國立中興大學機械工程研究所

碩士論文

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單缸二行程引擎排氣噪音量測與計算

Measurements and Calculations of Noise Radiation of the Exhaust Pipe of A Single Cylinder Two Stroke Engine

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摘 要

　　機車所產生的噪音主要有兩大來源，一是由引擎所產生，一是由車輛所產生。本文主要探討單缸二行程機車引擎所產生的排氣噪音。過去有關引擎噪音之研究偏重在消音器設計及傳輸損失上，而對二行程引擎排氣系統之研究則偏重於對性能之影響。本研究是希望將排氣噪音與整個引擎循環這兩部份整合起來，由排氣管的結構與氣體在排氣管內的動態特性，來瞭解排氣噪音的產生機構及噪音在消音器內衰減的過程，以建立排氣噪音控制的理論基礎。

　　研究引擎排氣噪音的方法可分成兩大類，第一類是以傳統的線性聲學理論來研究排氣消音器之聲學特性，另一類則考慮排氣管內一維的非線性氣體動力學。本文採用第二種做法，以特徵線法(characteristics line method)解一維不穩定可壓縮管流，來計算引擎運轉時排氣管內的壓力與流量變化，再由排氣管出口的瞬時流量來計算排氣噪音的頻率分佈及音壓位準。

　　在本文中共量測了三支不同長度的直管、兩支漸擴漸縮管與一支單膨脹室管，在三種不同轉速下的排氣壓力與噪音，並與理論計算值比較。結果顯示六支排氣管內壓力計算值與量測值很接近，頻譜分佈也能大致掌握。但受到理論模式的限制，噪音頻譜在某些頻率下的計算值與量測值差異較大。

ABSTRACT

The noise of motorcycles has two main sources; one is the engine; the other is the frame of the motorcycle. The noise radiation from the exhaust pipe of a single cylinder two stroke engine motorcycle is studied in this paper. There were some investigations on the engine noise; however, they usually put emphasizes on the muffler design and the transmission loss. As for the investigation on the exhaust system of two stroke engine, they usually emphasized on how it influences the engine performance. In this paper, we try to combine the two parts of noise radiation and the whole engine cycle operation to study the mechanism of noise radiation and the process which the noise decays in a muffler through the structure of exhaust pipe and the dynamic characteristics of the gas in the exhaust pipe so that we can establish the theoretic basis of noise control.

There are two methods to study the noise of engine exhaust are as follow: one is to use traditional linear acoustic theory to analyze the acoustic characteristics of the muffler, and the other is to use one dimensional unsteady gas dynamic theory. In this paper, the second method is used to calculate pressure variations in the exhaust pipe and the mass efflux at the end of the exhaust pipe thus obtained is then used to calculate the spectrum distribution of sound pressure and the noise level.

Six different configurations of exhaust pipe were studied in this paper: three straight pipes with same diameter and different length, two diverging-converging pipes with different diameter and length, and one pipe with an expansion chamber. The engine was driven by a motor at three different speeds. Pressure variations in the exhaust pipes and outside the exhaust pipe noise level were recorded. And the measured data were compared with the calculated result. Results of calculations show the pressure calculated and measured in the six exhaust pipes are fairly close, and the noise spectrum distribution can be predicted approximately. However, because of the restriction on the theory; the noise spectrum of calculation and measurement are some difference under the some frequency.

目 錄