FACULTY OF MECHANICAL ENGINEERING

MECHANICAL SYSTEM DESIGN
BMM 4623

PROPOSAL

DESIGN AND DEVELOPMENT 5 PARALLEL ENGINES FOR LUBRICANTS AND FUEL TESTING EXPERIMENTAL RIGS

PREPARED BY: ***GROUP 11***

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ABSTRACT

This project is to design and develop a 5 parallel engines for lubricant and fuel testing experimental rigs. Single-cylinder engine is chosen as the tester engine for this project. Single-cylinder engine is a basic piston engine configuration of an internal combustion engine. It is often seen on motorcycles, auto rickshaws, motor scooters, mopeds, dirt bikes, go-karts, radio-controlled models, and has many uses in portable tools and garden machinery. It has been used in automobiles and tractors. Single-cylinder engines are simple and compact, and will often deliver the maximum power possible within a given envelope. Purpose of design and develop this project is to test the performance of 5 engines which running in parallel and analysis the fuel consumption of 5 parallel engines by experiment testing. The results will be discussed and analyzed after the experiment testing.

1.0 INTRODUCTION

1.1 Problem Statement

Nowadays, world is concerned about the reduction of energy consumption for the purpose of save energy and save the Earth. Engine is widely used in many applications such as automotive car. To improve the performance of the engine and reduce the energy consumption of those applications, engineers are working hard on finding method to solve this problem. A design and develop on 5 parallel engines for lubricant and fuel testing experimental rigs is carried out to reduce the energy fuel consumption and increase the performance of the engines.

1.2 Purpose

Purpose of this project to test the mechanical knowledge of students, and make use the knowledge to design and development a 5 parallel engines for reduce its energy consumption by saving fuels consumption and increase its performance.

1.3 Objectives

1. To design and develop a complex mechanical system and components.
2. To analysis the fuel consumption of 5 parallel engines by experiment.

1.4 Project Scope

1. Fabricate a 5 parallel engines for lubricant and fuel test rig.
2. The experimental will be conducted with controller by controlling the running speed of the engine from middle range to maximum range.
3. Compare the different between the fuel consumption of the 5 parallel engines and the single engine.

2.0 LITERATURE REVIEW

Diesel cycle is a combustion process of a reciprocating internal combustion engine. In the engine, fuel is ignited by heat generated during the compression of air in the combustion chamber, into which fuel is then injected. This is in contrast to igniting the fuel-air mixture with a spark plug as in the Otto cycle engine. Diesel engines are widely used in aircraft, automobiles, power generation, diesel-electric locomotives, and both surface ships and submarines.[1]

The diesel internal combustion engine differs from the gasoline powered. Otto cycle by using a higher compression of the fuel to ignite the fuel rather than using a spark plug which "compression ignition" rather than "spark ignition". In the diesel engine, air is compressed adiabatically with a compression ratio typically between 15 and 20. This compression raises the temperature to the ignition temperature of the fuel mixture which is formed by injecting fuel once the air is compressed.[2]

The ideal air-standard cycle is modelled as a reversible adiabatic compression followed by a constant pressure combustion process, then an adiabatic expansion as a power stroke and an isovolumetric exhaust.[3] Figure 1 shows the schematics diagram of single cylinder engine. The engine is running with single cylinder or piston for internal combustion.

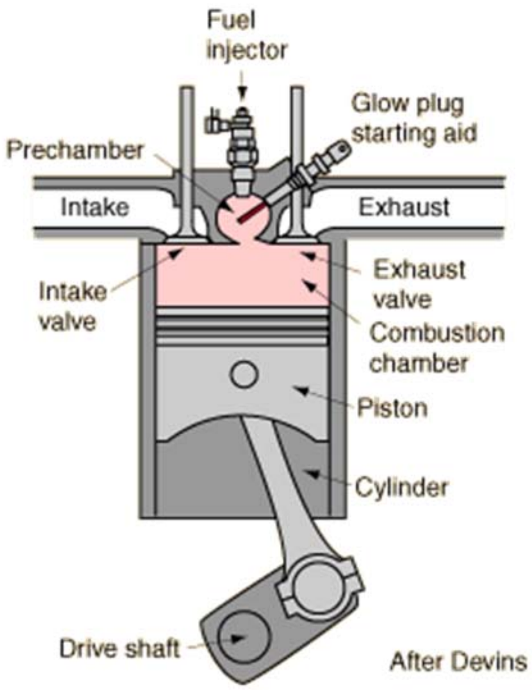


Figure 2.1: Schematics diagram of single cylinder engine

A single-cylinder engine is a basic piston engine configuration of an internal combustion engine. It is often seen on motorcycles, auto rickshaws, motor scooters, mopeds, dirt bikes, go-karts, radio-controlled models, and has many uses in portable tools and garden machinery. It has been used in automobiles and tractors. Single-cylinder engines are simple and compact, and will often deliver the maximum power possible within a given envelope.[4] Cooling is simpler than with multiple cylinders, potentially saving further weight, especially if air cooling can be used.

Single-cylinder engines require more flywheel effect than multi-cylinder engines, and the rotating mass is relatively large, restricting acceleration and sharp changes of speed. In the basic arrangement they are prone to vibration - though in some cases it may be possible to control this with balance shafts.[5] A variation known as the split-single makes use of two pistons which share a single combustion chamber.

Single-cylinder engines are simple and economical in construction. The vibration they generate is acceptable in many applications, while less acceptable in others. Counterbalance shafts and counterweights can be fitted but such complexities tend to counter the previously listed advantages.[6] Components such as the crankshaft of a single-cylinder engine have to be nearly as strong as that in a multi-cylinder engine of the same capacity per cylinder, meaning that some parts are effectively four times heavier than they need to be for the total displacement of the engine.[7]

The single-cylinder engine will almost inevitably develop a lower power-to-weight ratio than a multi-cylinder engine of similar technology.[8] This can be a disadvantage in mobile operations, although it is of little significance in others and in most stationary applications. Figure 2 shows the sample of engines of lawn mower. The engine of lawn mower is a single cylinder engine.

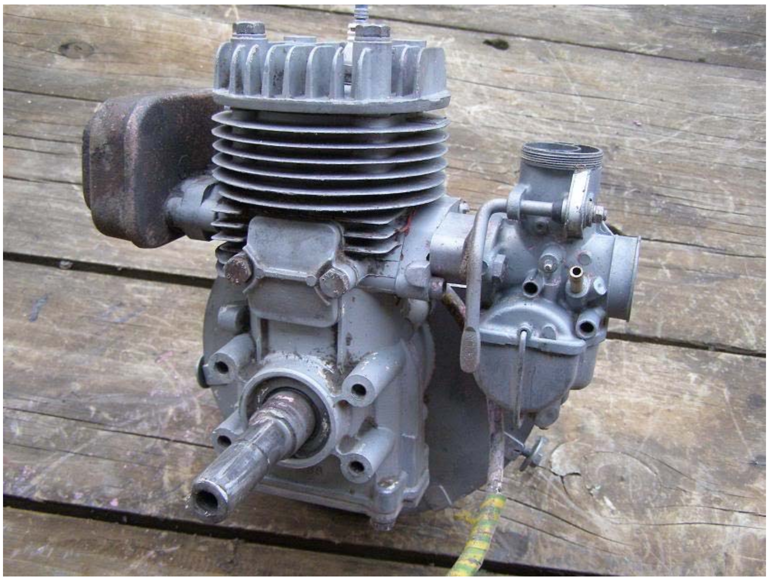


Figure 2.2: Engine of lawn mower

3.0 METHODOLOGY

3.1 MATERIALS

The materials that we planned to use for our design project are:

Materials	Description
1. Single Piston type engine which is Lame mower engine or it is known as Grass cutter engine set. 	This engine type is much cheaper if compare to more advance and complex car or motorbike engines for our project designing purpose. This engine that we planned to buy with its set of fuel tank, piping hoses and engine oil filter.
2. Engine oil 	This engine oil acts as lubricant for engine piston and overall its system.

3. Fan 	The fan for cooling purpose for engine since us going to run the experiment for 24 hours as one of our need to conduct this project for our case study.
4. Diesel oil 	Act as fuel for this engine for our experiment
5. Engine test rig / cage	This is to hold and fix all the engine (5 UNITS) including its fuel tank and also the fans in a parallel design in that cage so that we are able to conduct our testing successfully for case study.

3.2 MACHINES

The machines that we required for our fabrication and experiment study are:

1. Welding machine
2. Cutter machine

3.3 JOININGS

There are certain joining that we would like to explain here which are:

1. Welding joining – this joining is done when we fabricate the test rig cage for the engine and its part to be fix inside it.
2. Bolt and nut set or screw joining – this joining for the basement part to be fixed for the test rig cage and do the locking part for the front part of the cage (it's like opening part of cage)

3.4 ELECTRICAL SYSTEM

The electrical system that we going to use is the controller part which is using personal computer with Aurdino software and the setting up the fans for the cooling process at the test rig cage which need some electrical applications.

3.5 TOOLS

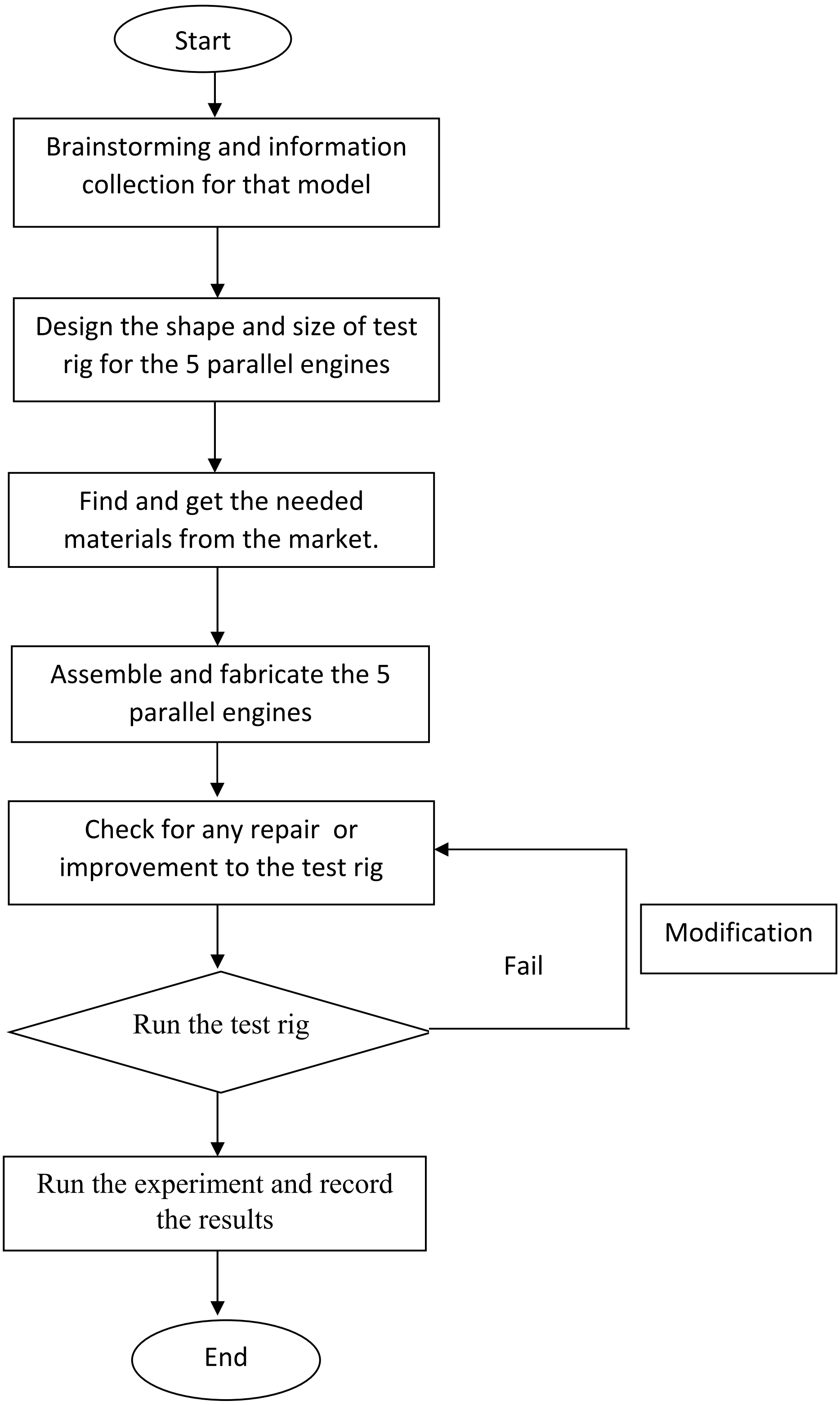
The tools that we going to use are all the mechanical equipment tools such as screw drivers, measuring tape, cutter, etc and some electrical parts of tools such as connecting wires and extensions for the setting up the fan for engines

3.6 OTHERS

Software:

1. Aurdino software for controller (to control the throttle value to accelerate the speed of engine)
2. Solidworks for overall test rig design

3.7 Flow chart



4.0 MANUAL DESIGN CALCULATION AND CAD DRAWING

Sample calculation for fuel consumption (5 parallel engines)

$V_{\text{initial}} = 1\ Liter$

$V_{final} = 400\ ml$

$Percentage\ of\ fuel\ consumption = \frac{600}{1000}\ x\ 100\% = 60\ \%$

Sample calculation for fuel consumption (Single engines)

$V_{\text{initial}} = 1\ Liter$

$V_{final} = 100\ ml$

$Percentage\ of\ fuel\ consumption = \frac{900}{1000}\ x\ 100\% = 90\ \%$

$Percentage\ of\ fuel\ saving = \frac{90-60}{90}\ x\ 100\% = 33.33\%$ (5 parallel engines)

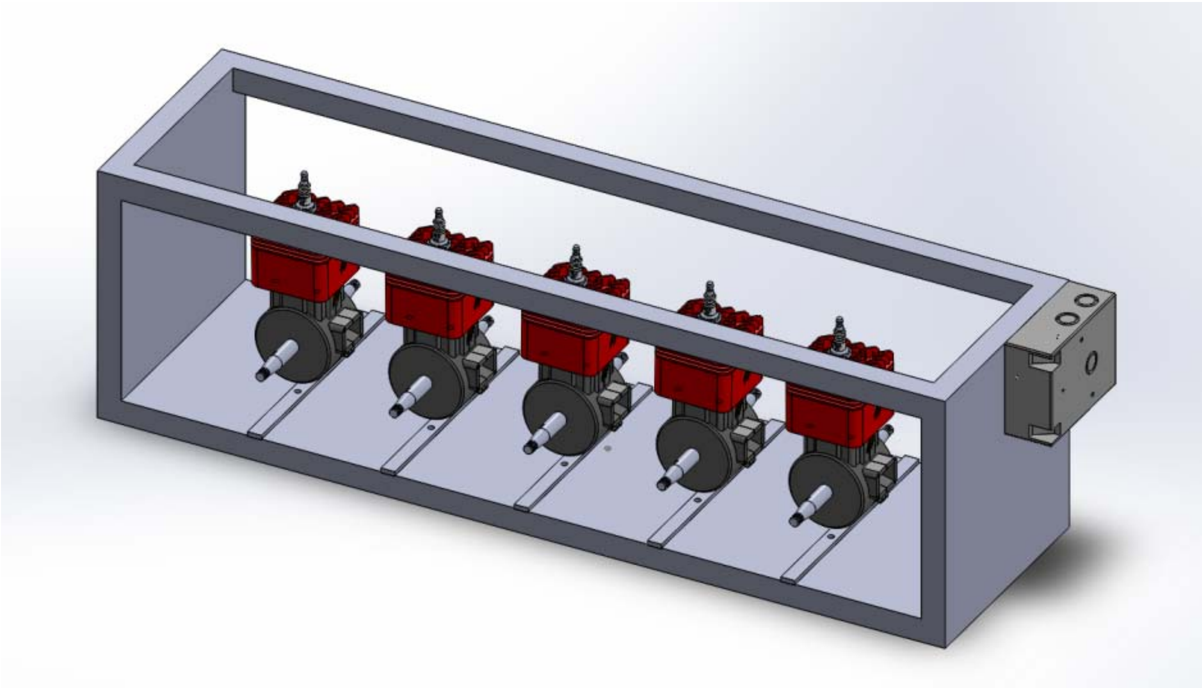


Figure 3.1: CAD drawing

5.0 DETAILED COST ESTIMATION

ITEMS	IMAGES	ESTIMATED UNIT PRICE	QUANTITY
Lawn Mower (known as Grass cutter engine)		RM 200	5
Engine oil		RM 50	1
Diesel		RM 1.80 per Liter	20 Liters
Bolts and Nuts / Screws	 	Few amounts	RM 10
Hoses		Depend	RM 50
		Total	∑ = RM 1146.00

6.0 EXPERIMENTAL PROCEDURE

1. Set up the Arduino programming for the controller to control the running speed of engine.
2. Set up the 5 parallel engines experimental test rig.
3. Fill in the diesel oil into each engines.
4. Start the five parallel engines at the same time.
5. Run the engine to middle range of running speed for six hours.
6. Record the volume of the fuel consumption after six hours.
7. Repeat the step from 2 until 5 for full range of running speed for six hours.
8. Repeat the step from 2 until 5 for middle range of running speed for six hour but the experiment run with single engine.
9. Repeat the step from 2 until 5 for full range of running speed for single engine for six hours.
10. Compare the results of the fuel consumption for middle and full range speed between five parallel engines and single engine.

7.0 EXPECTED TESTING RESULTS

1. The 5 parallel engines of experimental test rig can be run very well and smoothly.
2. After the experiment testing, the results showed that the fuel consumption of 5 parallel engines is low and more save fuel than the single engine which run in the same condition compare to the 5 parallel engines.
3. The 5 parallel engines work together can save fuel and save the lifespan of the engines, because the burden of works have been dividedly well to each 5 engines.

8.0 CONCLUSIONS

As a conclusion for our group project proposal, we expect that the fuel consumption is for each engine can be reduced as the arrangements of engines in parallel manner. The engine efficiency can be increase for a better engine performance as it can be used for many application widely in future.

9.0 REFERENCES

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10.0 APPENDIX

10.1 TEAM ORGANIZATION CHART

10.2 Project Gantt Chart

Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Project briefing and group forming														
Project proposal and title selection														
Title has been confirmed and proposal preparation														
Research on the needed materials														
Purchase materials and tools														
Fabricate and assemble the parts														
Testing and analysis														
Final project completion														
Run the experiment and record the results														
Project presentation														
Report preparation														
Report submission														

Plannin	
Actual	