UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EXPERIMENTAL STUDY ON CAMSHAFT PROFILE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree of Engineering Technology Automotive (Hons.)

By

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DECLARATION

I hereby, declared this report entitled “Experimental Study on Camshaft Profile” is the results of my own research except as cited in references.

Signature : ……

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Date : …….....

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology Automotive (Hons.). The member of the supervisory is as follow:

…….

(En. Adnan Katijan)

ABSTRAK

Camshaft boleh dirujuk sebagai nadi kepada enjin kerana ia mengawal kemasukan campuran udara dan bahan api. Oleh itu, bentuk camshaft terdiri daripada banyak aspek penting yang perlu di pertimbangkan oleh jurutera antaranya adalah tinggi, tempoh, sudut pemisahan lobus, pertindihan dan lain-lain Setiap parameter yang kita ubah akan memberi perubahan besar kepada tork dan kuasa kuda. Tujuan kajian ini adalah untuk membandingkan reka bentuk profil camshaft yang berbeza dan juga untuk mengkaji kesan profil camshaft pada tork dan kuasa kuda enjin. Untuk projek ini saya akan menggunakan motorsikal Yamaha LC 135 untuk menjalankan ujian dyno. Tiga jenis camshaft akan digunakan untuk mendapatkan tork dan kuasa kuda, ianya ialah standard camshaft, camshaft profile rendah dan camshaft profil tinggi. Sebelum ujian dinamometer telah dijalankan, motosikal mesti berada dalam keadaan yang baik untuk mengelakkan daripada keputusan yang tidak tepat. Jadi bahagian haus dan lusuh bahagian mesti ditukar, kemudian ujian dyno boleh di teruskan. Keputusan keseluruhan tertinggi bagi tork adalah camshaft standard dan bagi kuasa kuda adalah camshaft tinggi. Dari itu kita boleh tahu bahawa ciri-ciri yang berbeza camshaft lobe boleh menghasilkan tork dan kuasa kuda yang berbeza pada RPM tertentu. Oleh itu, ciri-ciri camshaft menentukan berapa lama injap akan terbuka dan ini berkaitan dengan kemasukan campuran bahan api udara ke dalam kebuk pembakaran. Pada rpm rendah masa pembukaan injap yang lebih pendek adalah mencukupi untuk pembakaran yang cekap berlaku kerana pergerakan omboh adalah perlahan dan pada rpm tinggi bukaan injap yang lama di perlukan kerana pergerakan piston dan komponen bergerak lebih laju.

ABSTRACT

Camshaft can be referred as the heart of engine since it controls the admission of mixture of air and fuel. Therefore, the shape of camshaft consists of many important aspects that should be concerned by the engineers which are lift, duration, lobe separation angle, overlap and etc. Each of the parameter that we change will give a big transformation to the torque and horsepower. The purposes of this study are to compare different camshaft profile design and also to study the effect of the camshaft profile on the torque and horsepower of the engine. For this project I will use Yamaha LC 135 motorcycle to run dyno. Three types of camshaft will be used to obtain torque and horsepower result, the camshaft used is standard camshaft, low camshaft and high camshaft. Before dynamometer test were conducted, the motorcycle must be in good condition to avoid from inaccurate result. So the wear and tear part must be change, then can proceed with dynamometer test. The overall highest result for torque is standard camshaft and for horsepower is high camshaft. From that we can know that different characteristic of camshaft lobe can generate different torque and power at certain RPM. Therefore, the characteristic of camshaft determine how long the valve will open and this related with entering of air fuel mixture into combustion chamber. At low rpm the shorter time valve opening is sufficient for efficient combustion to occur since the movement of piston is slow while at high rpm there will need a longer time to open the valve for efficient combustion to occur as the piston and other part moving faster.

DEDICATION

My dedication are especially to my beloved parents who encourage me to gain knowledge, support for what I'm doing and not tired giving me advices. They always stand still behind me no matter what I'm doing, hold my hand when I fall down and never disappoint me. In addition, they also give financial support to undergo this project from beginning of the project until the end of it. I also would like to thanks my friends who give some ideas about the project and introduce me with the place to pursue my study.

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I would like to thanks to those who involve in completing this study, especially my supervisor, En. Adnan Katijan who gave me full moral support and correct my mistakes during the process of finishing the study. En Adnan also gave me guidance on how the experiment should be done and the things that I need to considered carefully in order avoiding mistake in this research. Besides that, I'm not forget to thanks to En Redzuan, the owner of Alang Motor Workshop, who is specialist with camshaft. He had done research over years in camshaft and now he is producing his own camshaft for sales over country in Malaysia, especially for low cubic capacity (CC) motorcycle. En Redzuan give advised and opinion regarding my project and would share some knowledge related to camshaft. I also would like to thanks to Moto Dynamic for giving me permission to continue my research to do dynamometer for each camshaft. They also teach me on how to read the graph and analyse the data accurately. Thank you.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

OHC	-	Overhead Cam
SOHC	-	Single Overhead Cam
DOHC	-	Double Overhead Cam
TIG	-	Tungsten Inert Gas
RPM	-	Rotation per Minute
CC	-	Cubic Capacity
IC	-	Internal Combustion

ABSTRACT

Camshaft can be referred as the heart of engine since it controls the admission of mixture of air and fuel. Therefore, the shape of camshaft consists of many important aspects that should be concerned by the engineers which are lift, duration, lobe separation angle, overlap and etc. Each of the parameter that we change will give a big transformation to the torque and horsepower. In addition, to design the camshaft, we must follow the specification of the engine such as the bore size, stroke of the engine, type of the engine (OHC, SOHC, and DOHC), valve size, compression ratio and induction system of the engine. Besides that, the engineer should also consider the purpose of the car, either for daily used or racing. For daily used, the camshaft design should be good at low end and middle rpm but for racing used, it must be good at high rpm to achieve high torque and horsepower.

CHAPTER 1
INTRODUCTION

This section explain about background of study, objective of the project, problem statement that occur and scope of the project.

1.1 Background

Camshaft is defined as machine element which is cylindrical rod that consists of a few or numerous cylinder bank with a number of oblong lobes surrounding it. In automotive field, Camshaft and its follower play an important role to run the engine by using several mechanisms to lift the valves. The shape of the camshaft profile defines the valve lift. Thus, the fundamental adjustment parameter in the design of the gas exchange and combustion process occurs. As the camshaft spins, the lobes will open and it close the intake and exhaust valves in time with the motion of the piston, springs on the valves that return them to their closed position. Actually, there is a direct relationship between the shape of the cam lobes and the way that the engine performs in different speed ranges. Nowadays, the car maker has developed various shape of camshaft profile to match it with desired engine to give the engine maximum performance. The system deals with high load and high speed since many analyses has been carried out on the engine to increase the torque and horsepower of the engine.

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In my research, I have chosen different camshaft profile to study on how this part will affect the performance of engine. In my project, I will use three different camshaft profile which are low camshaft and high camshaft and compare with standard camshaft. I want to test and review which one will give the best torque and horsepower.

1.2 Objective

The purposes of this study are to compare different camshaft profile design and also to study the effect of the camshaft profile on the torque and horsepower of the engine.

1.3 Problem Statement

Camshaft can be cited as the brain of the engine, since it can decide when to open, how long it will allow mixture, and how much the valves will open and close in relation to the pistons according to the amount of mixture burnt. There are numbers and terms used when describing a camshaft design that must be understood when choosing a cam. It's good to know exactly how each of this spec affects the engine's performance, and one of the most important spec is lift.

The problem is, there are many things to consider when choosing a cam, and it involved more than just the other engine parts. The entire vehicle and the total of its parts are important. In order to maximize the torque and horsepower of an engine, engineer has developed a camshaft profile that is suitable to drive at low end and high rev rpm. It is well known that camshaft profile have the important role in increasing the performance of engine especially when it comes to torque and horsepower.

1.4 Scope

As seen, this study is subjected to the usage of several camshafts and to review the effect of each cam profile design with the aim to determine the torque and horsepower of the engine. The engine used is 4stroke motorcycle engine and 4valve with single overhead camshaft (SOHC) with the carburetor system as an actuator to control the air fuel ratio. In order to obtain the result for each camshaft profile, the motorcycle will be placed on a machine that is known as dynamometer.

CHAPTER 2
LITRETURE REVIEW

This section explain about the research study that was done by the others. Its include material of the camshaft, tappet, rocker arm, intake manifold and cam shape or design.

2.1 Material

2.1.1 Chilled hardened layer

Camshafts of a valve operating system for an internal combustion engine are required to be high in wear resistance at the cam surface which is can be slide easily, contactable with an opposite of a rocker arm. In order to improve the wear resistance, it has been proposed to use a set of chilling block at a part of a die for casting the camshaft, so that super cooling is made to a part (in contact with the chilling block) of the die thereby forming a chilled hardened layer in the casting.

As other methods for forming the chilled hardened layer, camshafts with chilled cams are made using the upper surface remelting method. It is usually done with an electric arc TIG method and rarely with laser light or an electron beam (J. Michalski, J. Marszalek, K. Kubiak, 2000) and thereafter by allowing the camshaft to be self-cooled.

A variety to produce conventional remelting treatments have been proposed to form the chilled hardened layer in the camshaft material.

According to Li Ping , Li Fengjun , Cai Anke2 and Wei Bokang, (2009) the measures of surface hardening include phase transformation such as surface chilling and heat treatment, and precipitation processes occurring in the material during surface thermochemical treatment by ion nitriding and nitrosulphurizing or spraying of multicomponent layers and so on.

For such camshaft, the cam surface is chilled to get high hardness containing transformed ledeburite without graphite during primary crystallization (Li Ping , Li Fengjun , Cai Anke2 and Wei Bokang, 2009).

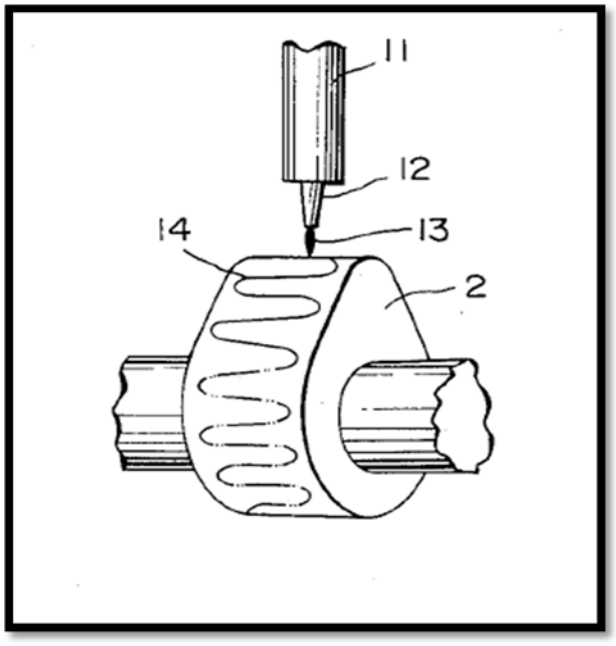

Figure 1.1: A schematic perspective view showing a manner of a remelting treatment to produce the camshaft.

2.1.2 Ceramic

The present invention relates in general to a camshaft for an engine, and more particularly to a structure of such an engine camshaft by using a ceramic material, which is improved in wear resistance and durability and reduced in weight.

In the valve train car engine, wear and abrasion of the components, particularly camshaft and rocker arms that having sliding surfaces, are a serious problem that should be considered and overcome for improving the durability of the engine. These camshaft used in the valve train car engine are usually made of cast iron, and their sliding surfaces are chilled or hardened by heat treatment to increase the wear resistance against friction. Efforts have been made to enhance the durability of the rocker arms. For example, the sliding surfaces of the rocker arms is made of cast iron that can be nitrided or coated with a hard-chrome plating layer.

In order to follow up with recent technological progress, engines of automotive vehicles are struggle to provide higher performance and capability. On the other hand, their invention are needed for controlling emissions from the engine. As a result to fulfill the emission control requirements, the lubricating conditions or environments of the engine are aggravated. Under these circumstances, further improvements are needed for the cams which are formed as longitudinally spaced-apart integral sections of a camshaft, and of the rocker arms in sliding contact with the camshaft, so as to increase the wear resistance of their sliding surfaces, more specifically, resistance to pitting and scuffing of the sliding surfaces.

At this end, various studies have been made for use as camshafts and rocker arms. In other things, special attention of the industry has been paid to produce a composite camshaft, the cam portions of which are made of a highly wear-resistant material that are

different from the material of the shaft portion. In general, the cam portions of such a composite camshaft may be made of a ceramic material. However, a ceramic material for the cam portions and the other material for the shaft portion have very different properties. Therefore, there will arise a problem of how these two different materials will united together into an integral assembled composite camshaft

2.2 Tappet

Tappet is the term that widely used to associate with internal combustion engines. It usually refer as a maintenance job for overhead valve engines, for adjusting the tappets. It is done by adjusting or modified the overall clearance in the valve system. The name of tappet born as it is clearance from the tappets are adjusted, although the adjustment was not made by the tappets themselves.

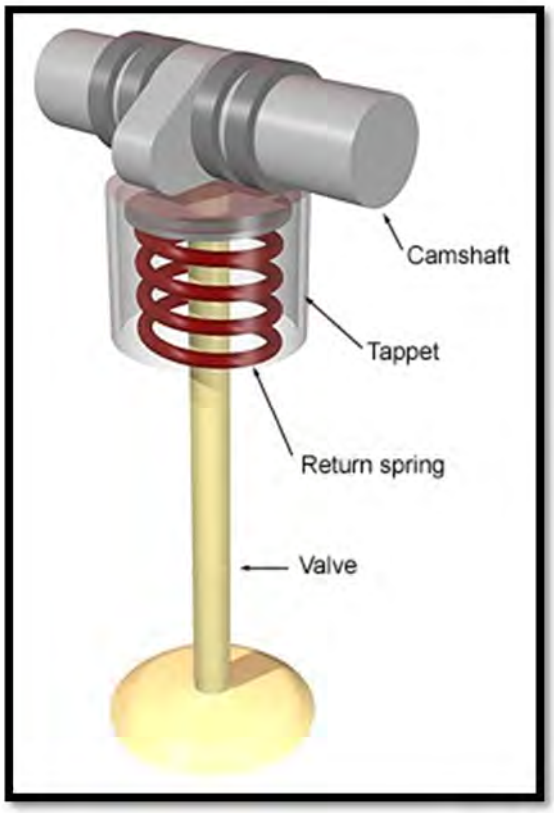

Figure 2.1: The example of tappet

When we talk about the tappet, it consist of the part which can be known as camshaft follower that located on the camshaft and is created to contact vertically by rotation of the camshaft. In pushrod engine, this tappet is located down in the engine block, from there it will push the pushrod to the top of the engine by rotation of camshaft. In cylinder head the rockers arm are arranged on a rocker shaft, it then will push the valves downwards to open them.

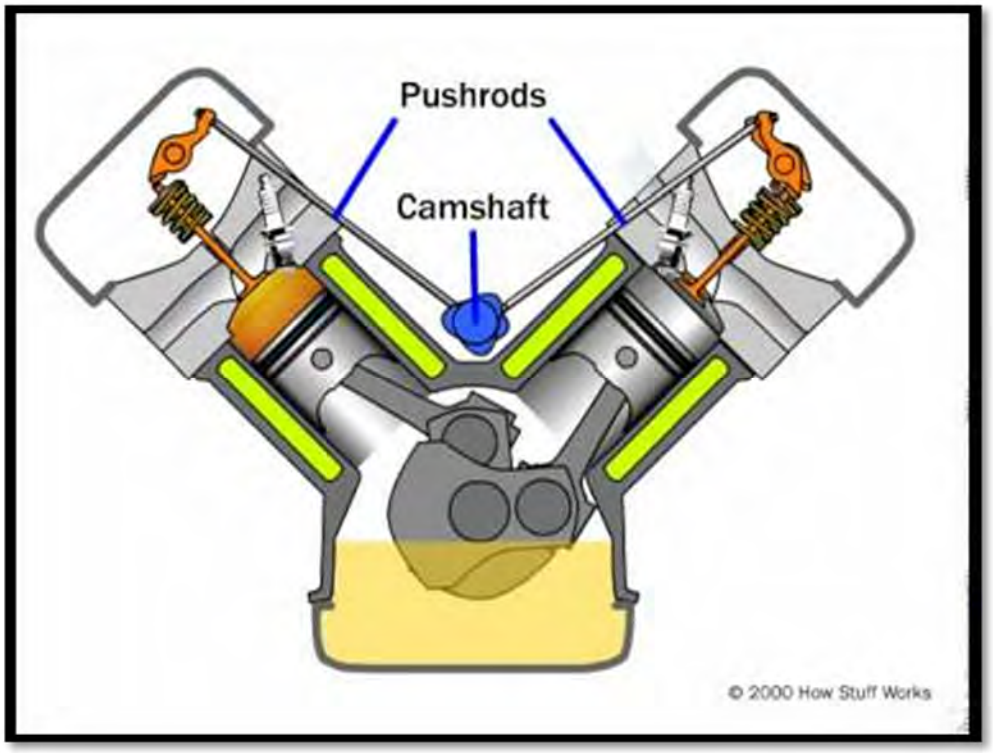

Figure 2.2: How camshaft open the valve via pushrod

Earlier tappets consist of rollers to reduce wear and tear from the rotating camshaft, but it was found that the roller pivots wear more rapidly than camshaft. The engineers then produce a plain flat ends tappet, the shape were slightly radiuses as 'mushroom' tappets as a perfectly flat end to hit the camshaft in order to open the valve.

As to overcome wear problem from the rotation of the camshaft, the tappets were usually crated circular shape and allowed it to rotate. This will prevent grooves generating from the same point of the camshaft. In some internal combustion engines, commonly in V8 engines with a limited space, the tappets were small and non-rotating.

Figure 2.3: The hydraulic lifter

A hydraulic valve lifter, which is also known as a hydraulic tappet or a hydraulic adjuster. It is created to ensure no valve clearance in an engine for optimum performance. General valve lifters is required in regular adjusting to retain a small amount of clearance between the valve and its rocker arm. The space or valve clearance is allowed for thermal expansion between them, and prevented the parts from stick that can cause friction and wear. According Cemal BAYKARA, Mehmet PALABIYIK (2002), Hydraulic systems increase engine performance and efficiency by improving valve timing and reducing maintenance need and improving comfort by eliminating clearances. Different types of hydraulic lifter systems can be designed.