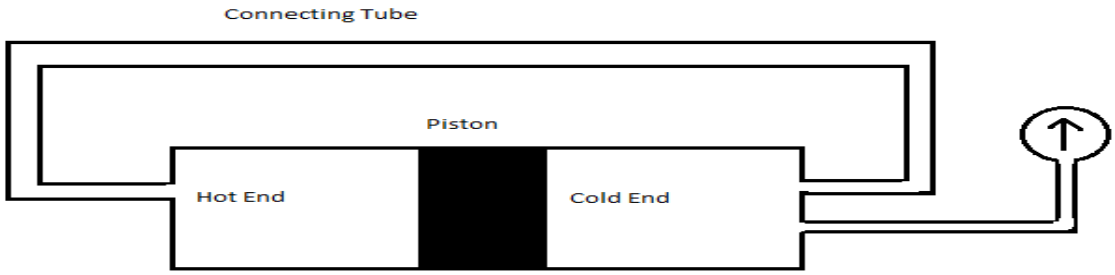

Figure 2-Expansion phase

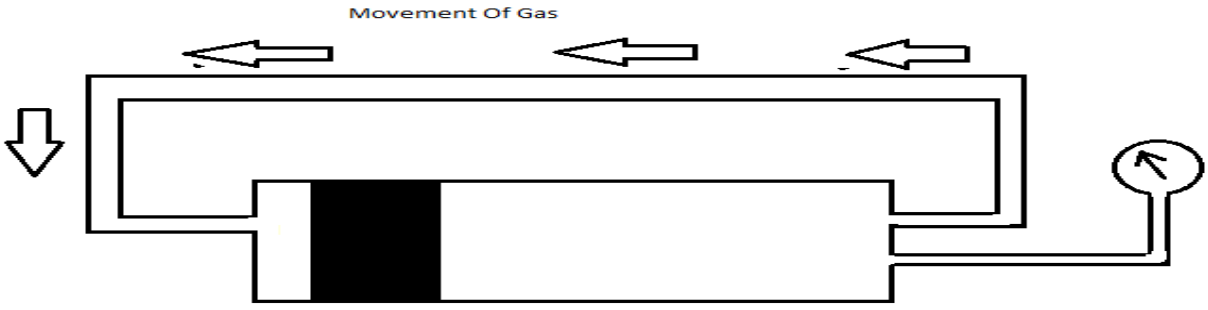

Figure 3-Contraction phase

3. Methodology

The main purpose of this work is to develop a competencies model for an effective performance of maintenance managers A test rig was designed and developed to gather more information about working of fluidyne engine. This setup used a displacer pipe of 45cm length(L) and 1.2 cm in diameter(D). Pumping line used had 15 cm height (H)& 0.78 cm in diameter(d). Methanol spirit was used as a fuel to heat up hot end. A typical lay out of system is shown in fig 4.

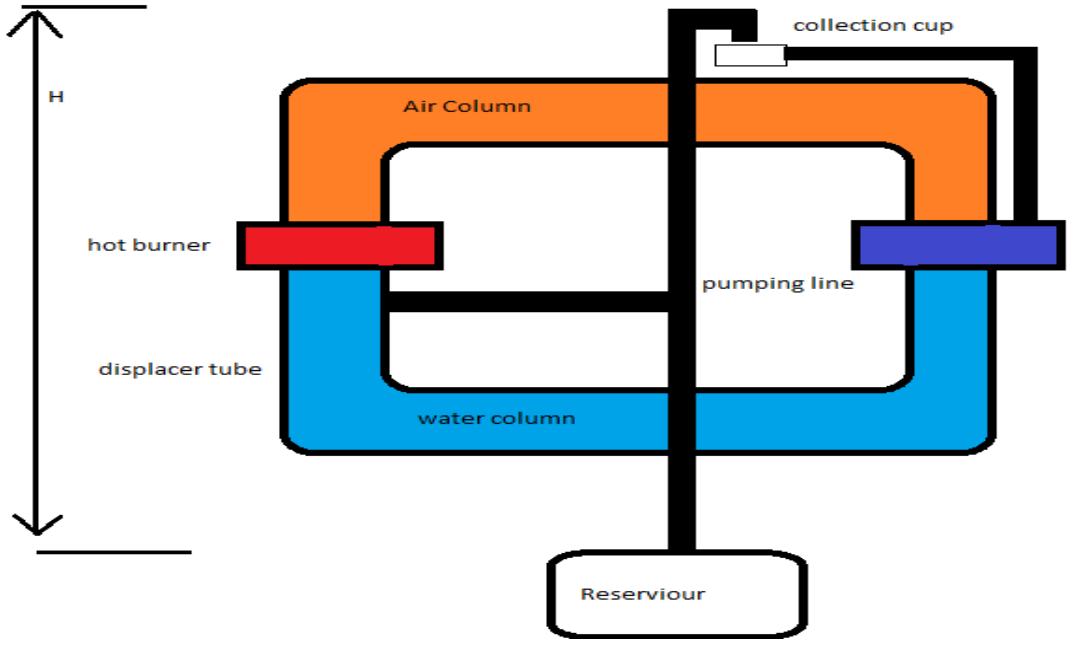

Figure 4-Experimantal setup

Frequency of oscillations was found to be 1.57Hz .Volume of water pumped from pumping column is given by Q:

$Q=A\sqrt{2gH}= 8.19cm^3/s = 8.19\times10^{-6}m^3/s$

Power needed to pump water $=\rho \times Q \times g \times H$

$=1000 \times 8.19\times10^{-6}\times 9.8 \times 0.15=0.012$ W

Further thermocouple and a manometer was used to record the temperatures and pressures in hot air column. Values of these can be seen in table no 1.

Table 1-Variations of pressure and temperature

Pressure (mm of Hg)	Temperature (K)	Time (s)
720	296	0
980	298	300
910	300	320

1210	302	340
910	305	360
1360	307	380
760	309	400
1440	311	420
740	313	440

3. Conclusion

Temperature & pressure in the air column rises with time as air gains more and more heat from the burning fuel as seen from values in table no 1,.Peak values of pressure was found to be around 1400 mm of mercury , whereas the peak temperature was found to be around 39°C indicating poor heat transfer to the air. In order to improve heat transfer the air column can be covered with an insulation material. Further in order to improve the heat transfer rate, bigger columns can be used so that more mass of air is able to gain heat from the burning fuel. Commercial form of such fluidyne engines can be developed by using solar energy as source of heat to create pressure oscillations, thus pumping ground water from a certain depth.

References

[1]http://www.saylor.org/site/wp-content/uploads/2011/01/Nervous-System.pdf

[2]http://soils.stanford.edu/classes/ges175items/lect-3_water_visual.pdf

[3] http://thevirtualheart.org/3dpdf/Heart_3d.pdf

[4] http://puretecwater.com/resources/basics-of-reverse-osmosis.pdf

[5] http://www.menet.umn.edu/~vandeven/ConfPaper-Developments%20Towards%20a%20LP%20Stirling%20Engine.pdf

[6]http://ftp.demec.ufpr.br/disciplinas/TM106/FK_AO_Final.pdf

[7] C. D. West, Liquid Piston Stirling Engine, Van Nostrand Reinhold, New York, 1983.