國立中興大學機械工程研究所

碩士論文

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小型氣冷式機車引擎缸壁瞬時熱傳量測

The Instantaneous Heat Transfer on the Cylinder Wall of a small Air-cooled Moped Engine

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中文摘要

熱傳是引擎循環過程中十分重要的物理現象，尤其是小型氣冷式的機車引擎，其熱傳特性對引擎性能的影響十分重要。本研究主要是建立一套引擎瞬時熱傳量測系統，並說明在一具小型氣冷式二行程機車引擎上的量測結果。

在本研究中，只進行了引擎汽缸頭上一個位置的熱傳量測，量測的引擎狀態包括低負載，半負載以及全負載。引擎轉速則在2000RPM到5000RPM之間。二行程引擎在低負載時有相當嚴重的循環變異現象，而在半負載或是全負載的狀況下，循環變異現象就較不明顯。二行程引擎在發生循環變異時，有的循環會完全沒有燃燒或是燃燒不完全，沒有燃燒的循環的汽缸壓力明顯的比有燃燒的循環的汽缸壓力要低得多，沒有燃燒的循環汽缸壓力約在10-12atm之間，其最大瞬時熱傳約爲1.0 MW/m^2；而有燃燒循環，包括低負載到全負載，最大瞬時熱傳約在3.0-4.5 MW/m^2之間，與Enomoto等人在一具四汽缸1800c.c.汽油引擎上的量測數值很相近。各單一循環內最大壓力與最大缸壁熱傳及缸壁熱傳量與該循環的指示平均有效壓力(IMEP)間都有約略的線性關係。

而本研究的量測值與一般常用的熱傳經驗估計值比較有偏高的現象，這是因爲熱傳經驗公式都是由氣缸壁許多點的量測數據平均而來的。此外，本研究並且分析不同熱電偶與轉接頭材質所產生的熱傳問題，發現如果要維持一維熱傳導的假設，則所選用的熱電偶的材質必須和其安裝位置周圍的材料相同或是熱傳導性質相近，否則必須做二維暫態熱傳導的修正。

ABSTRACT

Cylinder wall heat transfer is important in determing the performance of small air-cooled moped engines. The objectives of this study are to establish a system for the transient heat transfer measurement in engine cylinder wall and to conduct some measurements in a small air-cooled moped engine.

The instantaneous heat transfer was measured at one location in the cylinder head for several engine running conditions, including three engine speeds and three engine loads at each speed. Severe cyclic variations occurred at low load conditions in which some cycles burned incompletely, and some cycles did not burn at all. In cycles with no combustion the maximun heat transfer rate is about 1.0 MW/m^2 , while in cycles with complete combustion, the peak heat transfer rate is between 3.0 to 4.5 MW/m^2, which are close to the data reported by Enomoto obtaine from a four cylinder, 1800 c.c. gasline engine. It is found that the maximum cylinder pressure and maximum heat transfer rate are approximately in a linear relationship .The total heat transfer in a single cycle is also approximately linear with the IMEP of the cycle.

However, the measured data in this study are higher than those obtained from the semi-empirical

formulas which are widely used in engine heat transfer calculations, e.g., Woschni's formula. This is pbobably due to the fact that these semi-empirical formulas were the average of several locations in the whole engine surface while only one location of measurement was conducted in this study.

The problem of measuring heat transfer with different types of thermal couple was also analyed in this study,. It is assumed in the heat transfer calculation that the temperature distribution in the cylinder wall is one dimensional. It will be an acceptable assumption if the material of thermal couple is indentical to that of the cylinder wall. However, if different type of thermal couple was used, the one dimensional assumption would not be valid. A simple analysis was conducted in this study to show that in the case that a T type thermal couple was replaced with an E type thermal couple, an error of about 50% would occur in determining the peak heat tranfer rate.

目錄