Experimental Investigation of Laser Surface Texturing on Piston Ring for Reduction of Friction of a Four Stroke Single Cylinder Si Engine Fuelled With CNG

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Abstract—In this research work, the surface micro structure of piston rings is changed by Laser Surface Texturing method, in order to change wear resistant. Piston Ring with full Laser Surface Texturing will be compared to base data say Un-textured Piston Rings. Average percentage of Reduction in Friction is 31.94% by using Laser surface texturing piston ring.

Key words: Bi-fuel engine, Laser surface texturing, LST, Piston ring, Friction

I. INTRODUCTION

Petrol engine has gained the name and fame in serving the society in many ways. Its main attractions are ruggedness in construction, fuel efficiency of 60 km/lit. to 65 km/lit., simplicity in operation and ease of maintenance. Small petrol vehicle enjoy the market share more than 65% for domestic, commercial, agriculture and family passenger vehicles purpose. So it is preferable to select piston ring system of same vehicle for study of piston ring assembly friction in single cylinder engine system.

But due to friction, we may not be able to avail its services for long time. Hence efforts are being made all over the world, to reducing the friction between the parts in petrol engine. The friction loss in an internal combustion engine is the most important factor in determining the fuel economy and performance of the vehicle utilizing the power of the engine. Approximately 50% of the friction losses in an internal combustion engine are due to the piston/cylinder system, of which 70–80% comes from the piston rings.

II. LASER SURFACE TEXTURING (LST)

Proper lubrication and surface texture are key issues in reducing friction in a piston/cylinder system and, hence have received great deal of attention in the relevant literature. Surface texturing as a means for enhancing tribological properties of mechanical components is well known for many years. Perhaps the most familiar and earliest commercial application of surface texturing in engines is that of cylinder liner honing. Surface texturing in general and laser surface texturing (LST) in particular has emerged in recent years as a potential new technology to reduce friction in mechanical components.

In this work, the surface micro structure of piston rings is changed by Laser Surface Texturing method, in order to change lubrication regime of surface, and wear resistant. Piston Ring with Full Textured and the friction data will be compared to base data say Un-textured Piston Rings.

Fig. 1: Piston Ring with Laser Surface Texturing

III. TEST RIG DESCRIPTION

A special experimental set-up was developed at laboratory scale to measure piston ring assembly friction of single cylinder petrol engine system indirectly by measurement of Friction power consumption under different operating parameters i.e. speed & ring geometry. In the fabrication of laser surface piston ring assembly friction measurements test rig, 4-stroke Single cylinder, air cooled, pulsar 150cc petrol engine is used (Figure 2). Here dynamometer is used for measuring force: moment of force (torque), or power of engine. The test engine is converted into the CNG fuelled SI Engine. The CNG fuelled engine set up along with CNG kit components is shown below:

Fig. 2: Experiment set up of SI Engine converted to CNG Engine

In this set-up following components are to be fitted to convert the SI engine into CNG engine. These components are as CNG filling Valve and Cylinder Valve, CNG Cylinders, High Pressure Pipe, Solenoid Valve, CNG...
As per literature review, friction losses at piston cylinder assembly system is maximum, means power consumption with this piston cylinder assembly system will also be maximum in comparison to the other friction generating system power consumption. Thus it is important to understand the contribution of frictional power loss by piston ring at different speed under normal and laser surface texturing piston ring, following results are derived.

IV. EXPERIMENTAL METHODOLOGY

The experimental work is carried out on developed single cylinder L.C engine test rig under different variable i.e. speed & ring geometry. In this experimental work williams line method is used. It is generally adopted to get the first impressions about frictional losses of single cylinder engine. One the base line data is measured for the normal piston ring of engine. In this method, gross fuel consumption vs. brake power at a constant speed is plotted and the graph is extrapolated back to zero fuel consumption. The point where this graph cuts the brake power axis is an indication of the friction power of the engine at that speed. Test started at 300 rpm and readings are taken at different rpm as 700, 1500, 2100, 2700, and 3000. Initially the system is to be run for at least 5 to 10 minutes, so that the system gets stabilize and the lubricating oil can reach properly up to the surface of piston ring and cylinder liner.

After getting the stable condition, dynamometer records the actual power consumed by the system, rpm by the tachometer. Now for the next measurement tachometer is used to change the rpm of the system. During the changing there is no need to switch off the power. Record all the measurements in the observation sheet and plot the graphs of Specific Fuel Consumption v/s. Brake Power.

V. RESULTS AND DISCUSSION

Following major observations are derived from the plotted graph.

- Percentage of Reduction in friction is decreases with speed from 300 rpm to 1500 rpm.
- Max. Percentage of Reduction in friction at 2100 rpm
- Speed [intermediate speed].
- Min. Percentage of Reduction in friction at 1500 rpm.
- Average percentage of Reduction in friction is 31.94% by using Laser surface texturing piston ring.

REFERENCES

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