國立中興大學機械工程研究所

碩士論文

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機車引擎排氣管流量特性與排氣噪音之量測與比較

The Measurement and Comparison of the Flow Performance and Noise on the Pipe of Engine

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中文摘要

排氣管的設計從最簡單的直管到複雜由數個氣室與連通管的組合的都有。主要目的就是在兼顧引擎性能的條件下，將噪音量減至最低。排氣管不同的設計對機車引擎性能與噪音有很大的影響，由於二行程機車引擎無進、排氣閥門的設計，所以必須靠排氣管的反射波提高閉合壓力，增加新鮮油氣的捕捉率，稱爲排氣調諧。本文主要是進行機車引擎在穩定運轉時的性能與排氣噪音量測，探討各種不同排氣管設計對單缸機車引擎性能與噪音的影響。

將目標排氣管分別接上機車引擎進行噪音量測，比較各排氣管之傳輸損失與冷、熱流場下的噪音值量測結果。發現在構造簡單的排氣管中，傳輸損失較低的頻率時，噪音值有相對附近頻率噪音值較高，在傳輸損失較高的頻率時，噪音值有相對附近頻率噪音值較低，與量測十分接近。故傳輸損失有實用之價值。

本文進行冷流場下排氣管內壓力與出口流速的量測與計算，探討以一維可壓縮流這種方法計算排氣壓力與流速的準確程度。分別針對四隻不同形式的排氣管，探討二行程引擎在沒有點火的三種轉速下，在排氣管內的壓力變化及在排氣管出口的瞬時流量變化。並說明以一維非線性氣體動力學來分析排氣管是非常可行的。接著是進行引擎在熱流場下排氣管內氣室的壓力量測及計算，探討二行程引擎在點火的九種轉速下在排氣管內氣室的壓力變化，由於在熱流場中所以不能使用熱線流速儀來進行排氣管出口速度的量測，必須靠排氣管內氣室的壓力變化來推算排氣管出口速度，進而估計其噪音值。最後討論排氣管的設計對引擎性能之影響。

ABSTRACT

The exhaust pipes of motorcycle engines are composed of several short straight pipes and expansion chambers. The main function of exhaust pipe is to reduce the exhaust noise while maintaining the engine performance . Both the engine performance and the exhaust noise are affected by the exhaust pipe design, especially for two stroke engine. The objective of this paper is to study the effect of exhaust pipe design on the exhaust noise engine characteristics as well as the engine performance.

A series of mufflers were designed for testing and analysis in this study. The muffler was attached to the exhaust system of a commercial two stroke moped engine. The transmission loss of each muffler was measured. The pressure variations in the muffler, the instantaneous flow rate at the exit of exhaust pipe, the total sound pressure level, and the spectral distributions of the emitted noise for each combination of engine and muffler were recorded at motoring and firing conditions. The engine performance was also recorded. Besides, one dimensional unsteady gas dynamic model was used to obtain the temporal variations of the velocity in the pipe.

It was found that the spectral characteristics of exhaust noise were closely related to the transmission loss of muffler at motoring conditions. That is, the noise level is high at the frequency range that the transmission loss is low. On the other side, the noise level is low at the frequency range that the transmission loss is high. However, these relationships were not as clear at firing conditions. The noise obtained from the exit flow variations agreed with the measured noise at low frequency. At frequency higher than 1 kHz, discrepancy between the calculated and the measured noise occurred. The short extension tubes between expansion chambers may considerably reduced the exhaust noise. However, the engine performance was reduced too.

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