

Gasoline Engine Inlet Structure Design and Performance Analysis

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Abstract: By creating a three-dimensional model of the intake pipeline, using AVL software to mesh and virtual simulation experiments, using the control variable method, changing the temperature conditions and pressure conditions one by one to observe the flow of the air pipe and the cylinder, and observing the numerical changes of the flow direction coefficient and tumbling flow ratio, the best solution was found. Through the virtual simulation experiment of the 3D model, the influence of external factors such as temperature and pressure on the air flow in the cylinder is obtained. The relationship between the characteristic parameters of the air intake tract was found through AVL numerical simulation, and the established three-dimensional model could accurately obtain the data after testing, which provided theoretical proof for the subsequent optimization scheme. The experimental results show that the tumbling flow ratio is increased as much as possible without changing the flow coefficient and the fuel economy of the engine is improved. But it also affects the flow coefficient, making it go down. Temperature has little effect on the flow in the cylinder. The flow velocity in the cylinder changes significantly under different pressures, and the area of the vortex area increases.

Keywords: Air intake ducts; Pressure; Flow direction coefficient; Tumble flow ratio.

1. Introduction

Since the 1980s, virtual software simulation experiments have been continuously promoted among major automobile manufacturers, and the United States, the United Kingdom and other countries have become more and more widely used in automotive research and development. The UK and France have conducted in-depth research on CFD technology, and have made remarkable achievements in the development of automotive air intake ducts.

Gosman et al. [1] used a three-dimensional computational model based on the k- ϵ two-way model to explore the influence of the air flow inside the engine on the shape of the combustion chamber. Taylor W et al. [2] proposed a calculation method for predicting the loss of the intake area of an internal combustion engine. J.N.KIM and H.Y.KIM used a full 3D model to investigate the optimal value of the intake valve lift of a CAI engine. Homogeneous mixing in the engine is a key parameter affecting the reliability and thermal efficiency of engine spontaneous combustion. The way the supply air is inlet often determines the homogeneity of the fuel-air mixture [3]. Kang Y H found that the in-cylinder flow characteristics of fuel injection and subsequent interaction with fuel spray and combustion are fundamental considerations for diesel engine performance and exhaust emissions [4]. Yi J W invented a new engine, EcoBoost, and combustion system performance is key to the success of the EcoBoost engine [5]. Godrie et al. [6] simulated steady-state flow in two typical inlet channel shapes: straight inlet and vortex inlet. The engine torque predictions based on the emission factor calculations are in good agreement with the test bench results in various situations. Schurov et al. [7] used a computer to simulate the flow and heat transfer phenomena in the intake tract of a spark-ignition engine. The resulting forecast provides a detailed picture of the characteristics of the air-fuel mixture along the intake tract. Bailly, Buchou, and Floch [8] developed a computational code for a hybrid finite

element tetrahedral finite element method for engine simulation. A comparison was made between the calculation and measurement of the engine intake and compression stages.

With the advancement of computer technology abroad and the development of related research fields, the popularization of computer applications in China, and the progress and improvement of related research fields, China has correspondingly developed the application technology of numerical simulation of engine intake systems. Sun Jimei et al. [9] established a flow field analysis model for the engine intake system and used a modified k- ϵ . The model calculated the operating conditions, and by comparing the experimental results with the steady-state calculation results, it was found that the corrected k- ϵ . The prediction accuracy of the engine inlet flow field of the model is much higher than the pre correction prediction accuracy. Huang Zhen and Romoji [10] proposed a new numerical model mesh generation method, which combines the Euler method and Lagrange method to perform transient numerical simulation on the intake system of a certain engine. Pei Pucheng et al. [11] conducted several sets of steady-state flow experiments, in which they found that the flow direction and velocity of the airway were greatly changed when the airway structure was observed in the longitudinal and transverse planes with different structural planes. Wang Qiao et al. [12] found that the simulation results obtained by using FLUENT simulation software can accurately predict the test value of an engine, so as to verify the accuracy of CFD numerical simulation. Lu Yong et al. [13] developed a new cylinder, which has a different tumbling ratio from previous products. This combustion chamber optimizes the vortex currents in the cylinder and has proven itself in practice. Yang Xiaofeng [14] found that the gas flow is very closely related to the valve lift, and when the air flow is relatively stable, the valve lift is about in the upper middle position. The tumble flow ratio increases as the lift increases.

The testing methods for airway characteristics include AVL evaluation method, FEV evaluation method, and Ricardo

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Gasoline Engine Analysis John Fenton, 2005-07-18 Aimed at filling the gap between theoretical works on thermodynamics and descriptive works on engine combustion Gasoline Engine Analysis provides calculations for internal combustion engines based on some fifty articles previously published in Automotive Design Engineer and Automotive Engineer Gas Engine, 1919 **The Gas Engine**, 1907 **The Gas-engine** Frederick Remsen Hutton, 1907

Natural Gas Engines Kalyan Kumar Srinivasan, Avinash Kumar Agarwal, Sundar Rajan Krishnan, Vincenzo Mulone, 2018-11-03 This book covers the various advanced reciprocating combustion engine technologies that utilize natural gas and alternative fuels for transportation and power generation applications It is divided into three major sections consisting of both fundamental and applied technologies to identify but not limited to clean high efficiency opportunities with natural gas fueling that have been developed through experimental protocols numerical and high performance computational simulations and zero dimensional multizone combustion simulations Particular emphasis is placed on statutes to monitor fine particulate emissions from tailpipe of engines operating on natural gas and alternative fuels **The Gas Engine** Sir Dugald Clerk, 1890 **A Practical Treatise on Modern Gas and Oil Engines** Frederick Grover, 1902 A Practical Treatise on Modern Gas and Oil Engines Frederick Warren Grover, 1897 **Knocking in Gasoline Engines** Michael Günther, Marc Sens, 2017-11-21 The book includes the papers presented at the conference discussing approaches to prevent or reliably control knocking and other irregular combustion events The majority of today's highly efficient gasoline engines utilize downsizing High mean pressures produce increased knocking which frequently results in a reduction in the compression ratio at high specific powers Beyond this the phenomenon of pre ignition has been linked to the rise in specific power in gasoline engines for many years Charge diluted concepts with high compression cause extreme knocking potentially leading to catastrophic failure The introduction of RDE legislation this year will further grow the requirements for combustion process development as residual gas scavenging and enrichment to improve the knock limit will be legally restricted despite no relaxation of the need to reach the main center of heat release as early as possible New solutions in thermodynamics and control engineering are urgently needed to further increase the efficiency of gasoline engines **Modeling of End-Gas Autoignition for Knock Prediction in Gasoline Engines** Andreas Manz, 2016-08-18 Downsizing of modern gasoline engines with direct injection is a key concept for achieving future CO₂ emission targets However high power densities and optimum efficiency are limited by an uncontrolled autoignition of the unburned air fuel mixture the so called spark knock phenomena By a combination of three dimensional Computational Fluid Dynamics 3D CFD and experiments incorporating optical diagnostics this work presents an integral approach for predicting combustion and autoignition in Spark Ignition SI engines The turbulent premixed combustion and flame front propagation in 3D CFD is modeled with the G equation combustion model i.e. a laminar flamelet approach in combination with the level set method Autoignition in the unburned gas

zone is modeled with the Shell model based on reduced chemical reactions using optimized reaction rate coefficients for different octane numbers ON as well as engine relevant pressures temperatures and EGR rates The basic functionality and sensitivities of improved sub models e g laminar flame speed are proven in simplified test cases followed by adequate engine test cases It is shown that the G equation combustion model performs well even on unstructured grids with polyhedral cells and coarse grid resolution The validation of the knock model with respect to temporal and spatial knock onset is done with fiber optical spark plug measurements and statistical evaluation of individual knocking cycles with a frequency based pressure analysis The results show a good correlation with the Shell autoignition relevant species in the simulation The combined model approach with G equation and Shell autoignition in an active formulation enables a realistic representation of thin flame fronts and hence the thermodynamic conditions prior to knocking by taking into account the ignition chemistry in unburned gas temperature fluctuations and self acceleration effects due to pre reactions By the modeling approach and simulation methodology presented in this work the overall predictive capability for the virtual development of future knockproof SI engines is improved

Modern Gas & Oil Engines Frederick Grover,1909 **Analysis of a Direct Injected Gasoline Engine** G. Karl,Society of Automotive Engineers,1997 **Automotive Gasoline Direct-Injection Engines**

Fuquan Zhao,David L Harrington,Ming-chia Lai,2002-05-15 This book covers the latest global technical initiatives in the rapidly progressing area of gasoline direct injection GDI spark ignited gasoline engines and examines the contribution of each process and sub system to the efficiency of the overall system Including discussions data and figures from many technical papers and proceedings that are not available in the English language Automotive Gasoline Direct Injection Systems will prove to be an invaluable desk reference for any GDI subject or direct injection subsystem that is being developed worldwide Industrial Arts Index ,1926 **The Journal of the Society of Automotive Engineers** ,1927

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Kirkpatrick,2020-08-28 A comprehensive resource covering the foundational thermal fluid sciences and engineering analysis techniques used to design and develop internal combustion engines Internal Combustion Engines Applied Thermosciences Fourth Edition combines foundational thermal fluid sciences with engineering analysis techniques for modeling and predicting the performance of internal combustion engines This new 4th edition includes brand new material on New engine technologies and concepts Effects of engine speed on performance and emissions Fluid mechanics of intake and exhaust flow

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