ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization Volume 4, Special Issue 2, February 2015

5th International Conference in Magna on Emerging Engineering Trends 2015 [ICMEET 2015]

On 27th & 28th February, 2015

Organized by

Department of Mechanical Engineering, Magna College of Engineering, Chennai-600055, India.

Theoretical Analysis Of A Newfangled Internal Combustion Engine

Dineshbabu D, Deepak Kumar M, John Leonard, Prem Kumar D, Deepak Kumar K

Department of Mechanical Engineering, Velammal Engineering College, Chennai, India

ABSTRACT: This work deals with "Valved Two Stroke Engine with Extended Expansion" which is an hybrid of two stroke and four stroke engine. i.e. like two stroke engine - the four strokes viz. suction, compression, power and exhaust will completed in a single rotation of crank shaft. At the same time the escaping of fresh charge without burning through exhaust port wh ich is an inherent deficiency of a conventional Two Stroke Engine is controlled by a specially designed Transfer Valve arrangement. Secondly the pressure at the end of expansion stroke reaches nearly to atmospheric presssure by suitably designing the engine construction which is refered as Extended Expansion.Increase of mileage, reducing emission temperature and noise level, reducing manufacturing cost of the engine are the main objectives.

I.INTRODUCTION

On par with increasing population, automotive engines are also rapidly teeming up. The depletion of fuel resources and heat rejection of automotive engines to the environment are the few challenges ahead of us. This work deals with a newer type of engine to intially demonstrate the working of a Basic model whose main objectives are to attenuate emission temperature thereby reduce global warming, reduce exhaust noise level addressing to environment, increase mileage and also reduce engine components by which manufacturing cost of the engine can be reduced. In a nut shell the project work demonstrates in total upgrading of conventional engines.

Conventional engines are based on Otto Cycle (for petrol engine) / Dual Cycle (for Diesel engines). The "Valved Two Stroke Engine with Extended Expansion" (whether the Pilot Model or the Ultimate Model) is based on Atkinson Cycle which is a corrolary to the above cycles.

Secondly, all the four cycles are completed in a single rotation of crank shaft. Unlike in a two stroke engine, the escaping of fresh charge through exhaust port without burning is controlled by a special transfer valve arrangement.This model will be useful for both SI & CI engines of higher capacity.

II. ATKINSON CYCLE, THE ATKINSON ENGINE &THE PROPOSED ENGINE

The p-v diagram of Atkinson cycle is shown in comparison with Otto cycle to differentiate the increase in work output by Atkinson Cycle. Atkinson Cycle is a corollary of the Otto Cycle. In the Otto cycle, the intake volume and the expansion volume are equal. Suppose that if intake volume during suction stroke is 100 cc. then expansion volume during power stroke is also 100 cc. in the same domain. But in the primitive Atkinson Cycle (fig. 1b) the above volumes are made unequal by having two different stroke lengths during (suction/compression) and (power/exhaust) and the piston (diameter/area) remains constant. A fixed intake volume called the swept volume Vs of air is taken in at point 1. The air is compressed adiabatically from1-2. At point 2 heat is supplied (Q_S) and the pressure abruptly rises to point 3. From point 3 the air is expanded adiabatically to the point 4' where the pressure reduces to atmospheric level to a volume called expansion volume $V_e$where V_e>V_s. In the conventional engine which is based on Otto Cycle, compression ratio r_c andexpansion ratio r_e are equal as expansion stroke length l_e is equal to suction stroke length l_s. But in the Atkinson Cycle r_e >r_c and V_e>V_s. Thus the pressure at the end of expansion / BDC reaches to atmospheric level and hence work output increases in the Atkinson Cycle, which is shown in the p-v diagram of figure1.

IJIRSET

ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization Volume 4, Special Issue 2, February 2015

5th International Conference in Magna on Emerging Engineering Trends 2015 [ICMEET 2015]

On 27th & 28th February, 2015

Organized by

Department of Mechanical Engineering, Magna College of Engineering, Chennai-600055, India.

III. EXPERIMENTAL STUDY

The four strokes viz. suction, compression, power and exhaust strokes are described below:
Suction Stroke **-** Piston moves from TDC to BDC i.e. 0^o to 180^o. The ShuttleValve is in the upper position. As piston moves down air fuel mixture from carburetor is inducted into the annular chamber of the compressor unit as shown by the arrows in the drawing.

Compression stroke -Piston moves from BDC to TDC i.e. from 180˚ to 310˚. The Shuttle Valve moves down. As the piston moves up the inducted air fuel mixture is compressed and transferred through transfer manifold and temporarily stored in the transfer chamber which is above the TV. During compression stroke, the transfer valve rests in its lower position. Hence the air fuel mixture which is delivered from annular chamber is stored above the transfer valve disc. This temporary storing of air fuel mixture takes place up to 50˚ before TDC.

Transferring operation - Around 50˚ before TDC, as the piston still moves up to the TDC, the exhaust valve closes cutting of the exhaust of previous cycle. Simultaneously, the transfer valve cone suddenly moves up from its seat of TV disc causing a wide gap in between them. As the piston is still continues moving up and also due the pressure built up in the transfer chamber during the period of 180˚ to 310˚ the charge which was held above the transfer valve disc gets transferred below the disc and mixes with residual exhaust gas trapped. At 330˚ the TV disc also moves up squeezing the left over fresh charge above it and transfers into the central chamber. Now the transfer port is blocked.
Ignition and combustion - Around 20˚ before TDC,the fuel is ignited by the spark plug. Temperature as well as pressure increases abruptly during combustion.

Power stroke - The brunt of the combustion products over the piston causes the power stroke and piston moves down from TDC to BDC. During power stroke the pressure inside the cylinder will be reduced to that of atmospheric pressure as the annular volume swept by the compressor (V_s) and is lesser than that of the expansion volume (V_e) which is displaced by the expansion chamber unit following Atkinson Cycle. This volume difference is suitably designed so that the gas can expand nearly to atmospheric pressure during expansion stroke by which additional work can be extracted. Simultaneously suction stroke is affected in the compressor unit for the next cycle.

Exhaust cum compression stroke - When piston moves upward from 180˚ to 360˚, the exhaust valve is opened and the products of combustion are discharged out to atmosphere as shown by the arrows in the drawing. The exhaust valve is closed at 50˚ before TDC

It can be seen that during this upward movement of piston, simultaneously compression stroke is affected in the annular chamber for the next cycle. The cycle gets repeated.

All the four strokes are completed in one complete rotation i.e. in 360˚ and hence the engine is two stroke engines. Alternatively, disc valves which are used in conventional reciprocating air compressors may also be replaced instead of the shuttle valve. The disc valve can perform the function of air admission and discharge from the annular chamber. The disc valve operates on the differential pressure between valve plates and hence no cam arrangement is required.

IJIRSET

ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization *Volume 4, Special Issue 2, February 2015*

5th International Conference in Magna on Emerging Engineering Trends 2015 [ICMEET 2015]

On 27th & 28th February, 2015

Organized by

Department of Mechanical Engineering, Magna College of Engineering, Chennai-600055, India.

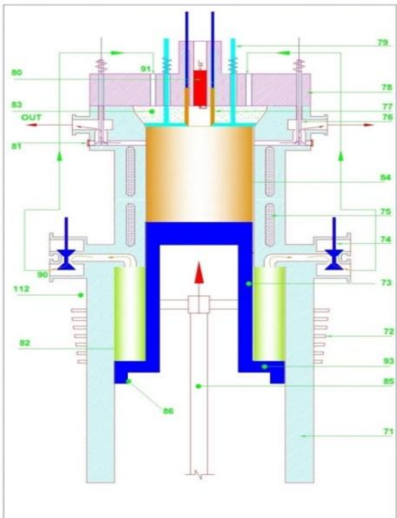

Fig 2: Proposed engine model (Stepped piston type)

IV. CONCLUSION

The proposed engine is being fabricated and the prototype model analysis was successful. For clarity, this description has been depicted keeping petrol engine as reference. However, the research work, obviously applicable to diesel engine with suitable fuel injection arrangements & which are all within the scope of present research work.

Therefore the present research work is not intended to be limited to the embodiment shown, but is to be accorded the widest possible scope consistent with the principles & features disclosed herein.

REFERENCES

1. P.Ravi,"Hybrid Internal combustion with extended expansion", Indian patent 249709, November4, 2011.
2. Scuderi, C. J., "Split Four Stroke Cycle Internal Combustion Engine", WIPO Report WO03/008785A1, January 30, 2003.
3. Scuderi. C. J., "Varible Volume Crossover passage for a Split Cycle Engine", WIPO Report WO 2010 /120856 A1, October 21, 2010.
4. Scuderi. C. J., "Air Supply for components of a Split Cycle Engine", WIPO Report WO 2010/129872 A1, November 10, 2010.
5. Benjamin.H.Tour., "Double Piston Cycle Engine ", United States Patent US 7516723 B2, April 14, 2009.
6. Benjamin.H.Tour., "Double Piston Cycle Engine ",United States Patent US 7383797 B2, June 10, 2008.
7. Ford Phillips, Ian Gilbert, Jean-Pierre Pirault and Marc Megel, "Scuderi Split Cycle Research Engine: Overview, Architecture and Operation", SAE Technical Paper 2011-01-0403, December 2011.
8. Riccardo Meldolesi, George Bailey, Clive Lacy, Ian Gilbert, Jean-Pierre Pirault and Anthony Perkins, "Scuderi Split Cycle Fast Acting Valvetrain: Architecture and Development", SAE Internationals, 2011-01-0404, 2011.
9. Sei Watanabe, Hibiki Koga and ShoheiKono" Research on Extended Expansion General-Purpose Engine", SAE Internationals, SAE2006-32-0101, 2006.
10. Jorge J.G. Martins,KrisztinaUzuneanu ,Bernardo Sousa Ribeiro ,OndrejJasansky" Thermodynamic Analysis of an Over expanded engine" SAE Internationals 2004-01-0617 ,2004.
11. J.M.Mallikarjuna, K.Pradeep Kumar "Computer Simulation Of Gasoline Direct Injection (GDI) Extended Expansion Engine" SAE Internationals, SAE 2005-26-057, 2005 55.