HEAT BALANCE SHEET ONMULTI CYLINDER PETROL ENGINE

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ABSTRACT

An IC engine is used to produce mechanical power by combustion of fuel. Power is referred to as the rate at which work is done. Power is expressed as the product of force and linear velocity or product of torque and angular velocity. In order to measure power one needs to measure torque or force and speed. The force or torque is measured by Dynamometer and speed by Tachometer. The power developed by an engine and measured at the output shaft is called the brake power.While calculating brake power for single cylinder engine it is easy but in case of multi cylinder engine its quite difficult because of the inertia forces developed.In such cases the Morse test can be used to measure the indicated power and mechanical efficiency of multi cylinder engines.

Keywords: IndicatedPower, Brake Power, Mechanical Efficiency, Dynamometer, Constant Speed.

1. INTRODUCTION

The purpose of Morse test is to obtain the approximate indicated power of a Multi cylinder engine. It consist of running the engine against the dynamometer at a particular speed, cutting out the firing of each cylinder in turn and noting the fall in BP each time while maintaining the speed constant. When one cylinder is cut off, power developed is reduced and speed of engine falls.Accordingly the load on dynamometer is adjusted so as to restore the speed of the engine. This is done to maintain FP constant, which is considered to be independent of the load and proportional to the engine speed. The observed difference in BP between all cylinder firing and one cylinder cut off is the IP of the cut off cylinder. Summation of IP of the entire cylinder would then give the IP of the engine under test.The Morse Test is performed to find the power developed in each cylinder in a multi cylinder internal combustion engine. It basically gives the relationship between indicated power and brake power. It is assumed that friction and pumping losses do not change and remains same when the cylinder is in firing condition as well as in inoperative condition. Using these test frictional losses in the IC engine can be easily calculated. It is a simple approach to find the mechanical efficiency of the engine. First power developed by all the cylinders is determined experimentally. Then using the power supply cut off to the spark plug of cylinder, powers developed by individual cylinders are determined. Then for the remaining cylinders, power developed by engine is determined experimentally and obtained value is subtracted from the first value and this gives power developed in the cylinder whose spark plug was cut off. In the similar fashion, this test is performed on all the cylinders of the engine individually.The main intention of carrying out the Morse test in an IC engine is to provide an easy method of calculating the frictional losses. It provides a kind of top-down approach in calculating frictional losses easily and helps calculate mechanical efficiency.The total break power of the engine is first calculated using a dynamometer.The process is repeated with one cylinder off at each step. This the difference between total break power and break power of the remaining cylinders gives the indicated power of the first cylinder; and so on.In this way, indicated power of all cylinders are calculated and summed to obtain the indicated power of the engine Friction power = indicated power - total brake power. Once friction power is obtained, the mechanical efficiency of the engine can be calculated.

2. LITERATURE REVIEW

Professor R. S. Benson, MSc, PhD, DSc, CEng, Fimeche, (Eng.), P. C. Baruah, BME, MSctech, PhD, (Eng.),"Performance And Emission Predictions For A Multi-Cylinder Spark Ignition Engine."

A comparison is made of experimental results and predictions of performance and emissions from a multi-cylinder spark ignition engine over a range of air-fuel ratios and two throttle settings. The results showed that a simplified two zone combustion model, a seven reaction scheme for nitric oxide formation, a partial freezing model for carbon monoxide and the inclusion of chemical reactions and variable specific heat along the path lines in the wave equations gave good agreement with the measurements at the common pipe junction and exhaust outlet, but due to cyclic dispersion and misdistribution of fuel between cylinders the predictions of the emissions in the exhaust manifold adjacent to the cylinder were not so good.
The predicted air flow and indicated power agreed well with experiment

.Citation:*Proceedings of the Institution of Mechanical Engineers* Vol. 191, Issue 1, pp. 339 – 354
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- **Abdalla, M., "Cut-Off Control: A Promising Method of Load Regulation in Spark Ignition Engine,"**

This paper presents a theoretical and experimental study of the effect of cut-off control on engine performance. Cut-off control is an alternative method of load regulation in spark ignition engine. During cut-off operation, the charge is admitted at wide open throttle; hence the inlet charge passage is to be shut down before the completion of intake stroke. Cut-off is to be attained by means of an additional rotary valve mounted in series with the conventional inlet valve. The study indicates that cut-off control can provide a significant improvement in fuel economy. The effect of some important design parameters is also considered.

Citation: SAE Technical Paper 940202, 1994, doi: 10.4271/940202.

- **Dyer, T., "New Experimental Techniques for In-Cylinder Engine Studies,"**

A wide variety of new experimental diagnostic techniques have been developed to more fully characterize the physical and chemical processes occurring in an IC engine. The advent of lasers has spurred interest in the development and application of optical techniques for nonperturbing, in situ measurements of temperature, species concentration, velocity and turbulence. These supplement and expand the capability of those classical techniques that are reviewed in a companion paper. The new diagnostics are categorized according to the particular part of the engine cycle under investigation: precombustion fluid motion, fuel preparation, combustion, and emission formation. Current applications of each technique to engine experiments are surveyed and put into the perspective of resolving critical issues facing the engine design community.

Citation: SAE Technical Paper 850396, 1985, doi: 10.4271/850396.

- **Mitsuhiro Soejima.Yutaro Wakuri.Yoshito Ejima. "Studies on the measuring method of the total friction loss of internal combustion engines"**

In the given study a new test method is investigated to measure the total friction loss of engines over the whole range of speed and load. It is based on the idea that the friction loss close to the true one of fired and braked engines can be measured by the run-out method because the temperature mainly influencing the friction loss is almost stable for the short runout test duration.

Citation: Masahiko Nakada
Trends in engine technology and tribology
Tribology International, 1994, pp. 3-8

- **A Chow, M. L. Wyszynski, "Thermodynamic modeling of complete engine systems-a review"**

This paper gives an overview of engine systems modelling by first and second law analysis. Complex engine systems are becoming more commonly implemented to meet the increasing demands of fuel efficiency and emission legislation. Future engine systems may also include both exhaust gas treatment and fuel processing devices. This leads to complex interactions within the thermodynamics and chemistry of powerplant systems. There is therefore a need to improve the systems modelling methods. This concerns first of all the composition tracking and the models of three-way catalytic exhaust converters and fuel processors. The applicability of gas dynamics modelling to chemically complex systems is also discussed. All these processes need to be modelled as interacting parts of one system.

Citation: *Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering* Vol. 213, Issue 4, pp. 403 – 415 first published date: December-01-2005

- **G. Rizzoni Dept. of Electr. Eng. & Comput. Sci., Michigan Univ., Ann Arbor, MI, USA,"Estimate of indicated torque from crankshaft speed fluctuations: a model for the dynamics of the IC engine."**

It described contribution made in this task of constructing a global model for the IC (internal combustion) engine. A robust sub model is formulated for the dynamics of the IC engine, where-in the engine is viewed as a system with input given by cylinder pressure and output corresponding to crankshaft angular acceleration and crankshaft torque. The formulation is well suited to closed-loop engine control and transmission control applications. In the model, cylinder pressure is deterministically related to net engine torque through the geometry and dynamics of the reciprocating assembly. The relationship between net engine torque and crankshaft angular acceleration is explain in terms of a passive second-order electrical circuit model with constant parameters. Experimental results confirm the validity of the model over a wide range of engine operating conditions, including transient conditions. It is concluded that the model provides a powerful tool for estimating average and instantaneous net engine torque based on an inexpensive no contacting measurement of crankshaft acceleration, thus providing access to one of the primary engine performance variables.

Citation: Published in: IEEE Transactions on Vehicular Technology (Volume: 38, Issue: 3, Aug 1989) Page(s): 168 – 179 Date of Publication: 06 August 2002 INSPEC Accession Number: 3606542 DOI: 10.1109/25.45470

- **WANG Xiao ZHANG Baohuai(College of Energy & Environment Science, Southeast University, Nanjing 210096)** ,"**Development of the Measuring and Controlling System of Heat Exchanger Performance Testing Equipment Based on Lab VIEW"**

The principle of software of measuring and controlling system for heat exchanger testing equipment based on Lab VIEW software development platform are introduced, and the composition of system software and hardware and the work process are described. Several function modules including real time measurement, recording, analysis and regulation, are integrated in the software package. It collects data of temperature, pressure and flow rate via computer serial communication ports connected with all testing equipment under the control of computer during testing process, displays data on computer touch-screen after being analysed and calculated, and outputs from computer output cards for the regulation of test parameters. The operator can operate and control equipment's via computer touch-screen. Powerful function software reduces the number of peripheral equipment and makes system simple and reliable. The results of tests show that the system features high-precision measurement and control good reliability, high automation and good manoeuvrability, so it is worth using widely in various test systems of energy and chemical industries.

Citation: JIN Zhen hua ,LU Qing chun, NIE Sheng fang (Tsinghua University, State Key Laboratory of Automobile Safety and Energy Conservation, Beijing 100084, China);Development of Data Acquisition and Processing System for Diesel Injection Pump Performance Test-bed[J];Vehicle Engine;2001-03

- **S.P. Vendan, T. Sathish, S. Sathishkumar Department Of Mechanical Engineering, Psg College Of Technology, Coimbatore, India, "Reduction Of Fuel Consumption In Multicylinder Engine By Cylinder Deactivation Technique"**

Study on the four strokes Spark Ignition (SI) engine's the main reason for efficiency decrease at part load conditions for these types of engines is the flow restriction at the cross sectional area of the intake system by partially closing the throttle valve, which leads to increased pumping losses. This can be rectified by implementation of cylinder deactivation in four cylinder SI engine by developing proper control system.

- **Mistry, C. And Gandhi, A., "Experimental Investigation On Multi-Cylinder Engine Using Petrol And LPG As A Fuel,"**

Today's changing social and industrial scenario demands extensive use of fuel in vehicles which may lead to its depletion in near future. In view of the possible depletion of fossil fuel reserves, research is being done on various alternative fuels including renewable and nonrenewable resources. In the present study, experiments have been conducted on a conventional multi-cylinder engine, which was modified to work on a duel fuel mode with LPG and petrol as fuels. Engine testing was carried out at variable speed and load using both the fuels. For the measurement of friction power loss Morse test was carried out. In order to measure the unaccountable losses heat balance sheets were prepared.

Citation: SAE Technical Paper 2004-01-1653, 2004, Doi:10.4271/2004-01-1653.

- **Mistry, C., "Comparative Assessment on Performance of Multi cylinder Engine Using CNG, LPG and Petrol as a Fuel,"**

It is the explanation of study experiments that had been conducted on a conventional multicylinder MARUTI make) engine, which was modified to work on a dual fuel mode with CNG, LPG and petrol as fuels. Results of comparative tests involving spark ignition engines over a wide range of operating conditions are presented and discussed. Some of the performance characteristics considered are those relating to power output, friction power, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, fuel consumption, specific fuel consumption heat balance etc. were studied at constant speed and variable load conditions. Finally, the relative operational aspects of two fuels are evaluated. It is then suggested that in this regard, LPG has some excellent physical, chemical and combustion characteristics that make it as a preferable fuel.

Citation: SAE Technical Paper 2005-01-1056, 2005, doi: 10.4271/2005-01-1056.

3. SUMMARY

It becomes easy to calculate the performance of the Multicylinder IC engine with the help of Morse test. In future it may be most useful engine testing technique over any other because of the increase in the use of high speed vehicles and the high speed vehicles mainly contains the Multicylinder engines. Slow speed vehicles are going to escape very soon as every consumer demands the high speed vehicle. And the manufacturers also like to produce the Multicylinder engines. In that case for the testing of Multicylinder engines, Morse test will be more useful.

4. CONCLUSION

After performing the Morse test we can conclude that it is the most useful engine test to calculate the performance of the engine mainly the Multicylinder engines and in future the use is going to increase and it is very easy to calculate the performance of the engine. We can calculate the individual power developed by the engine cylinders separately and total indicated power is also calculated .we can also calculate the brake horse power of the engine It is also very easy to calculate the frictional losses of each cylinder.

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