A REVIEW OF TESTING OF MULTI CYLINDER S.I. PETROL ENGINE

Prof. Bhushan Mahajan[1], Tausif Ansari[2], Navaz Sheikh[3], Sagar Sadafal

[1]*Professor, J.D. C.O.E.M, Nagpur.*
[2,3,4]*Student, J.D. C.O.E.M, Nagpur.*

Abstract - *The basic task of the development engineer is to reduce the cost and improve power output and reliability of the engine. Trying to achieve these goals there is various design concepts to find the effects on engine performance of a particular design concept to resorts to testing. Thus, in general, developments of engine will have to conduct a wide variety of engine tests. 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: Indicated Power, 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.

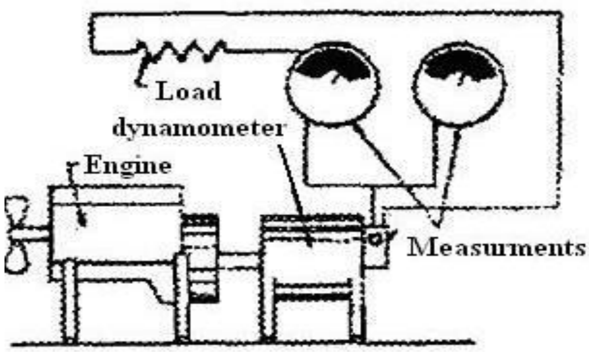

Fig 1. Testing Of Engine.

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.

1.1 Dynamometer.

Fig 1.1 Dynamometer

A **dynamometer** or **"dyno"** for short is a device for measuring force, torque, or power. For example, the power produced by an engine, motor or other rotating prime mover can be calculated by simultaneously measuring torque and rotational speed (RPM).

In addition to being used to determine the torque or power characteristics of a machine under test, dynamometers are employed in a number of other roles. In standard emissions testing cycles such as those defined by the United States Environmental Protection Agency, dynamometers are used to provide simulated road loading of either the engine (using an engine dynamometer) or full powertrain (using a chassis dynamometer). In fact, beyond simple power and torque measurements, dynamometers can be used as part of a testbed for a variety of engine development activities, such as the calibration of engine management controllers, detailed investigations into combustion behavior, and tribology.

2. LITERATURE REVIEW

2.1 Professor R. S. Benson, has investigated the Performance and Emission Predictions for a MultiCylinder 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.

2.2 Dyer, T., has given a 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 no perturbing, 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

2.3 Mitsuhiro Soejima.Yutaro Wakuri.Yoshito Ejima. Have done a Study 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.

2.4 A Chow, M. L. Wyszynski, have made a Thermodynamic modeling of complete engine systems review. This paper gives an overview of engine systems modeling 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 power plant systems. There is therefore a need to improve the systems modeling 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.

2.5 Abdalla, M., have investigated a "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.

2.6 Misty, C. And Gandhi, have done an., 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.

3. FUTURE SCOPE

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. In future this manual test rig can be computerized using software's which would be operator friendly. Modifications can be made for Morse test and also for specific Fuel consumption which can be measure by volume difference or by weight difference. Radiator can be eliminated with direct connection. And flow meter is required to measure mass and flow of exhaust gas

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.

The complete design of each component has been discussed in detail and the same details are used for fabrication. The trail is carried on the engine and various performance parameters such as Break thermal efficiency, mechanical efficiency and heat balance at various load conditions.

1. As brake power increases fuel consumption also Increases

2. Brake specific fuel consumption decreases with Increase in brake power

3. Exhaust temperature increases as brake power Increases

4. As brake power increases both brake thermal efficiency and mechanical efficiency increases our project might be have some its own limitations but an effort has been made to the fullest to make it successful.

5. Other than this theoretical view, in a real life scenario, the performance, comfort and fuel efficiency of a car depends on many other factors starting from the aerodynamics to the passenger weight.

6. There is no generalization that all three cylinder ones are fuel efficient and all four cylinder ones are better to drive.

7. It depends on many other factors like the manufacturer, engine refinement, quality components, and performance of the subsystems ET

5. REFERENCES

1. Gamelan, V (2012). "Internal Combustion Engine". McGraw Hill Education (India) Pvt. Ltd.

2. Raj put, R K. Thermal Engineering. Laxmi Publications. p. 1125. ISBN 9788131808047. 3. "I C Engine Testing" (PDF). Retrieved 20111022. 4. A Text Book of Automobile Engineering – R.K. Raj put – Google Books. Books.google.co.in. 20070101.ISBN 9788170089919. Retrieved 20111022.

5. The Internalcombustionngine in ... – Charles Fayette Taylor – Google Books. Books.google.co.in. 19850101.ISBN 978026270027

6. Retrieved 20111022. 6. "Methodology for Thermal Efficiency and Energy Input Calculations and Analysis of Biomass Cogeneration Unit characteristic's" (PDF). U.S. Environmental Protection Agency Office of Air and Radiation. Retrieved 20111022.

7. Ricardo, H.R, 1958. ―The high speed internal combustion engine‖, blackie&sons Ltd., London.

8. Rogowski, A.R, 1961. ―Method of measuring the instantaneous friction of piston and friction of piston ring in affirming engine‖, SAE, paper no. 379F.

9. Taylor, C.F., 1966. ―The internal combustion engine in theory and practice‖, The M.I.T. Press, Cambridge, Mass.

10. Willard, W.P., 2011 ―Engineering fundamentals of the internal combustion engine‖, PHI, New Delhi. 1) James D.Vaghmashi1 Mr.D.R.Shah2 Mr.D.C.Gosai3 - An Experimental Study of Petrol Engine Using Compressed Biogas as fuel - IJSRD Vol. 2, Issue 04, 2014 ISSN (online): 2321-0613

11. N. BalajiGanesh1,Dr. B Chandra Mohan Reddy2 - Performance Analysis of Multi-Cylinder C.I. Engine by using Various Alternate Fusel- Tijeras Volume 2,Issue 4, June-July, 2014 ISSN 2091-2730

12. SavitaPatil 1, Rupees Kumar Malviya2, Auber Dwivedi3 -Investigation on Performance Characteristics of Petrol Engine Using Alternate Fuel - IOSR e-ISSN: 2278-1684,p-ISSN: 2320- 334XIssue 4 Ver. V (Jul- Aug. 2014),

13. Adina T Folayan,"influence of engine parameter on performance characteristics of spark ignition engine", Pelagic research (200 8) pp1915-1922.

14. Ganeshan.V "Internal Combustion Engines",7 Tata McGraw Hill Publishing, New Delhi, 2002.

15. A Text Book on "Internal Combustion Engines" by Domkundwar

16. E.porpatham, A. Ramesh, B. Nag lingam (2011) Effect of compression ratio on the performance and combustion of a biogas fuelled spark ignition engine journal homepage: www.elsevier.com/locate/fuel

17. Hey wood John's, "Internal Combustion Engineers Fundamental", Mc. Grew Hill Book Company, New Delhi, 1988.

18. Carl S. Hansen, Coyly Hansen, Greg Sullivan, "Using Biogas as a Fuel for Trucks and Tractors", paper number: 074145, ASABE Meeting at Minnesota during 17 - 20 June 2007

19. C.C.M. Lucite, E. Kerchief, "Atrophic oil and biogas In a dual fuel CI engine for rural electrification ", Energy Conversion and Management 52 (2011) 1426–1438

20. R. Chandra, V.K. Vijay , P.M.V. Subarea , T.K. Kura, "Performance evaluation of a constant speed IC engine on CNG, methane enriched biogas and biogas ",Applied Energy xxx (2011)

21. A. S. Gautama, R .Garrick. J. H. Lee, C. M. Demise, P. E. Hanne and L. A.Villasmil, "A Comparison of the Emission from Gasoline vs. Compressed Natural Gas for an Electronic Fuel Injected Two Cylinder, Four- Stroke Engine" SAE Technical Paper 2012-32-0016, 2012.