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A Review of Piston Analysis by using Finite Element Analysis

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Abstract- The purpose of the column is to transfer power from the expanded pressurized gas via a piston rod to the crank shaft. The engine may be started in this manner. The piston must endure cyclic gas pressure and inertial stresses when operating, and this working condition may lead to piston tiredness damage, such as piston-side wear and piston-head fractures, etc. Aluminum pistons are often utilized due to its lightweight and heat conduction. However, it is not advised to be used in high-temperature applications due of its poor heat resistance and high expansion coefficient.

Key Terms— Piston, Aluminum, Crank Shaft.

I. INTRODUCTION

When it comes to mechanical engineering, the piston is one of the utmost important components. Piston has a broad range of applications in mechanical systems such as internal combustion engines, pneumatic cylinders, hydraulic cylinders, and so on. A piston is a mechanical component that is present in a range of operations, including reciprocal pumps, gas compressors, pneumatic cylinder and reciprocal engines. It is the moving component within a cylinder that is stored gastight by piston rings, which are utilized with a piston. The task of a piston rod and/or a rod connector in a motor is to transfer the force via the crankshaft from rising gas in the cylinder to the shaft. Because of the shape of the piston and its exposure to structural and thermal loads, a study is required. A piston is a moving part of the cylinders included in reciprocal engines, reciprocal pumps, gas compressors and pneumatic cylinders. The pressure from the expanding combustion gas in the combustion chamber on the piston-connecting rod assembly operates on an internal combustion (IC) motor that transfers the motion to the crankshaft through piston-connecting rod assembly. One approach is to alter the material of a component in the combustion chamber to increase engine performance.

Figure 1: Piston within a sectioned petrol engine

Major components of a Piston.

Piston head or crown: depending on the architecture of the combustion chamber, piston head or crown form is flat, convex or concave. It can withstand the gas pressure in the cylinder.

Piston rings are used to screen the cylinders to prevent gas leakage beyond the piston.

It acts as a support for a side push on the cylindrical walls of the connecting rod. The skirt. The skirt.

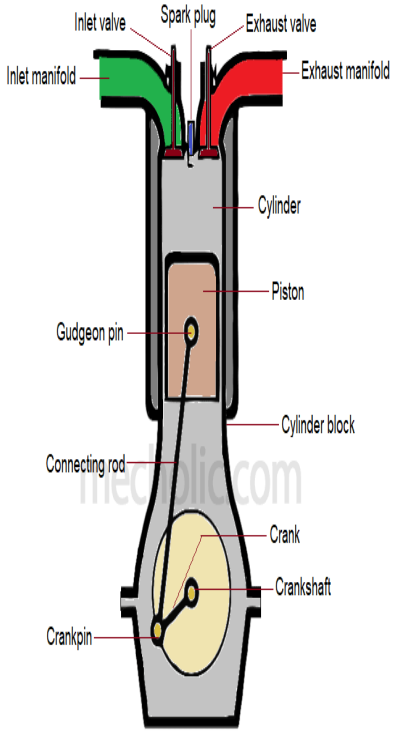

Figure 2: components of a piston

Piston Function

The piston is an element of power transmission in the engine cylinder, the energy bounded up in fuel is rapidly converted into heat and pressure during the combustion process. In a short period of time heat and pressure valve increase greatly, and the piston has the task of converting released energy into mechanical work. The usual structure of the piston is a hollow cylinder closed on one side with the segment piston head with ring belt, pin base, and skirt. The piston head transfers the gas forces (fuel-air mixture) from the combustion chamber resulting pin boss, piston pin, and connecting rod to a crankshaft.

II. LITERATUERE SURVEY

S. Bhattacharya 2020 -The piston has been modelled in CATIA V5, and the meshing and analysis have been completed in ANSYS 16.0 software. Both the thermal and static behavior of the piston have been investigated, and the findings have been tabulated. The investigation of different stresses operating on the piston is now being conducted.

Manisha B. Shinde, T. V. Sakore, and V. D. Katkam2019 have collaborated on this project (2016). The structural analysis of a typical piston constructed of the aluminum alloy A2618 is studied in this research. The second step is to conduct an analysis on a piston constructed of Al-GHY1250 and Al-GHS1300. Lightweight, low-cost, structurally and thermally resistant materials should be utilized in the construction of pistons since the conditions that would be encountered throughout the combustion process are very high pressures and temperatures.

Abino John, Jenson T Mathew, and colleagues (2018) have developed a lightweight alternative to aluminum in this research. In order to create a 3D model, CATIA v6 was used, and structural and thermal analysis were performed using ANSYS 14. Abrasion resistance and creep resistance are superior in AlSiC compared to aluminum. It also offers extremely excellent stiffness-to-weight and strength-to- weight ratios as well as superior high temperature performance. The fabrication of pistons from AlSiC is also less complicated.

Darwai, and Anurag Kulshreshtha 2013 This calculation includes the determination of the distributions of thermal stresses, mechanical stresses, and thermo-mechanical stress-couples distributions, as well as deformations. Following that, using the ANSYS workbench software, a fatigue study was carried out to determine the factor of safety and life of the piston assembly. The piston material is made of an aluminum-silicon hybrid. As a consequence of the stress analysis findings, component design may be improved at an earlier stage, and the time needed to produce the piston component and its cost can be reduced.

Jenson, Abino2012-Pistons are a crucial component of an internal combustion engine, and their design and analysis take structural and thermal issues into account. A linear static and a linked thermal-structural analysis of a broken piston in an internal combustion engine were carried out effectively by

Gudimetal and Gopinath utilizing reverse engineering and the finite element technique, which was utilized in conjunction with a damaged IC engine piston.

Rajan et al 2010, According to them, the design parameter may be altered, such as crown thickness, barrel thickness, ring lands thickness and an optimum solution for an existing design.

Saigowtham Ponnathi (2009) found that the cylinder liner and piston rings had frictional losses that accounted for 20% of the total amount of mechanical losses. Because the frictional losses in the piston rings and cylinder liners may be minimized, the efficiency of the engine can be increased while the fuel consumption is decreased. It is also possible for the piston, piston rings, and cylinder liners to operate at greater temperatures and pressures, which lowers frictional losses

III. CONCLUSIONS

1. At higher pressures, the elastic deformation of both the piston and cylinder induces a change in the effective area of the unit.

2. The elastic distortions are related to the pressure applied, the unit's material properties and the pressure properties

3. Some material is having low deformation and high heat flux properties

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