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REVIEW ON DESIGN AND ANALYSIS OF IC ENGINE CONNECTING ROD

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Abstract - *The Connecting Rod is one of the main parts of internal combustion engine. The main function of connecting rod is to transmit the power. Connecting Rod is designed for the purpose to transmit the power from the engine to the shaft and to convert reciprocating motion into rotary motion. Therefore, the strength together with fatigue and high temperature resistance of the material become important parameters for completing the designing process of the connecting rod. The main objective of this work is to modify the existing design. Modification is being done by changing in material composition. Material uses in this study are Aluminum, Aluminum alloy, Aluminum alloy with titanium coating. Different materials and their alloys are being tested and compared to generate the final result to design connecting rod with upgraded material and enhance mechanical properties.*

Key Words: **Connecting rod, Aluminium alloy connecting rod, Analysis of connecting rod**

1. INTRODUCTION

The connecting rod is the link between the piston and the crank shaft. Its main function is to transmit the to and fro motion from the piston pin to the crank pin because it is rigid, and thus convert the reciprocating motion of the piston into rotary movement of the crank. It consists of a long shank, a small end and a big end. The cross section of the shank may be rectangular, circular, tubular, I-section or H-section. Generally circular section is used for low speed engines while I-section is preferred for high speed engines.

The connecting rod is under tremendous stress or pressure due to the reciprocating load of the piston which increase with every rotation and engine speed. Various forces acted on the connecting rod are as follows

1. Inertia force acting on the piston due to gas pressure
2. Bending stress due to the inertia acting on the connecting rod
3. The Force acts due to friction between piston pin and crank pin bearing

Thus the Connecting Rod must be hard and tough enough to withstand all these forces at high speed and temperature.

1.1 DESIGN OF CONNECTING ROD

The following dimensions are required to be determined to design a connecting rod:

1. Dimensions of cross-section of the connecting rod,
2. Dimensions of the crankpin at the big end and the piston pin at the small end,
3. Size of bolt for securing the big end cap, and
4. Thickness of the big end cap

2. MATERIALS USED FOR CONNECTING ROD

Connecting rods are fabricated mainly by two methods drop forging operation and molding operations. The steel forging process fabricate a light weight but more costly connecting rods. Malleable or spheroidal-graphite iron casting or sinter forgings process are being used to produce small to medium sized IC engines. Steel connecting-rod uses a bronze or brass small-end bush with a detachable large-end shell bearing is of white metal. The problem face in using steel is that they are extremely heavy and as a result consume more power result in more stresses. Aluminum alloy is also employed for connecting-rods ocassionally. The aluminum alloy connecting rods are advantageous on steel connecting rods as they are lighter in weight and both small-end and big-end bearings can be directly bored into the parent metal of rod and need not be disjoined. Babbitt lining bearing are used for gas engine of small, light duty purpose and bearing with copper-lead lining is used in compression Ignition engines.

3. FALIURE OF CONNECTING ROD

Connecting Rod fails for any of the reasons. The rod is expanded and compressed at every stage. The rod break due to this pressure and other responsible factors. The deformed rod can completely block the engine, ruining the engine condition known as “throwing a rod.”

3.1 Fatigue

Fatigue is the main cause of broken connecting rods mainly in older engines. The constant compression during the power stroke and stretching during the exhaust stroke, over thousands of times a minute, eventually wears the metal out and it gets brittle and eventually stops.

3.2 Pin Failure

Piston pin or gudgeon pin connects the connecting rod to the piston. A lot of wear is acting on piston pin. Due to walkover of this pin the connecting rod disconnected to the engine. For some engines this results in catastrophic engine failure--the connecting rod goes through the engine block or the crankshaft is bent--but in some engines it causes a heavily loss of power.

3.3 Over Revving

Over revving is the primary reason of connecting rod failures in new and high performance engines. If the tachometer hits the red--even briefly--the connecting rods are in peril of falling apart. This is because the forces acting on a connecting rod increase dramatically at high revolutions. It does not count if the tachometer is going into the red because the auto is traveling at a high fastness.

3.4 Hydro lock

Hydro lock is a distortion of the connecting rod caused when water gets into the piston chamber. This usually occurs after the automobile has been pushed through deep water, such as a flooded street.

4. LITERATURE SURVEY

Various research papers are studied to find the new method and new area of study that increases the efficiency, performance and life of connecting rod. So various design are studied to reach the appropriate conclusion.

B. Anusha et al [1] presented work on " Comparison of materials for Two wheeler Connecting Rod using ANSYS. The modeled connecting rod imported to ANSYS software for analysis. Analysis is done to determine von misses stresses, shear stresses and strain. In this study two materials are selected and analyzed. The result is helpful and utilize in designing the connecting rod.

Singh [2] had conducted a study in which the conventional material of connecting rod i.e. steel or cast iron is replaced with composite material (E-Glass/Epoxy). By using FEA method von misses stresses, distortion and other effective parameters are ascertained. There was reduction of 33.9% of stresses when comparing with present material replaced with (E-Glass/Epoxy).

Leela Krishna Vegi [3] had carried out a study in which the present material of the connecting rod is replaced by forged steel material. By comparing both the material on ANSYS the result indicates the factor of safety and stiffness increases comparable to carbon steel connecting rod. Also, there is a reduction in weight and an increase in life cycle of connecting rod having forged steel material.

Ramakrishna and Venkat [4] had carried out a study of connecting rod of petrol engine of LML freedom. The work focused on optimization of the material in which current 4340 alloy steel connecting rods are replaced by AlSiC 9 results in a 61.65 % reduction in weight.

A. Prem Kumar [5] had carried out a study in which the present material Al 6061 is replaced by Al 6061 + B4C. When compared with present material, Al 6061 + B4C have lower deformation and also sustain a low Von misses strain. Thus result in high hardness.

Bin Zheng, Yongqi Lou and Ruixiang Liu [6] had carried out a study in which the material utilized for connecting rod in small commercial vehicle is 40Cr. It was analysis that maximum compression condition increases and factor of safety of connecting rod increases by 59%.

K. Sudershan Kumar et al. [7] "Modelling and Analysis of Two Wheeler Connecting Rod," In this paper connecting rod material is replaced by Aluminium coated with Boron carbide. A model is design by using PRO-E software and analysis is done on ANSYS software.

G. Naga MalleshwaraRao et al. [8] "Design Optimization and Analysis of a Connecting Rod using ANSYS" The aim of this work is to find opportunities for weight reduction by analyzing various material like Genetic Steel, Aluminium, Titanium and Cast Iron.

Prof. Vivek C. Pathade (2013) [9] worked on the stress analysis of connecting rod by Finite Element Method using Pro/E Wildfire 4.0 and Ansys Workbench 11.0 software. Experimental method of Photoelastic is used for comparison and verification of the results obtained in FEA.From the FEA and Photoelastic Analysis he found that the stresses induced in the small end of the connecting rod are higher than the stresses induced at the big end. It is also found from the photoelastic that the stress concentration effect exist at both small end and big end and it is negligible in the middle portion of the connecting rod. Therefore, the connecting rod fails may be at fillet section of both ends.

G. M. Sayeed Ahmed [10] worked on "Design Fabrication and Analysis of a Connecting Rod with Aluminium Alloys and Carbon Fibre" he replaced a forged steel connecting rod with Aluminium alloy and Carbon fibre. The Connecting Rod is modelled on Pro/E. Connecting rod of materials aluminium 6061, aluminium 7075, aluminium 2014 and carbon fibre 280 GSM are used and analysis is done.

Bagri & Telang [11] focus his work on optimization of shank fillet radius to reduce maximum equivalent von misses stress. In optimization it is found that shank fillet radius has big influence on the stress distribution on the shank portion of the connecting rod. Modal analysis is done with changed shank fillet radius and reduced deformation was observed in the model and compared with the initial model.

Others works are also reviewed in addition to above mention work as Serag et al. developed approximate mathematical formulae to define connecting rod weight and cost as objective functions. Prof. N.p.doshi "analysis of connecting rod using analytical and finite element method. Kuldeep B "Analysis and optimization of connecting rod using ALFASiC composites".

4. CONCLUSIONS

Connecting Rod play a vital role in the performance and power capacity of IC engine. Failure of connecting rod be limited by improving design or by improving material quality or by improving both the parameters. Performance of connecting rod can be improved by changing the material composition. Different materials have different properties and by alloying materials the desired properties can be achieve. Thus in this paper a literature review is done to formulate the methodology for further work.

REFERENCES

[1] B. Anusha, C.VijayaBhaskar Reddy, "Modelling and Analysis of Two Wheeler Connecting Rod by Using Ansys",. IOSR-JMCE, Volume 6, Issue 5, e-ISSN: 2278-1684, May 2013.

[2] B. Anusha, C.VijayaBhaskar Reddy, "Comparison of Materials For Two Wheeler Connecting Rod Using Ansys," International Journal of Engineering Trends and Technology, Volume Issue 9- Sep 2013.

[3] Ramanpreet Singh, "Stress analysis of orthotropic and isotropic connecting rod using finite element method," International Journal of Mechanical Engineering and Robotics Research, 2, 2013.

[4] Leela Krishna Vegi, "Design And Analysis of Connecting Rod Using Forged steel," International Journal of Scientific & Engineering Research, Volume 4, Issue 6, June-2013 ISSN 2229-5518.

[5] A. Prem Kumar, "Design and Analysis of Connecting Rod by Composite Material," IJRDO- Jornal of Mechanical And Civil Engineering. Volume- 1, Issue- 7, July 2015.

[6] Repgen, B., 1998. "Optimized Connecting Rods to Enable Higher Engine Performance and Cost Reduction," SAE Technical Paper Series, Paper No. 980882.

[7] K. Sudershn Kumar, Dr. K. Tirupathi Reddy, Syed AltafHussain" Modeling and Analysis of Two Wheeler Connecting Rod" International Journal of Modern Engineering Research Vol.2, Issue.5, Sep- Oct. 2012 pp3367-3371.

[8] Balasubramaniam, B., Svoboda, M., and Bauer, W. Structural optimization of I.C. engines subjected to mechanical and thermal loads. Comput. Meth. Appl. Mech. Engrg, 1991, 89, 337–360

[9] Ram Bansal, "Dynamic simulation of connecting rod made of aluminum alloy using finite element analysis approach", IOSR Journal of Mechanical and Civil Engineering, Volume 5.

[10] Pranav G. Charkha and Dr. Santosh B. Jaju "Analysis and optimization of a connecting Rod" Second International Conference on Emerging Trends in Engineering and Technology, ICETET-09.

[11] Pravardhan S. Shenoy and Ali Fatemi "Connecting Rod Optimization for Weight and Cost Reduction", the University of Toledo SAE International 2005-01-0987, 2005.

[12] Ram Bansal "Dynamic Simulation Of A Connecting Rod Made of Aluminum Alloy Using Finite Element Analysis Approach" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e- ISSN: 2278-1684 Volume 5, Issue 2 (Jan – Feb. 2013),

[13] Nagaraju K L and Chandan R, "Buckling analysis of connecting rod", IRJET ISSN 2395-0056, Vol 3, Issue 8, 2016, pg 1358-1361.

[14] Afzal, A. and A. Fatemi, 2004. "A comparative study of fatigue behavior and life predictions of forged steel and PM connecting rods". SAE Technical Paper.

[15] Pranav G. Charkha and Dr. Santosh B. Jaju "Analysis and optimization of a connecting Rod" Second International Conference on Emerging Trends in Engineering and Technology, ICETET-09.