

Impact of Modified Piston - A Review

S. Manavalan, Ramesh Rai, Ravi Ranjan Kumar, Ritesh Kumar Chaudhary, Subodh Kumar Chaudhary

Abstract

The piston could be a heart of the engine and its operating condition is that the most passing unhealthy one amongst the key elements of the engine within the work. A piston could be a section of responding piston responding pumps gas compressors and gas chambers among alternative comparative systems. It's the moving half that's contained by a barrel and is formed air-tight by piston rings. During a piston, its motivation is to exchange force from growing gas within the barrel to the rotating shaft through a piston bar and in addition associating pole rod. the most objective is to analyze and analyze the behavior stress and structural analysis of changed piston at the \$64000 engine condition throughout the combustion method. This work advancement by utilizing finite component analysis to anticipate the upper stress and significant space is on the part.

Keywords: piston, mechanical fatigue machines, materials survey.

I. INTRODUCTION

The automotive piston is so an extremely thermal automatically loaded half that generally needs specific options and characteristics so as to enhance its performance and thereby to cut back the polluting emissions. From a thermal cycle purpose of reading throughout traditional engine operation, a piston initial gets heated by the combustion method and is cooled thenceforth by engine oil rings and block.

A. Parts of the heat engine and their functions

The performance of the mechanism of any engine is to supply a way whereby the warmth energy of the fuel is often expeditiously born-again into helpful mechanical work. The cylinder is sometimes made from exhausting fine-grained forged iron and will be organized horizontally vertically or at an associated angle to the vertical per the sort of engine. Pistons are typically made from a decent grade of fine-grained forged iron or atomic number 13 alloys. In larger engines, forged steel is usually used.

Revised Manuscript Received on xxxxx

S. Manavalan, Mechanical Engineering, Bharath Institute of Higher Education and Research, Chennai, India.

Ramesh Rai, Mechanical Engineering, Bharath Institute of Higher Education and Research, Chennai, India.

Ravi Ranjan Kumar, Mechanical Engineering, Bharath Institute of Higher Education and Research, Chennai, India.

Ritesh Kumar Chaudhary, Mechanical Engineering, Bharath Institute of Higher Education and Research, Chennai, India.

Subodh Kumar Chaudhary, Mechanical Engineering, Bharath Institute of Higher Education and Research, Chennai, India.

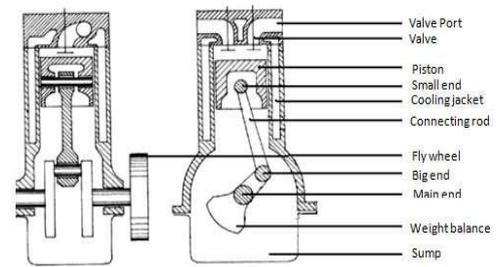


Fig.1 Insight of a typical single cylinder engine (Courtesy: spz ltd)

B. Piston Ring

The seal could be a split band that matches into a groove on the outer diameter of the piston in an exceedingly internal-combustion engine ironed against the wall of the cylinder by springs mounted within the inner "junk ring.

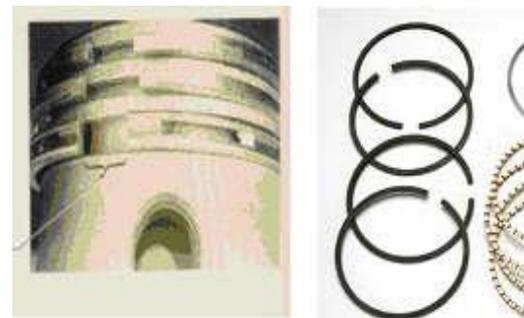


Fig. 2 Piston Ring

Ring groove could be a recessed space situated round the perimeter of the piston that's accustomed retain a seal. Ring lands are the 2 parallel surfaces of the ring groove that operate because the waterproofing surface for the seal. A seal is Associate in nursing expandable split ring accustomed offer a seal between the piston and therefore the cylinder wall. Piston rings are ordinarily made up of forged iron.

C. Cylinder Liner

Cylinder liner a cylinder liner could be a cylindrical half to be fitted into associate cylinder block to make a cylinder. it's one in all the foremost necessary practical elements to form up the inside of associate engine. The cylinder liner serving because the inner wall of a cylinder forms a slippery surface for the piston rings whereas retentive the lubricating substance inside. the foremost necessary perform of the cylinder is that the wonderful characteristic as of the slippery surface and there ar four necessary points that should be thought-about for the cylinder liner they are: one. high anti-galling properties two. Less go down the cylinder liner itself. 3. Less go down the partner seal four. Less consumption of lubricating substance. fig 3. Cylinder liner the cylinder liner receives combustion heat through the piston and

piston rings and transmits the warmth to the agent.

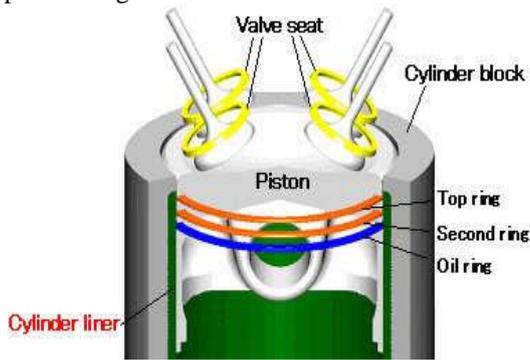


Fig. 3 Cylinder Liner

The cylinder liner prevents the compressed gas and combustion gas from escaping outside. it is necessary that a cylinder liner which is hard to transform by high pressure and high temperature in the cylinder.

II. Piston Materials

Piston materials the foremost ordinarily used material for the piston of IC engines is Al alloy and iron. However al alloy is desirable compared of forged iron thanks to its light-weight. the warmth conduction of Al-alloy is fourfold that of forged iron metal pistons area unit created thicker that is important for strength so as to administer correct cooling. Pistons area unit a gaggle of engine ensembles fabricated from cylindrical metal that exhibits vertical movement among the cylinder. Pistons area unit employed in varied machines like gas and gas compressors pumps and reciprocal engines. the most operate of a piston in a very machine is to transfer force from the gas increasing within the cylinder to the rotating shaft with the assistance of pistons or connecting rods.

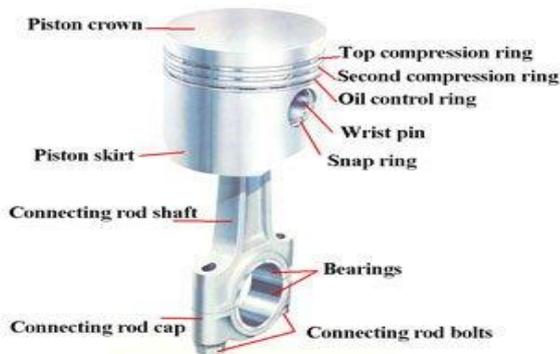


Fig. 4 Components of piston

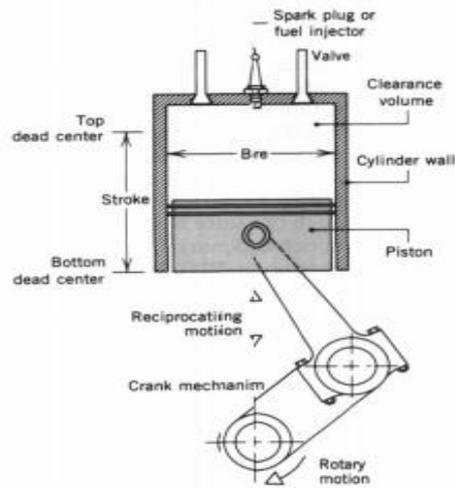


Fig. 5 Arrangement of piston cylinder

A. Factors Considered for Proper Functioning of Piston

1. The piston ought to have huge strength and warmth resistance properties to face up to force per unit area and inertia forces. They must have minimum weight to attenuate the inertia forces.
2. The fabric of the piston ought to have smart and fast dissipation of warmth from the crown to the rings and bearing space to the cylinder walls. It ought to kind of good gas and oil seal.
3. The fabric of the piston should possess smart carrying qualities in order that the piston is ready to take care of adequate surface-hardness unto the operative temperatures.
4. The piston ought to have rigid construction to face up to thermal mechanical distortion and adequate space to stop undue wear. it's even enlargement beneath thermal masses, therefore, ought to be free as attainable from discontinuities.

III. Different types of Pistons Design

HCCI stands for homogenized charge compression ignition is engine combustion. The look of pistons is vital for engine performance. Pistons should have low friction to enhance engine performance and fuel economy. The profile of the piston cavity conjointly the configuration of the nozzle also plays important roles in engine combustion fuel emission and fuel consumption. Style the planning the look of the piston cavity nozzle design piston bowl sort and therefore the in-cylinder charge air is all necessary parameters that have an effect on engine performance. The pure mathematics of the piston cavity and varied dimensions like the pipe region torus radius impingement space and therefore the cavity lip space has an effect on the formation of emissions in engine combustion. Analysis has shown that combustion chambers with best shapes facilitate cut back emissions throughout engine combustion.

A. Square Bowl Piston Design

As its name suggests this piston could be a changed version of the bowl piston. it's an sq. bowl house on its prime this

form includes a direct influence on the speed of warmth discharged particularly with HCCI engines. As a matter of concern most HCCI combustion is restricted to load as a result of air mass and quick combustion; therefore, the speed of combustion will cut back the load varies. Therefore, sq. bowl pistons manufacture micro-turbulence derived from rounded corners that account for the superior air-fuel mixture.

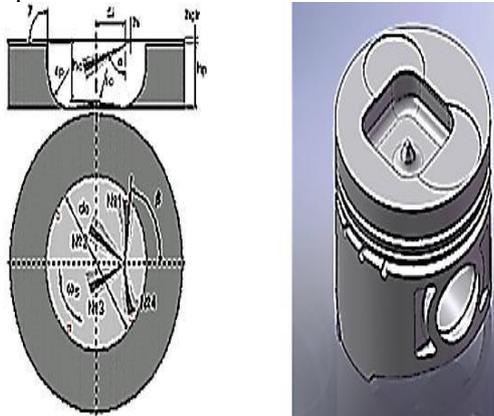


Fig. 6 Square bowl piston design

B. Bowl Piston Design

Bowl piston style bowl pistons are applied to attenuate compression ratios thanks to the extra blow combustion volume. they'll be used on supercharged or turbocharged engines to eliminate detonation that's the spark knock below the boosted conditions of the 2 styles. Bowl pistons have compact combustion chambers and quick combustion rates figure shows a sample bowl piston employed in an internal-combustion engine during which the bowl is employed to confine the gas spray permanently and quick combustion.



Fig.7 Bowl piston design

C. Dome Piston Design

Dome piston style the dome piston has the extra volume on the highest compared to flat pistons whose superior square measure flat as shown within the figure. the additional volume is for up the compression magnitude relation of the piston and consequently up performance. However, unskillfulness within the cylinder surface style and extremely rounded pistons cause inefficient combustion and slow burning rates of the air-fuel mixture. Convexity is employed to develop and improve optimum chamber form with a high compression magnitude relation and economical combustion rate.

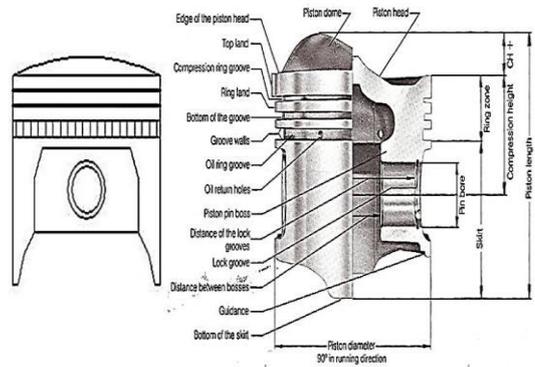


Fig. 8 Dome piston design

D. Flat-Top Piston Design

This piston is usually employed in factory-made engines. They're simple to develop that keeps the price of the engines low. Some flat prime pistons have material extracted from the highest to confirm the valves don't hit the pistons throughout the gap and shutting off the intake and exhaust valves. This improves their compression ratios by permitting the pistons to rise higher into the top of the cylinders. The last decade has seen advancements in piston technology.



Fig. 9 Flat -Top Piston Design

E. Two Stroke Pistons

In a two-stroke HCCI engine, a flat-topped piston may be used. The combustion chambers steep roofs yield bigger clearance volume making a lower compression magnitude relation once employing a flat piston. This alternative of piston style reduces the compression magnitude relation to a minimum of regarding 9:1.



Fig. 10 Two -stroke piston

F. Four-Stroke Engine Pistons

This piston style with a bowl on high is vital in directional the

fuel about to the piston throughout late injection timings. Moreover, the crown piston is slightly raised for the raised compression ratios that square measure typical for gasoline primarily based HCCI engines. for gasoline-based HCCI engines, higher compression ratios become helpful in overcoming the disadvantages caused by the reduction of firing frequency compared to engines with the two-stroke.



Fig. 11 Four-stroke piston

IV. LITERATURE SURVEY

Andersson, Peter, Tamminen, Jaana, Sandstrom, CarlErik.

There is ne'er the most effective seal or the most effective seal assembly which might meet all the strain of totally different completely different}completely different}|the various} operational conditions therefore for various operational conditions different material different shapes & different coatings piston rings are used. the fabric of the ring ought to be capable of resisting fracture even in extremity conditions. the fabric of the ring ought to be elastic and corrosion resistance to serve its purpose inappropriate method. Ring material ought to even have smart thermal conduction to conduct heat from the piston to the cylinder walls. the fabric of the ring ought to be specified it ought to face up to the mechanical stresses thanks to combustion of fuel additionally because of the thermal stress thanks to heat generation within the cylinder. ring form ought to offer minimum friction between ring and liner.

A. V. Sreenath and N. Raman

Studies the agreement between the liner and rings of an indoor combustion engine and located that it depends upon chiefly on the linear wear dimensional loss throughout running-in. running-in wear studies exploitation the factorial style of experiments on a compression ignition engine showed that at bound position locations of piston rings the linear wear of the cylinder liner will increase with increase within the initial surface roughness of the liner.

Wakuri Y, Hamatake T, Soejima M, Kitahara

The friction force is significantly laid low with the oil starvation. Because the average and cyclic amendment of oil film thickness becomes smaller the

friction force of the seal assembly becomes larger perceptibly.

Peter Andersson, Jaana Tamminen, Carl-Erik Sandstrom. Piston ring tribology in 2002

The material of the ring ought to be capable of resisting fracture even in extremity conditions. the fabric of the ring ought to be elastic and corrosion resistance to serve its purpose inappropriate means. Ring material ought to even have sensible thermal physical phenomenon to conduct heat from the piston to the cylinder walls. the fabric of the ring ought to be such it ought to stand up to the mechanical stresses because of combustion of fuel additionally because the thermal stress because of heat generation within the cylinder. Ring form ought to give minimum friction between ring and liner.

MS Motor Service International GmbH_ Piston Rings for Combustion Engines_2nd Edition 01.2010

Nowadays coating for the ring is being employed wide to boost the properties of the piston rings usually used coating materials square measure metal Mo metallic element and their alloys. metal is employed wherever the wear and tear rate of the seal is high and corrosion atmosphere is a gift. Mo coating is employed wherever the matter of scuffing is there. Flame spraying method or plasma spraying is used for coating of Mo. Mo conjointly offers the advantage of porous structure on the face of the ring leading to accumulation of lubrication oil on the surface allowing the ring to run in extreme operational conditions.

V. CONCLUSIONS

This literature review given some problems associated with the consequences of various piston crown styles in one HCCI engine. The direction of the piston is crucial to overall engine performance and potency. Innovations in engine technology use styles that drive higher performance for HCCI engines. Piston style is vital for the most effective engine performance. Researchers attempt to attain triple-crown piston style for HCCI gasoline-based combustion engines to eliminate varied failure modes like structural failure uncommon noise and skirt scuffing. Pistons play associate degree particularly crucial role in engines. The styles and pure mathematics of pistons contribute to overall engine performance.

References

- [1] Hairuddin A A, Wandel A P, Yusaf T. An introduction to a Homogeneous Charge Compression Ignition engine. Journal of Mechanical Engineering and Sciences.2014; 7:1042-52.
- [2] Andersson, Peter, Tamminen, Jaana, Sandstrom, CarlErik, 2002. Piston ring tribology- A literature survey. Espoo. VTT Tiedotteita Research Notes, 2178.PP 1108.
- [3] Wakuri, Y., Hamatake, T., Soejima, M., Kitahara, T. Piston ring friction in internal combustion engines. Tribology International, Vol. 25, No. 5, PP. 299308, 1992.
- [4] Idriscesur, Vezir AYHAN, Adnan PARLAK, Omer SAVAS. The effect of different fuel on wear between piston ring and cylinder in 2013.

[5] Peter Andersson, Jaana Tamminen, Carl-Erik Sandstrom. Piston ring tribology in 2002.

[6] H. Abdullah Tasdemir, Masaharu Wakayama, akayuki Tokoroyama, Hiroyuki Kousaka, Noritsugu Umehara, Yutaka Mabuchi, Tsuyoshi Higuchi. Wear behaviour of tetrahedral amorphous diamond like carbon (ta-C DLC) in additive containing lubricants. Wear 307 (1-9) in 2013.

[7] M. Uchida, H. Liu, K. Yamamoto, A. Iwabuchi. Effects of hard water on tribological properties of DLC rubbed against stainless steel and brass. Wear 307 (79-85) in 2013.

[8] Y. Mabuchi, T. Higuchi, Y. Inagaki, H. Kousaka, N. Umehara (2012) Wear analysis of hydrogen-free diamond-like carbon coatings under a lubricated condition. Wear 307 (48-56) in 2013.

[9] Fenghua Su, Canshen Liu, Ping Huang. Friction and wear of nanocrystalline Co and Co-W alloy coatings produced by pulse reverse electrodeposition. Wear 307 (114-125) in 2013.

[10] V. Chaudhry, Satish V. Kailas. Damage quantification under sliding and seizure condition using first of a kind fretting machine. Wear 307 (114-125) in 2013.