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Investigation of Flow Field Development in Di Diesel Engine with Different Intake Manifold (Review)

S. R. Bhende[1], P. M. Pandit[2], S. G. Latherkar[3], T. R. Mohod[4]

Student, Mechanical Engineering, JDIET, Yavatmal, India [1, 2, 3]

Professor, Mechanical Engineering, JDIET, Yavatmal, India [4]

Abstract: The aim of project is to design different types of inlet manifolds for the Internal Combustion Engine in order to create the turbulence by swirl. A good swirl promotes the fast combustion and improves the efficiency. The engine should run at low speeds in order to have low mechanical losses and fast combustion, enabling good combustion efficiency. Therefore to produce high turbulence prior to combustion within the cylinder, swirl induced by the inlet channel within the cylinder head will be helpful. In view this, experimental investigation has been carried out to find the effect of swirl on the performance of the engine as well as on its emissions, by inducing swirl with different inlet manifolds having helical, spiral and helical-spiral shapes. Detailed analysis has been carried out and discussion on the experimental results is presented in this project work. At the outset, it is inferred that, the helical-spiral inlet manifold gives better performance and yields less emissions compared to spiral, helical and normal inlet manifolds.

Keywords: Manifold, Helical-spiral shapes.

I. INTRODUCTION

The purpose of the master thesis project is both to evaluate the intake manifold and to develop feasible intake manifold concepts that have good prerequisites to be implemented in the final engine design. Many uncertainties are involved in the project and the designs should thereby take these uncertainties into account and allow us to make changes to the chosen concepts easily.

Swirl is one of the principal means to ensure rapid mixing between fuel and air in Diesel Injection diesel engine, and is used in gasoline engines to promote rapid combustion. In Diesel Injection diesel engine, as fuel is injected, the swirl converts it away from the fuel injector making fresh air available for the fuel about to be injected.

Helical ports are more compacted than normal manifold. They are capable of producing more swirl than directed ports at low lifts, but are inferior at higher lifts. Either design creates swirl at the expense of volumetric efficiency. In trying to optimize the port design for both good swirl and volumetric efficiency, current high swirl ports are in part of both directed and different technique inlet manifolds.

II. LITERATURE VIEW

Benny Paul, V. Ganesan et.al. [1] A study on the effect of helical, spiral, and helical-spiral combination manifold configuration on air motion and turbulence inside the cylinder of a Direct Injection (DI) diesel engine motored at 3000 rpm. Swirl inside the engine is important for diesel engine. Hence, for better performance a helical-spiral inlet manifold configuration is recommended.

P. Reddy, K. Rajulu and T. Naidu et.al [2] designing different types of inlet manifolds for the Internal Combustion Engine in order to create the turbulence by swirl. A good swirl promotes the fast combustion and improves the efficiency. The engine should run at low speeds in order to have low mechanical losses and fast combustion, enabling good combustion efficiency.

Christoph Garth, Robert S. Laramee et.al [3] An optimal combustion process within an engine block is central to the performance of many motorized vehicles. Associated with this process are two important patterns of flow: swirl and tumble motion, which optimize the mixing of fluid within each of an engine's cylinders

III. OBJECTIVE

- Describe the function of the air intake system in the engine and calculate required air flow.
- Evaluate and test the OEM intake system and thereby verify its capabilities.
- Develop new intake manifold concepts with increased performance.
- Test and evaluate the new concepts.
- Give recommendations regarding future air intake system configuration.

IV. WHY TO USE HELICAL SPIRAL MANIFOLD

The volumetric efficiency rates the effectiveness of the air induction process from the manifold to the cylinder and is another performance parameter. A well designed manifold

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and valve raises the volumetric efficiency, which implies that more air could reach the cylinder during the inlet stroke.
The principle of working is to ensure rapid mixing between fuel and air in diesel injection Diesel Engine and also use in gasoline engine to promote rapid combustion.
The induction swirl is generated either by tangentially directing the flow into the cylinder using directed ports or by pre swirling the incoming flow by use of a helical or spiral or helical-spiral ports. Helical ports are more compacted than normal manifold. They are capable of producing more swirl than directed ports at low lifts, but are inferior at higher lifts. Either design creates swirl at the expense of volumetric efficiency. In trying to optimize the port design for both good swirl and volumetric efficiency, current high swirl ports are in part of both directed and different technique inlet manifolds.

Firstly the air compressed in turbo pump and then passed through intercooler. Then this air entered into the plenum, when the plenum is completely filled, this air introduced into the runner of **HELICAL SPIRAL MANIFOLD.**

Fig. IV.I Helical shape

Fig. IV.II Spiral Shape

Now in these manifold, air become more turbulent due to helical spiral pattern of manifold's runner. The plenum increased volumetric efficiency while helical spiral structure increases the combustion rate.

Fig. IV.III Helical-spiral Shape

V. MATERIAL SELECTION

- High-heat-treatment fibres (HTT), where final heat treatment temperature should be above 200°C and can be associated with high-modulus type fibre.
- Intermediate-heat-treatment carbon fibres (IHT), where final heat treatment temperature should be around or above 150 ºC and can be associated with high-strength type fibre.
- Reinforced Plastic material.

VI. LIMITATIONS

- The material and manufacturing is expensive and not easily available.
- Simulation is hectic as compared to conventional intake manifold.
- The project is limited to cover the development of intake manifold concepts to fit with an air intake system.
- No designs are final as decisions could not be final this early in the project. The concept will meet the overall requirements.

VII. CONCLUSION

It is significant to note that concentration of oxides of nitrogen emissions was reduced 171 ppm observed at 2.5kW load for helical-spiral inlet manifold compared to normal inlet manifold. Further it can be noted from the graph that emissions of the engine NOx are far below the permissible levels of as per BS-III norms at all the loads.
The following conclusions were drawn on performance and emissions of single cylinder, four stroke, and watered cooled engine while running the engine with three different inlet manifolds.

All the three types of inlet manifolds helical, spiral and helical-spiral were found to yields much better performance in comparison with normal manifold.

1.The maximum enhancement in brake thermal efficiency, volumetric efficiency ,Brake specific fuel consumption, Brake mean effective pressure for spiral inlet manifold were found to be 3.4%, 1.65%, 15.20%, 23.58kN/m2 at 2.5kW load.

2.The maximum enhancement in brake thermal efficiency, volumetric efficiency ,Brake specific fuel consumption, Brake mean effective pressure for helical inlet manifold were found to be 5.23%, 9.88%, 22.08%, 42.25kN/m2 at 2.5kW load.

3.The maximum enhancement in brake thermal efficiency, volumetric efficiency ,Brake specific fuel consumption, Brake mean effective pressure for helical-spiral inlet manifold were found to be 8.22%, 4.32%, 22.08%, 81.17kN/m2 at 2.5kW load.

All the three types of manifolds considered by the present investigation yielded fewer amounts of emissions. To demonstrate the amount of reduction in emissions in comparison with normal inlet manifold are given below table at 2.5kw load.

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