Analysis of Air Flow in Intake System Using Computational Fluid Dynamics

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ABSTRACT

Air motion within the intake system is one of the important factors which govern the performance of an engine. Hence the flow phenomenon inside the intake system should be understood. The whole intake system of 1.3L twin venturi carburetor engine from air induct until manifold is modelled by SolidWorks and 3-D simulation is presented by using COSMOS FloWorks. Flow field velocity varying to engine speed is observed and is compared with theoretical result for validation. CFD simulation is also done in the filtering which the flow in a section of an intake system is considered resisted by a porous media. Besides that, steady state simulations have been accomplished to obtain the flow behavior due to the pressure loss for variation operating condition of idle speed, wide open throttle and sudden acceleration in the intake system. At last, comparison between the flow behavior in the first runner and second runner are observed. Finally, according to the simulation result, some suggestions are recommended to improve the performance of intake system.

INTRODUCTION

Air motion inside the intake system is one of the important factors, which governs the engine performance of multi cylinder SI engines. An intake system conveys drawn air from atmosphere into engine and mix with the fuel for combustion. The purpose of air intake system is to filter and measure the air into engine. Air is filtered by air filter and passed into the intake manifold in varying volume. The amount of air entering the engine is a function of throttle valve opening angle and engine rpm. Air velocity is increased as it passes through the long, narrow intake manifold runners and resulting in improved engine volumetric efficiency. The correct amount of air is very important for correct engine operation to provide maximum power. Hence the flow phenomenon inside the intake system should be fully understood in order to consider the current requirement of higher engine efficiency.

INTERNAL COMBUSTION ENGINE

Classification Engine

The simulation will be conducted on Proton Saga Magma 12 valve 4 Stroke engine and the engine classification is show in **Table 2.1**.

Table 2.1: Classification of Engine

Type of Classification	Specification
Cycle of operation	Otto cycle engine
Type of fuel used	Petrol engines
Method of charging	Naturally aspirated engines
Type of ignition	Spark-ignition engine
Number of cylinder	Four cylinder
Methods of fuel injection	Carburetor
Engine Capacity	1300cc

Intake System Parts

Air Induct

Air induct as shown in **Figure 2.2** is used to draw the air from atmospheric and direct the air into the intake manifold.

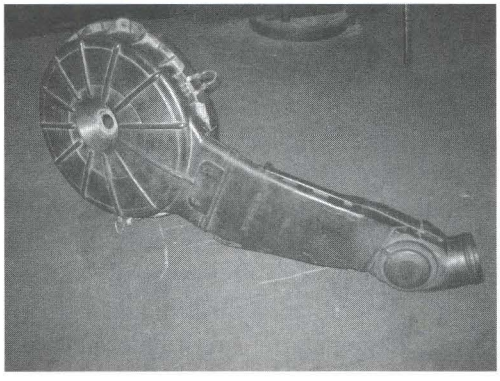

Figure 2.2: Air induct

Air Filter

The intake air must be clean. Airborne contaminants can shorten engine life or even cause premature failure. Air filters as shows in **Figure 2.3** are used on engines to trap contaminants, yet provide a free flow of air into the engine.

Carburetor

This carburetor model is a downdraught or downdraft progressive twin venturi instrument with vacuum-controlled secondary throttle as shown in **Figure 2.4** and **2.5**. The choke control is automatic in operation and is controlled by a coolant-heated wax capsule. [3] The air-fuel mixture burns in the combustion chamber of the engine. The carburetor is a device which is used to supply the engine with a combustible air-fuel mixture in the proper ratio for the purpose of combustion. The quantity of fuel and air can be mixed in different ratios inside the carburetor. The speed of the engine changes according to the quantity of the fuel in the air-fuel mixture.

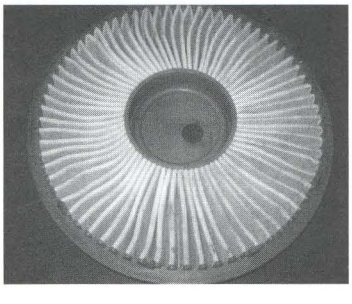

Figure 2.3: Ring type air filter.

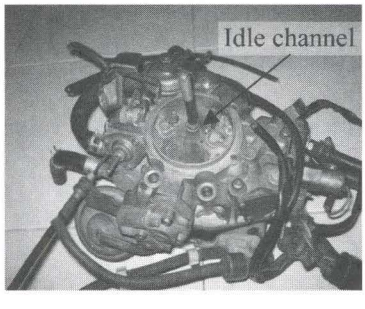

Figure 2.4: Down draft carburetor.

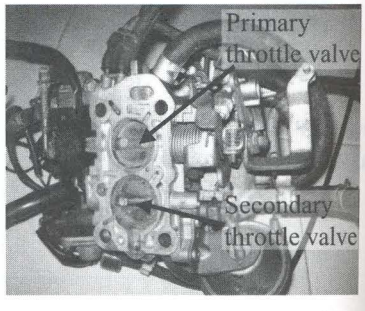

Figure 2.5: Twin venturi with primary and secondary throttle valve.

Internal System of Fixed-Venturi Carburator

The fixed venturi carburetor system needs several special systems or circuits which change the air-fuel ratio to suit varying operating conditions.