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JUDUL: SIMULATION OF ELECTROMECHANICAL VALVE DRIVE ON SINGLE CYLINDER FOUR STROKE FREE PISTON DIESEL ENGINE

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SIMULATION OF ELECTROMECHANICAL VALVE DRIVE ON SINGLE
CYLINDER FOUR STROKE FREE PISTON DIESEL ENGINE

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LIST OF SYMBOL

τ_{θ}	transformer torque in the Θ domain
F_z	transformer force in the z domain
J_{θ}	inertia in the Θ domain
m_z	mass in the z domain
B_{θ}	friction in the Θ domain
B_z	friction in the z domain
K_T	motor torque constant
K_z	effective spring constant for two spring
i	motor current
Θ	displacement in the rotational domain
z	displacement in the vertical domain
$g(\theta, t)$	time-varying gas force acting on the valve reflected to the θ domain.
$\frac{d\theta}{dt}$	the rotational speed in the θ domain
$\frac{dz}{dt}$	velocity in z domain
$\frac{d^2\theta}{dt^2}$	rotational acceleration
$\frac{d^2z}{dt^2}$	acceleration in the z domain
$\frac{dz}{d\theta}$	slope of the NMT characteristic

LIST OF ABBREVIATION

BDC	Bottom dead center
TDC	Top dead center
EMVD	Electromechanical valve drive
NMT	Nonlinear mechanical transformer
NTF	Nonlinear mechanical transformer
VVT	Variable valve timing

ABSTRACT

In conventional internal combustion engines, the camshaft is an apparatus often used in piston engines to operate the valves. The camshaft is connected to the crankshaft. The relationship between the rotation of the camshaft and the rotation of the crankshaft is of critically importance. Since the valves control the flow of air and fuel mixture intake and exhaust gases, they must be opened and closed at the appropriate time during the stroke of the piston. In the free piston engine, there is no crankshaft. So, the electromechanical valve drive (EMVD) will take the part in make the valve moving as usual. In this project, the model of EMVD will be developed in 3D CAD software.

ABSTRAK

Dalam enjin pembakaran dalam konvensional, aci sesondol merupakan bahagian yang selalu digunakan enjin beromboh untuk mengendalikan injap masuk dan injap ekzos. Aci sesondol berkait dengan aci engkol. Hubungan antara putaran aci sesondol dan aci engkol adalah bahagian yang sangat penting dan kritikal. Injap mengawal aliran campuran udara dan minyak, pada masukan dan ekzos, injap mesti dibuka dan ditutup pada waktu yang tepat ketika lejang omboh. Dalam enjin omboh bebas, tiada aci engkolyang hadir. Jadi sistem seperti panduan injap elektromekanikal akan mengambil bahagian untuk membuat injap bergerak seperti biasa. Di dalam projek ini, model untuk panduan injap elektromekanikal akan dibangunkan di dalam perisian 3 dimensi lakaran bantuan komputer.

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

In conventional internal combustion engine (ICE), engine valves are actuated by cams that are located at camshaft. Each cam at the camshaft has its degree and shape by considering a tradeoff between engine speed, power and torque requirements. These cams will determine the duration that means how long each valve will open and closed. Cams also will determine the phase that is when each valve is opened or closed and it also will determine the distance of the valve that will control the fuel into the combustion chamber. This is we called it variable valve timing (VVT).

The camshaft is connected to the crankshaft by a chain or belt, and rotates when the crankshaft does. As the camshaft rotates, it interfaces with the valves through a mechanical linkage and forces the valves open. The springs in the valve train will close the valve again once the cam stops forcing it open. Because the camshaft has a fixed profile, the valve displacement is fixed relative to the position of the crankshaft no matter what speed the engine is running at. In conventional valve drive, the valve motion is very smooth. It means that the valve moving upward and downward easily without any lagging.

The conventional valve drive also are highly regenerative, reliable and economically. But it also has its limitation that is the valve timing is fixed with respect to crankshaft position and it optimized performance at certain speeds and certain load conditions.

In many days, the internal combustion engine continues to evolve. Engines become more efficient because it produces more power per unit mass or volume and it also become cleaner. Many parts in engine have been modified including the valve actuation. After a few researches, the electromechanical valve drive (EMVD) has been found.

In EMVD system, we remove camshaft and we replaced it with motor to make valve moving as usual and we need to design a new cam to connect the valve and the motor. The motor supplies torque and control to open close and hold valve. Mechanical transformer converts rotary motion to linear motion and relates torque to applied force.

An IC engine valve's kinematics profiles for example valve position versus time or valve speed versus time are of fixed shape and are timed relative to the engine crankshaft position. With an electromagnetically driven Variable valve timing (VVT) system, one can independently control the phase and duration of the engine valve profiles, as well as carry out variable engine displacement, where certain cylinders in the engine may be deactivated. In these systems, the valves can be held in the open or closed positions for a variable time called the holding time.

They can also be commanded to transition from fully open to fully closed positions. They make this transition at a time that is well suited to the engine's instantaneous operation. In effect, VVT systems would replace the current camshaft driven valve actuation systems. To this end, VVT systems must have some of the same features as conventional valve actuation systems, while allowing the additional flexibility mentioned previously to be feasible.

1.2 PROBLEM STATEMENT

This project is concerns about the simulation of EMVD on single cylinder four stroke free piston diesel engine (FSFPDE).

1.3 OBJECTIVE

Firstly, the objective of this final year project is to build a model of EMVD by using 3D CAD software. Secondly, after modeling the model, the next step is to analyze the motion of valve at intake and exhaust.

1.4 SCOPE

The scope for these projects are, first is the literature study on EMVD. Then another is to design the valve on FSFPDE and lastly is to make analysis on the motion of valve for intake and exhaust.

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