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Convection And Mechanical Load Analysis The Coupling Gasoline Engine Piston

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Abstarct: **With a clear analysis program elements, it has been a clear analysis of three-dimensional element to the gasoline engine piston. Given the state of the thermal boundary conditions of stress and strain distribution of the piston under the influence of thermal coupling of the load pressure and the explosion they were calculated, which provides a reference for improving the design. The results show that the main reason for the safety of the piston, and the deformation of the piston and the pressure is great temperature, so it is possible to further reduce in piston temperature with an improved structure.**

I. INTRODUCTION

As a kind of thermal power generation, and the process engine is largely linked to the heat transfer machine, as decided by the different technical engine data, such as economic efficiency. The temperature increase will lead to an increased convection. The hot main part of the engine, the piston to support the weight of the complex mechanical and thermal load presented periodically to change. Analysis of the state of stress and deformation under load or mechanical convection is only far from enough to reflect the current valid action of the piston shape. We can only provide a reference for the design of the piston with the factors affecting convection found out, taking into account the total density of the piston under the influence of convection and coupling load. P. Mechanical O'Hara [1] analyzed the heat and thermal gradients show acute transport problems using finite element classic and generalized methods. V.Ucar, A. Özil [2] achieved using thermal and solution structure element transient analysis finite level in advanced thermal pressure plasma coating systems subjected to thermal load. Suggested Jarruwat Chareonsuk, Passakorn Vessakosol [3] controller higher order finite element (CVFEM) mode to explore the thermal stress of the materials and functionally graded analysis (FGM) in stable with a network condition is structured in a field of form arbitrary capacity. Douglas M. Baker, Dennis N. Assanis [4] provides a methodology for analysis thermodynamic heat transfer and combustion chambers of the diesel engine. Ua Benz, J.J.Rencis [5] and gave formulate treatment element similarly double border by using the elements of the second degree for coupling to a two-dimensional axial symmetry and heat transfer applications areas. Bao Lin Wang, Yu Mai Ala [6] establishes a method of solution (1 D) transient temperature dimensional and thermal stress fields in the inhomogeneous material. [7] Elisa Carvajal Trujillo proposes a methodology for estimating the average temperature of the inner surface of a cylinder in a internal combustion air cooled engine. Sook- Ying, Alan Ball [8] a relatively simple and fast way described implement models in the code aerodynamic heating thermal analysis and structural finite element structural-thermal vibrations of passing jet engine generally nonlinear Mach HyShot. Based on the fundamental thermal analysis, this document uses an analysis element clear program stress and deformation state of the piston under the influence of convection and mechanical load of the line and compares the state of stress and deformation under the influence of convection coupling and mechanical load. Through analysis, it was concluded that the main factor influencing the density of the piston is the temperature, and therefore provide a basis for the optimal design of the piston.

II. LITERATURE REVIEW

Abdul gave Ola (2002), the initial simulation engine four ignition times. It has been used to fire the formula Wiebe Predicting the pressure cylinder which was used to determine the specific work. The transfer of heat transfer losses and cylinder friction and pumping into account to predict the mean effective pressure, breaking the thermal efficiency and fuel consumption break. It has been studied more of the parameters that can affect engine ignition four times as parity ratio performance, ignition timing and the rate of heat release, the compression ratio, compression and expansion rate . Using actual combustion has a profound impact on the size of the similarity of personal pressure to that observed in the actual engine curve. The modeling process is getting closer to reality, obviously, now worth as an aid in the design.

Jihad A.A. Yaminl et al. (2003) study the effect of duration of combustion efficiency and emissions characteristics of 4-stroke engines S. I. Fueled by propane gas. analytical model includes the process of compression, combustion and expansion. Two typical combustion process of the combustion zone and then approved the accounts, and then proceed in three stages. First, initiate combustion, combustion chamber and then divided into two separated by a ball in front of the torch zones, and finally an area includes the entire combustion chamber. To initiate combustion is a unit of mass of the cylinder contents to record in a fixed size. Is designated internal energy of the initial reactants is equal to the internal energy of the products. It was supposed to be 12 species. OH ,,, ,, NO, CO2, H2O H2 N2 was H CO, O2, O and Aaron present in the products of combustion within the cylinder and in the exhaust gases. Model for the emission of carbon dioxide is also in the details and described the emissions of nitrogen oxides. validated model was developed with researchers and other experimental results.

Yanlin Ge et al. (2005) study the performance of a standard Otto cycle air with the loss of heat transfer and fluid temperatures specific variable work using thermodynamics limited time. And deriving the relationship between energy production and the compression ratio, thermal efficiency and the compression ratio, and the optimal ratio between the power and cycle efficiency. On the other hand, it was also the impact of the loss of heat transfer and high specific degrees different temperature working fluid in the cycle analysis performance. The results showed that the impact of the loss of heat transfer and high temperatures different specific working fluid in the performance of a clear direction, and should be seen in the analysis cycle.

He informed Yusuf et al. (2005) examined and provided analytical data on the effect of the compression ratio, and the parity ratio and spark timing engine fuel hydrogen as a guide for the design of the engine. He said the change in the thermal characteristics of fuel through the engine cycle. Using a modified version of Olikara and Burman way to track the mole fraction of the equilibrium state of the combustion products of hydrogen fuel. The mathematical model is applicable to any type of fuel, provided the fuel induction technology or, in other words carburetor system. balance values used for each type of prediction formation of nitrogen oxides.

Abu Nada et al. (2006), the thermal analysis of a spark ignition engine. The theoretical model Otto cycle with a working fluid consisting of a mixture of several gases and studied. Compared to those using air as working with temperature change it means heats the specific heat. The study has a wide range of engine parameters, such as parity, and the relationship of engine speed, and extreme heat and director, mean effective pressure, gas pressure, and the thermal cycle efficiency. For example, the air model, the maximum temperature, mean effective pressure (BMEP), and the effectiveness was about 3000 K, 15 bar, and 32%, respectively, at 5000 rpm and 1.2 equivalence ratio. Moreover, using a standard gas mixture under the same conditions, and the maximum temperature, BMEP, and efficiency of approximately 2,500 K, 13,7 bar, and 29%. However, in order to model the air at low engine speed of 2000 rpm ratio and parity 0.8, and the maximum temperature, BMEP, and efficiency of about 2000 K, 8.7 bar, and 28%, respectively. Futher was using a gas mixture model in these circumstances, the maximum temperature, BMEP, and efficiency of approximately 1900 K, 8.4 bar, and 27%, ie, with minor differences. Therefore, it is more realistic to use the gas mixture in the analysis cycle air instead assume that the means of action, especially at high speeds.

A. R. Maher Sadiq al-Baghdadi (2006) developed a simulation model to determine the performance of engines fueled spark ignition standards with a range of fuels (gasoline, ethanol or hydrogen) and mixtures thereof. Two combustion model includes a procedure to derive the estimate of the actual duration of combustion and associated burning biomass for different operating conditions and fuel type. class system of ordinary differential equations for pressure, mass, size and temperature of the burned gas and unburned, and the transfer of heat of combustion and the area not burned, the general flow inside and outside was obtained cracks and the formation of combustion products. Considered slightly twelve ten accounts resulting from combustion. Zeldovich mechanism was used to estimate emissions of nitrogen oxides and carbon dioxide second equilibrium by balancing the accounts. It has been validated mathematical model and simulation with experimental data.

III. METHODOLOGY

The piston is a vital component of a cylindrical engine. It reciprocates inside the cylinder bore. The piston acts as a moveable end of the combustion chamber. The cylinder head is the stationary end of the combustion chamber. piston head is the top surface (closest to the cylinder head) of the piston which is subjected to pressure fluctuation, thermal stresses and mechanical load during normal engine operation. By the forces of combustion, piston reciprocates inside the cylinder bore. In order to increase the efficiency of operation and better functionality, the piston material should satisfy the following requirements:

Light weight

Good wear resistance

Good thermal conductivity

High strength to weight ratio

Free from rust

Easy to cast

Easy to machine

Non magnetic

Non toxic

Piston should be designed and fabricated with such features to satisfy the above requirements.

A recessed area located around the circumference of the piston is used to retain piston ring. These rings are expandable and split in type.

They are used to provide a seal between piston and cylinder wall. Three such rings employed in a diesel engine are

1. Compression ring

2. Wiper or second compression ring

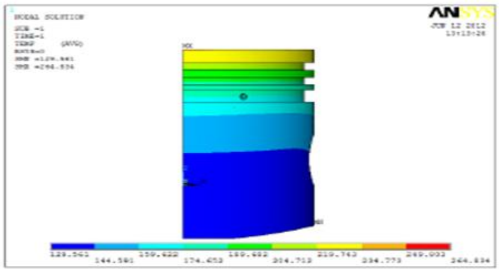
3. Oil ring

IV. RESULTS

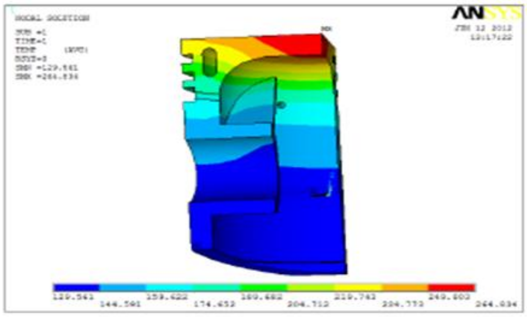
Thermal Stress Analysis to the Piston. The temperature field analysis to the piston is as shown in Figure 3 and Figure 4. Through the analysis, we can get that the temperature field distribution is basically reasonable. Then carry out a thermal stress analysis according to the temperature field of the piston. In the thermal stress analysis, it is necessary to convert thermal units within ANSYS to structural units and thermal units of solid 70 to structural units of solid45. After conversion, the thermal stress analysis can be carried out .

During the thermal stress analysis, it is necessary to make sure that no rigid body displacement will occur to the model. So it is necessary to carry out constraint to the piston in every direction, and the constraint applied cannot bring in additional mechanical load. The applied temperature load during the thermal stress analysis is the temperature load when the result for the temperature field automatically converts to nodes.

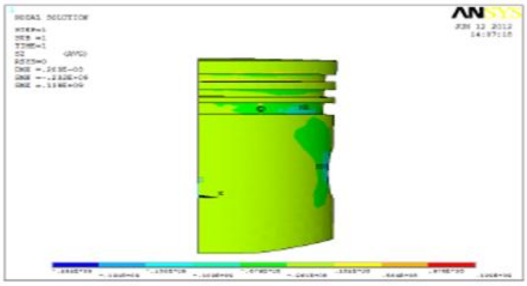
Because the mode is 1/4 model, it is necessary to apply the symmetry constraint to sections XZ and YZ, constrain the displacement in Z direction andconsidering the actual condition, apply constraint in Z direction within the piston pin boss. With the application of the aforesaid loads, carry out the thermal stress analysis to the 1/4 model of the piston with the definite-element software, thus obtaining the thermal stress distribution nephogram of the model, as shown in Figure 4.



Temperature Field At The External Surface OfThe Piston



Temperature Field Within The Piston



Thermal Stress Nephogram At TheExternal Surface Of The Piston In The Direction Of ZAxial

V. CONCLUSION

With heat stress and stress analysis of the piston, we can get stress Distribution and state of deformation of each of the piston. maximum thermal stress of the piston 139MPa and the maximum stress is 16.6MPa. The maximum distortion under the influence of heat stress is 0.166mm and 0.0324mm maximum effect distortion under mechanical pressure. with the Thermal mechanical coupling analysis, we can get the maximum pressure on the piston 62.2MPa, 0.132mm maximum deformation, and compression and distortion both within the allowable range, so that the insurance piston. deformation and pressure primarily on the temperature of the piston is determined, it is necessary to reduce the degree of heat from the piston through improving the structure, for example, using a piston with a small thermal conductivity and high coefficient of thermal conductivity of the skirt and the inner cylinder

VI. REFERENCES

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