EVALUATION OF THE PERFORMANCE AND EMISSION CHARACTERISTICS OF A HYDROGEN FUELED SI ENGINE USING CONCURRENT INDUCTION MECHANISM

by

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Dedicated to

my Parents

CERTIFICATE

This is to certify that the thesis entitled "Evaluation of the Performance and Emission Characteristics of a Hydrogen Fueled SI Engine Using Concurrent Induction Mechanism" submitted by Ashok Kumar Binjolkar to the Indian Institute of Technology, Delhi for the award of Doctor of Philosophy in Centre For Energy Studies, is a record of bonafide research work carried out by him under my supervision and guidance.

The thesis work in my opinion has reached the requisite standard, fulfilling the requirements for the said degree. The results contained in this thesis have not been submitted, in part or full, to any other university or Institute for the award of any degree or diploma.

18/4/13

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ABSTRACT

Spark ignition engines are being used in transportation sector all over the world. Petroleum fuels are being used in these engines, which result in release of severely harmful pollutants in environment. There is no substitute for these engines in near future, which is a cause of concern. Also fast depleting petroleum reserves necessitate the search for alternative clean burning fuel. The use of hydrogen in SI engine provides immense opportunity to solve these twin problems of energy crisis and environmental degradation. Therefore evolving a mechanism for operating SI engine on hydrogen under optimized conditions with an effective procedure for addressing safety problem associated with it, provides an viable contribution towards reduction in emission and dependency on petroleum fuel.

Hydrogen is considered an exceptionally clean fuel however, when it is used as a SI engine fuel it poses a problem of backfiring and also method of fuel induction into cylinder. The technique of fuel air mix formation and its induction is important for efficient and smooth engine operation over the entire range. After studying various fuel-air induction techniques, a necessity was felt to dwell upon a concurrent induction system with an aim of quality governing of hydrogen and air for simple and smooth operation with provision for safety. After analyzing all aspects of hydrogen fueled engine in detail, a improved concurrent induction system was design and develop with flame arrester for safety. The concept of flame arrester is based on a minimum experimental safe gap applicable to hydrogen gas to avoid flame propagation. The experimental set up was designed with an aim of simple, safe and reliable fuel system with less complicated components to avoid possible backfire.

In the present investigation, an effort has been made to study and obtain extensive experimental data of SI engine fueled with hydrogen on performance, combustion characteristics and exhaust emission. The investigations were conducted exhaustively over a very wide range of operating parameters.

It was found that SI engine when fueled with hydrogen shown remarkable advantage in brake thermal efficiency up to 60% load condition. At part load condition the thermal efficiency was observed higher as compared to gasoline. All observations were compared appropriately with baseline data obtain with gasoline and analyzed. The combustion analysis shows no abrupt pressure rise during the process. In the entire range of test the exhaust emission was very low particularly the NO_x emission.

On the basis of present investigation, it can be concluded that concept of improved concurrent induction system proved to be successful and easily adaptable. No undesirable combustion phenomenon has occurred during the complete investigation. The developed flame arrester ensured adequate safety in terms of preventing backfiring. The approach adapted in the investigation has tremendous potential for future application in transportation and other sector.

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