DESIGN AND FABRICATION OF DISPLAY UNIT FOR EXPLODED COMPONENTS OF SINGLE CYLINDER 4 STROKE ENGINE

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Report submitted in partial of the requirements

for the award of Diploma in Mechanical Engineering

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project report and in my opinion this project is satisfactory in terms of scope and quality for the award of Diploma in Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this report is my own except for quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurently submitted for award of other degree.

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ABSTRACT

This report shows the design and fabrication of the display unit for exploded component of single cylinder four stroke engine. The objective of the report is to develop the procedures to design and fabricate the display unit in exploded view for use of in teaching plan. Design generation is showed and solid three dimensional structure model was developed with the solid work software. Material selection and the reason behind the selection are shown based on criteria predetermined. Based on the selection, acrylic and steel are selected. This project is difficult to make because it is hard to find the references and information of similar project and it's the method to arrange part of the engine. The results show each part of component can be successfully assembled.

ABSTRAK

Laporan ini menunjukkan reka bentuk dan fabrikasi unit pameran bagi enjin empat lejang satu silinder. Objektif laporan ini adalah untuk meneroka dan mengaplikasikan proseduruntuk membuat reka bentuk dan reka unit pameran enjin dalam rancangan pembelajaran. Perkara utama yang perlu diketahui ialah mengenai melukis reka bentuk unit pameran menggunakan perisian Solidwork. Pemilihan bahan dan sebab di sebalik pemilihan yang ditunjukkan berdasarkan kriteriayang telah ditetapkan. Berdasarkan pemilihan, akrilik dan keluli dipilih. Projek ini adalah sukar untuk dibuat kerana ia adalah sukar untuk mencari rujukan dan maklumat serta kaedah untuk menyusun bahagian-bahagian enjin. Keputusan dapat dilihat setiap bahagian dapat digabungkan.

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INTRODUCTION

1.1 PROJECT SYNOPSIS

This project involves in designing and fabricating the engine display unit. The Fabrication of the display unit is for the teaching purpose. Basically, the working session could be divided into three stages, which were the concept review and development, designing, and fabrication. The device was invented by using the fasteners like rivet that were used to build the structure.

Furthermore, the purpose of this project is to practice the knowledge and skill of the student that have been gathered before in engineering solving.This project also important to train and increase the student capability to academic research.

The project also educated the student in communication like in presentation and educate them to define their research in presentation .The project also will generate student that have capability to make a good research report in thesis form or technical writing .This project also can produce and train student to capable of doing with minimal supervisory and more in and more independent in searching, detailing and expanding the experiences and knowledge. This project also important to generate and increase interest in research work field.

1.2 PROBLEM STATEMENT

The challenge of the study are related to with designing the support structure and finally planning the engine component layout that best presenting all engine components and sub system for the display unit

1.3 PROJECT OBJECTIVE

The objective of this project is:

- To design and fabricate a display unit of exploded components of a 4 stroke single cylinder engine.
- To design a component and system layout which best presenting for display unit

1.4 PROJECT SCOPE

The main scope of the project is including designing, fabricating and assembling a display unit for exploded of single cylinder 4 stroke engine. Besides that, for utilization of software like solid work and apply skill like welding and machining process.

1.5 PROJECT PLANNING

This project is begun with made a research and literature review via internet, books, supervisor, and others relevant academic material that related to my title, this literature review take about two week. In the same time, I do some schedule management for this project which included schedule management by using Microsoft Office Project using Gantt chart system. After interpreting all of data, I need to tare down the engine of Yamaha Fz150i to collect each of the component. Furthermore I need to make a proposal for my project. It consist background of the project, introduction, objective and scope of work task.

The next task is, preparation of design concept and select the final design to draw in Solidwork software. This task needs skill using that software. In order to complete the design and drawing is need support from friends because my weakness is to draw using this software.

After that, I have to discuss about the fabrication process and select the suitable material for this project, and then preparation for mid presentation must be done in a week. The fabrication process is schedule to takes after mid presentation, including cutting, assemble, until finishing. The last task is the final report and final presentation. This report is guided by UMP thesis writing guided. All the task is scheduled to take about 14 weeks overall.

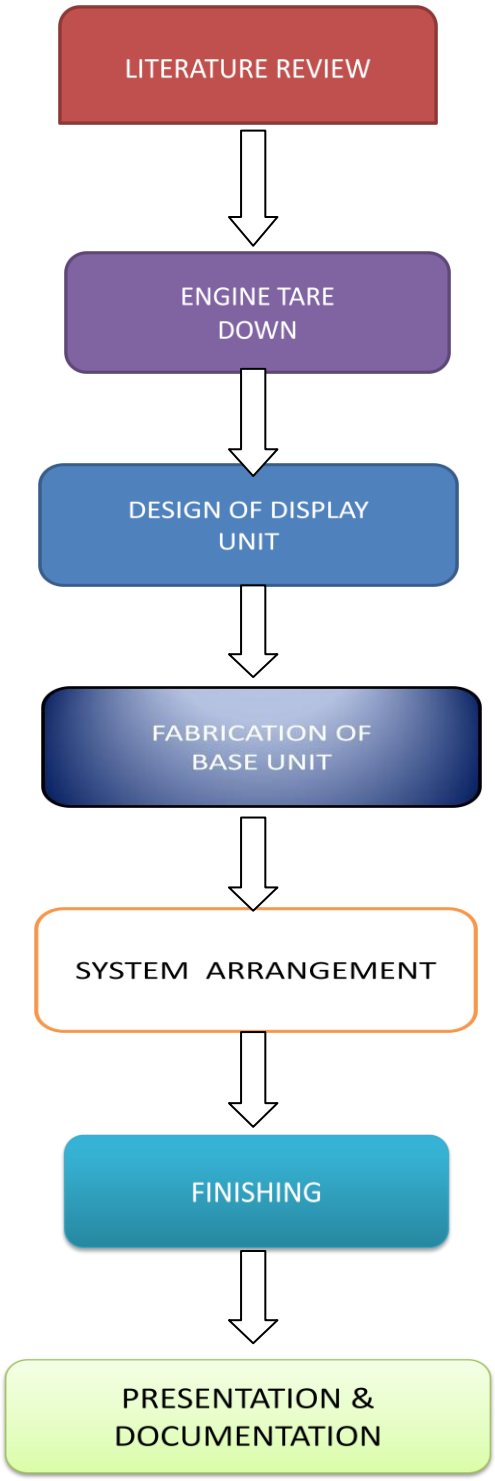

Table 1.1: Flow of the project

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The title design and fabrication of display unit for exploded component of single cylinder 4 stroke engine requires an amount of good understanding on the knowledge of the science. Therefore, executing a research is necessary to obtain all the information available and related to the topic. The information or literature reviews obtained are essentially valuable to assist in the construction and specification of this final year project. With this grounds established, the project can proceed with guidance and assertiveness in achieving the target mark.

2.2 ENGINE

2.2.1 Engine History

Engine: An engine is motor which converts chemical energy into mechanical energy History: Otto Cycle: Dr. Nicolaus Otto -1876

History One of the most important landmarks in engine design by Nicolaus August Otto in 1876 who is invented as effective four stroke

engine.that's why it is also called as “Otto cycle engine”. In 1885,German mechanical engineer,Karl Benz designed and built the world's first practical automobile to be powered by an internal-combustion engine. On January 29,1886. 2-Cycle Engine; Du gal Clerk -1878 History; Diesel Engine: Dr. Rudolph Diesel -1895

History:

Four Stroke Engine Four stroke engine was first demonstrate by Nikolaus Otto in 1876, hence it is also known as Otto cycle. It consist of 4 stroke ,one cycle operation is completed in 4 stroke of the piston, That is one cycle is completed in every 2 revolutions of the crankshaft. Each stroke consist of 180°,of crankshaft rotation and hence a cycle consist of 720°,of crankshaft rotation.

Working principle of four Stroke Engine Following are the four strokes 1 – Intake/Suction stroke 2 – Compression stroke 3 – Expansion stroke 4 – Exhaust stroke

2.3 COMPONENT AND OPERATION PRINCIPLE OF 4 STROKE ENGINE

2.3.1 Component

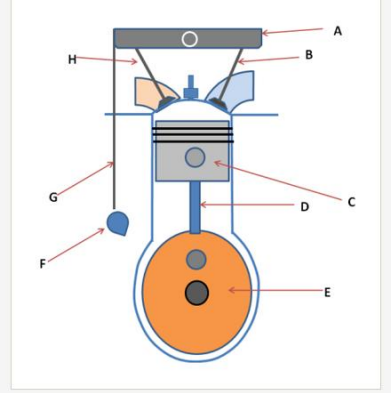

Figure 2.1: Component of 4 stroke engine

- Rocker (A)
- Inlet Valve (B)
- Piston (C)
- Connecting Rod (D)
- Crankshaft (E)
- Camshaft (F)
- Pushrod (G)
- Exhaust Valve (H)

Starting at the top, the cylinder head carries the valves, inlet (B) and exhaust (H), and the spark plug. In addition, in OHV designs the valves are operated by a rocking arm or lever (A), also carried in the head.

The head is generally bolted to the cylinder, and the cylinder is in turn bolted to the crankcases; however some 4 stroke designs have a combined cylinder and upper crankcase half. 4 stroke crankcases are split vertically on single cylinder designs; however the Japanese manufacturers in particular prefer horizontal splitting cases on the majority of their multi-cylinder engines. This horizontal splitting of the cases makes assembly and disassembly much easier.

The 4 stroke is so called as all the required functions to make the engine run are completed in 4 strokes of the piston-- inlet, compression, power, exhaust.

2.3.2 Inlet Stroke

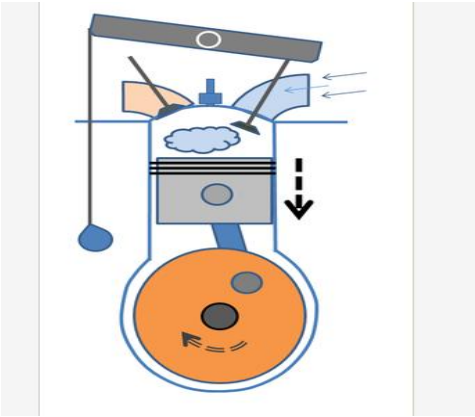

Figure 2.2: Inlet stroke operation

The first stroke is the inlet or induction stroke. As the piston moves down inside the cylinder, the inlet valve opens allowing a fresh change of mixed gasoline and air to enter the cylinder.

2.3.3 Compression

Figure 2.3: Compression operation

After the piston has completed the inlet stroke, the inlet valve closes and the piston returns back up inside the cylinder to compress the mixture in readiness for the power phase.

2.3.4 Power Stroke

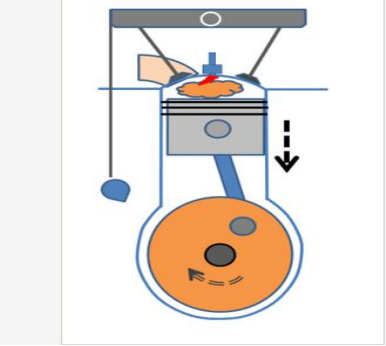

Figure 2.4: Power stroke Operation

After the gases have been ignited, the piston is driven down inside the cylinder forcing the crankshaft to rotate.

2.3.5 Exhaust

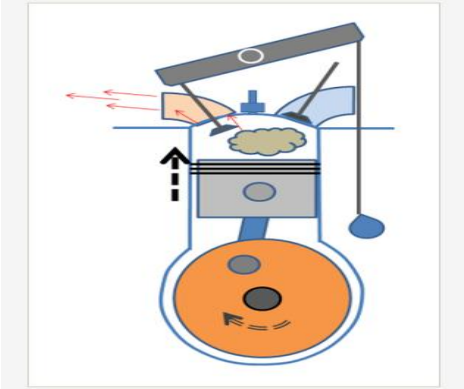

Figure 2.5: Exhaust stroke operation

As the piston completes its power stroke, the exhaust valve opens in readiness for the exhaust phase.

2.3.6 Engine Types

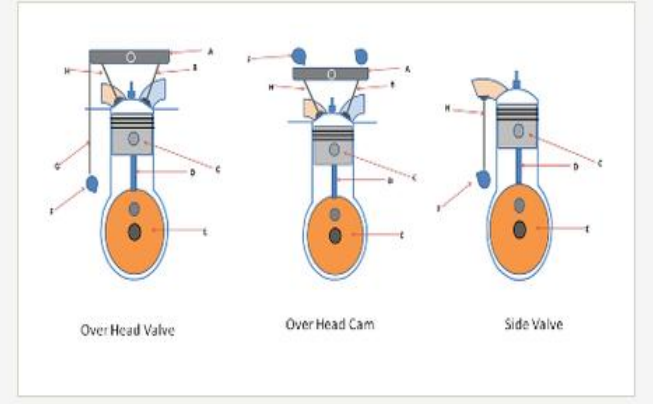

Figure 2.6: 4 stroke engine types

Over Head Valve:

The most common valve operating design up until the '70s was the OHV operated by push rods. The camshaft on this design is located in the crank cases or lower part of the cylinder block.

Over Head Cam:

In the over head cam design, a camshaft is carried in the cylinder head. Some designs have both an inlet and an exhaust camshaft (commonly known as DOHC, or double overhead cam).

Side Valve:

Side valve 4 strokes have their valves (B & H) mounted in the cylinder. This design was popular for many inexpensive, low performance engines.

2.4 YAMAHA FZ 150i COMPONENTS AND SUB SYSTEM

2.4.1: Cylinder block

The cylinder block, also called as engine block is the main bottom end structure. Usually it is made up of iron or aluminum. Function: In the bore of the cylinder the fresh charge of air-fuel mixture is ignited, compressed by piston.

2.4.2: Cylinder Head

The cylinder head is flat plate of metal bolted to the top of cylinder block with head gasket in between; Top of head contains rocker arm & push rod to transfer rotational mechanic from the crankshaft to linear mechanic to operate the valves. It is the key to performance of the internal combustion chamber.

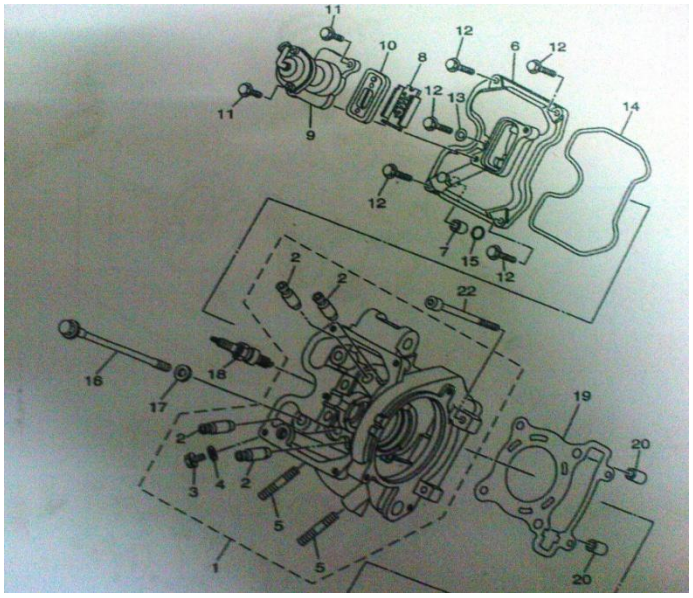

Figure 2.7: Cylinder Head

2.4.3: Piston

Piston is connected to the crankshaft through the connecting rod, when piston moves downward sucks fresh air-fuel mixture in suction stroke & ignited inside the cylinder due to this high temperature and pressure generated, thus expanded gas force down to piston.

2.4.4: Piston Rings

A piston ring is an open ended ring that fits into a groove or outer diameter of the cylinder. Piston rings have three major functions which are to seal the expansion chamber, support heat transfer & finally, regulate the engine oil consumption.

2.4.5: Connecting Rod & Gudgeon Pin

A small end of connecting rod is connected to the piston and other end is connected to the crankshaft. Its function is to transmit the reciprocating motion of piston to the rotary motion of crankshaft. Gudgeon pin is used to connect the piston & connecting rod**.**

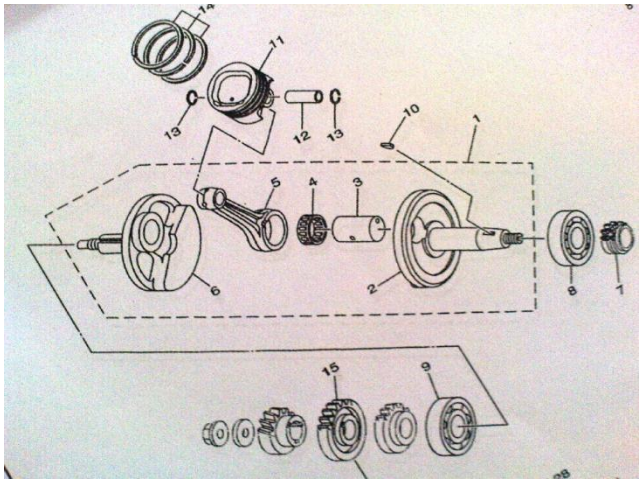

Figure 2.8: Crankshaft & piston

2.4.6 Crankshaft

Crankshaft is the part of an engine which translates the reciprocating linear motion of piston into rotation. To convert the reciprocating motion into rotation, the crankshaft has “crank pin”, it typically connects to flywheel, to reduce the pulsation characteristics four stroke cycle. The main function of crankshaft is receives the oscillating motion from connecting rod and gives rotary motion to main shaft. It also drives the camshaft which actuate the valves of the engine.

2.4.7 Camshaft

Camshaft is a part which is used in piston engine to operate valves. It consists of cylindrical rod with cams. The relationship between camshaft rotation & crankshaft rotation is of critical importance. Camshaft Since valves controls the flow of air-fuel mixture intake & exhaust burnt gases. Valves must be opened & closed at appropriate time during the stroke of piston, For this reason ,the camshaft is connected to the crankshaft either directly, via a gear mechanism, or indirectly via belt/chain called a timing belt or timing chain, the camshaft rotates at the same rate of crankshaft.

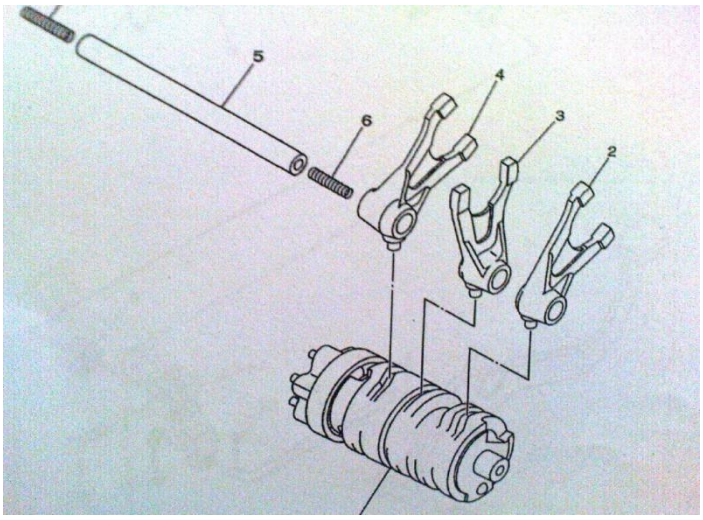

Figure 2.9: Shift cam & fork

2.4.8 Spark plug

Spark Plug Spark plug is used in petrol engine only which is help to ignite the air-fuel mixture for combustion.

2.4.9 Inlet valve & Exhaust valve Inlet valve

Its function is to intake the fresh air-fuel mixture into the cylinder. Exhaust valve: Its function is to exhaust is the burnt gases by the force of piston.

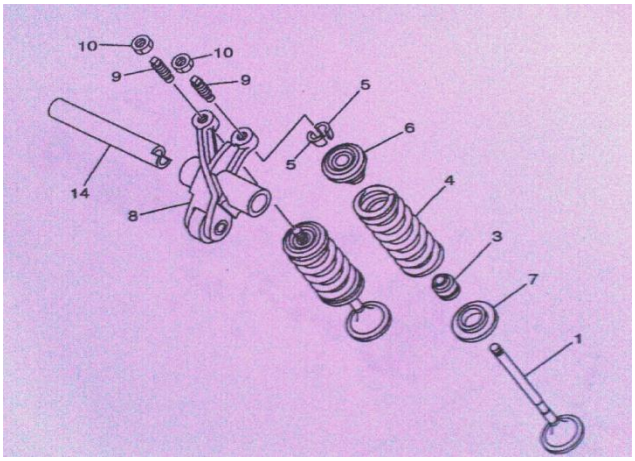

Figure 2.10: Valve

2.4.10 Transmission

All manual transmission two-wheelers use a sequential gearbox. Most modern motorcycles (excepting scooters) change gears (of which they will increasingly have five or six) by foot lever. On a motorcycle either first or second gear can be selected from neutral, but higher gears may only be accessed in order - it is not possible to shift from second gear to fourth gear without shifting through third gear. A five-speed of this configuration would be known as "one down, four up" because of the placement of the gears with relation to neutral. Neutral is to be found "half a click" away from first and second gears, so shifting directly between the two gears can be made in a single movement.

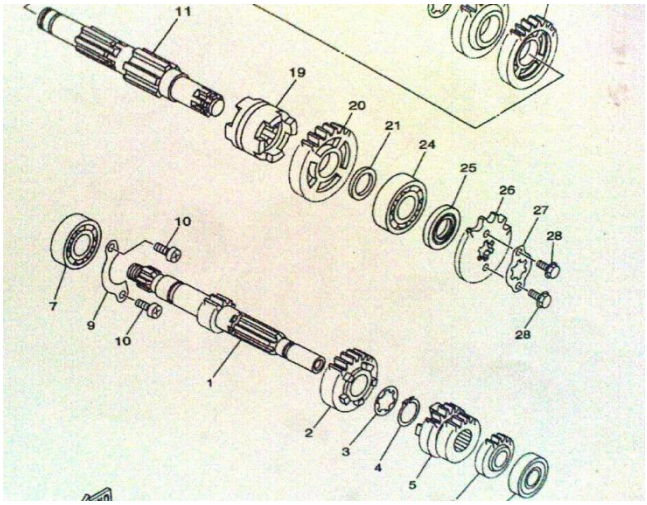

Figure 2.11: Transmission

2.4.11 Clutch

Clutch is to couple and uncouple the transmission and the engine. It can be disengaged to allow free rotation of engine without transfer to wheels as well as to permit changing or selecting of gears. It can be made to slip for smooth engagement and lessen the shock on gears, shafts and other parts.

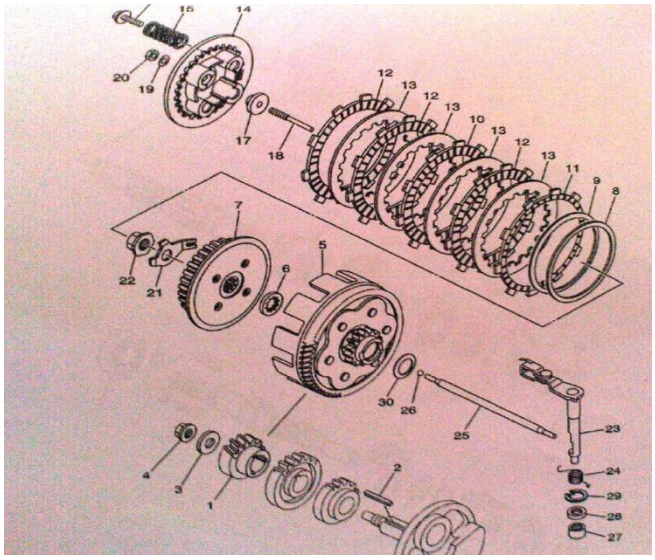

Figure 2.12: Clutch system

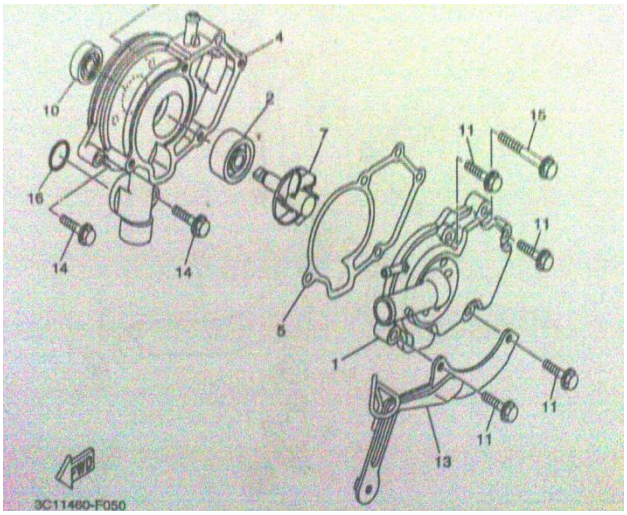

Figure 2.13: Water pump

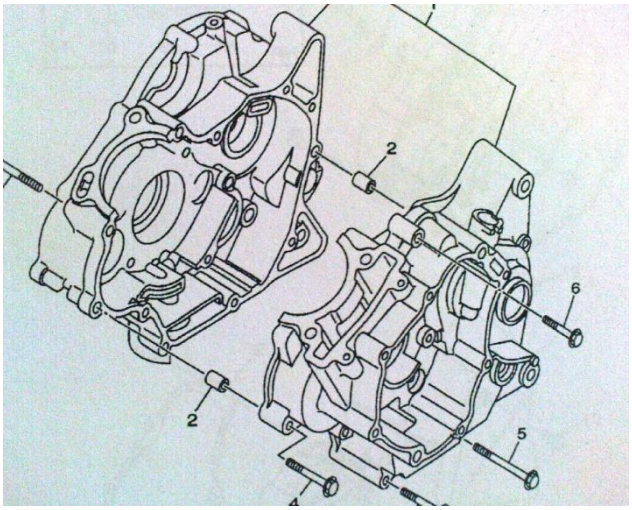

Figure 2.14: Crankcase

2.5 BASIC PART

2.5.1 Wheel: Usually made from rubber that joined together with the bolt and nut with steel frame to ensure strength.

2.5.2 Body: For outdoor use such as workshop that requires full strength of body, Hollow bar used to make the main body. This part must be made from hard material so it can support heavy load. In addition, this material has a property with light in weight so it can reduce the weight of the display unit

Figure 2.15: Hollow square bar

2.5.3 Cover/frame: for the frame of the display unit the material used is acrylic. It is because acrylic is transparent and very suitable for teaching purpose to show the detail for each component of engine. Acrylic has a low water absorption, it also can be saw, drilled, and machined like wood or soft metals. When heated to a pliable state, Plexiglas can be formed to almost any shape.

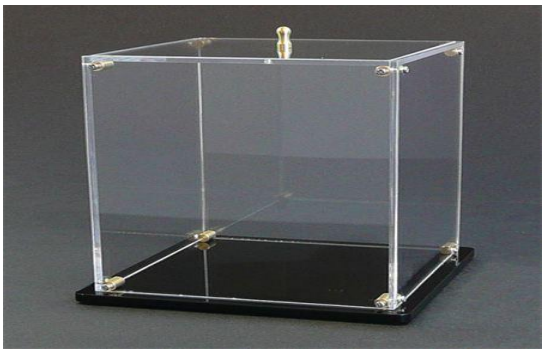

Figure 2.16: Acrylic

2.6 GRINDING PROCESS

Grinding is a finishing process used to improve surface finish, abrade hard materials, and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material. Information in this section is organized according to the subcategory links in the menu bar to the left.

In grinding, an abrasive material rubs against the metal part and removes tiny pieces of material. The abrasive material is typically on the surface of a wheel or belt and abrades material in a way similar to sanding. On a microscopic scale, the chip formation in grinding is the same as that found in other machining processes.

The abrasive action of grinding generates excessive heat so that flooding of the cutting area with fluid is necessary.

Figure 2.17: Grinding machine

2.7 DRILLING

2.7.1 Introduction

A drill is a tool with rotating drill bit used for drilling holes in various materials. Drills are commonly used in woodworking and metalworking. The drill bit was gripped by a chuck at one end of the drill, and is pressed against the target material and rotated. The tip of the drill bit dose the work of cutting into the target material, slicing off thin shaving (twist drills or auger bits) or grinding off small particles (oil drilling)

2.7.2 HAMMER DRILL

The hammer drill is similar to a standard electric drill, with the experience that was provided with a hammer action for drilling masonry. The hammer action maybe engaged or disengaged as required. The hammer action is cheap but delicate. It uses two cam plates to make chuck accelerate towards to the work. However because of the relative masses of the chick bit and the remainder of the drill the energy transfer is inefficient and will fail to penetrate harder materials and vibrates the operator's hand. The cams were fast. Compare this to a rotary/ pneumatic hammer drill where just the bit is accelerate to the work is sucking the bit inwards.

Large cam hammer drills, especially transverse motor, are crude in their action. The energy delivered in each stroke is highly variable. The cheaper drill wil smash its way through the work and vibrate the surroundings which can cause lots of collateral damage.

2.8 RIVET

2.8.1 Introduction

A rivet is a mechanical fastener. Before it is installed it consists ofsmooth cylindrical shaft with a head on one end. The end opposite the head is called the buck-tail. On installation the rivet is placed in a pre-drilled hole. Then the tail is "upset" (i.e. deformed) so that it expands to about 1.5 times the original shaft diameter and holds the rivet in place. To distinguish between the two ends of the rivet, the original head is called the factory head and the deformed end is called the shop head or buck-tail.

Because there is effectively a head on each end of an installed rivet it can support tension loads (loads parallel to the axis of the shaft); however, it is much more capable of supporting shear loads (loads perpendicular to the axis of the shaft). Bolts and screws are better suited for tension applications.

Fastenings used in traditional wooden boat building like copper nails and clinch work on the principle of the rivet but they were in use long before the term rivet was invented. So, where they are remembered, they are usually classified among the nails and bolts respectively.

2.8.2 Blind Rivet

Blind rivets are tubular and are supplied with a mandrel through the center. The rivet assembly is inserted into a hole drilled through the parts to be joined and specially designed tool used to draw the mandrel into the rivet. This expands the blind end of the rivet and then the mandrel snaps off. (These are also commonly called pop rivets from the sound and feel through the setting tool when the mandrel breaks.) These types of Blind rivets have non-locking mandrels and are avoided for critical structural joints because the mandrels may fall out, due to vibration or other reasons, leaving a hollow rivet that will have a significantly lower load carrying capability than solid rivets. Furthermore, because of the mandrel they are more prone to failure from corrosion and vibration.

Prior to the adoption of blind rivets, installation of a solid rivet typical required two assemblers: one person with a rivet hammer on one side and a second person with a bucking bar on the other side. Seeking an alternative, inventors such as Carl Cherry and Lou Huck experimented with other techniques for expanding solid rivets. Unlike solid rivets, blind rivets can be inserted and fully installed in a joint from only one side of a part or structure, "blind" to the opposite side. Due to this feature, blind rivets are mainly used when access to the joint is only available from one side.

The rivet is placed in a pre-drilled hole and is set by pulling the mandrel head into the rivet body, expanding the rivet body and causing it to flare against the reverse side. As the head of the mandrel reaches the face of the blind side material, the pulling force is resisted, and at a predetermined force, the mandrel will snap at the break point of the mandrel. A tight joint formed by the rivet body remains, the head of the mandrel remains encapsulated at the blind side, although variations of this are available, and the mandrel stem is ejected.

The rivet body is normally manufactured from one of three methods:

i. Wire, the most common method

ii. Tube, common in longer lengths, not normally as strong as wire

iii. Sheet, least popular and generally the weakest option.

FIGURE 2.18: Three aluminum blind rivets: 1/8", 3/32", and 1/16"

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

For the diagram in Figure 3.1 below, the project was starts with the literature review and research about the title. This chapter is consist about the review of the concept of the display unit device, type of the display unit, and the features of the engine display unit used in various fields. These tasks have been done through the research based on the internet, books, and other sources.

After gathering all the relevant informations, the project undergoes the designation process .In this step, the knowledge gathered are used to make several sketches or designs that may be fit for this project. After that, design consideration have been made in order to chose the best design so later on it can be build-up. The selected design's sketch is then transfered into the solid modelling generated by the solid work program. The materials and the measurements needed for the device were listed down and calculated in order to give an ergonomic shape of the device.

The fabrication process that involved in this project are assembling, welding, drilling and fastening. After each of these processes are finished, the product undergoes the inspection session so that the product obeys the design and drawing that have been made earlier.

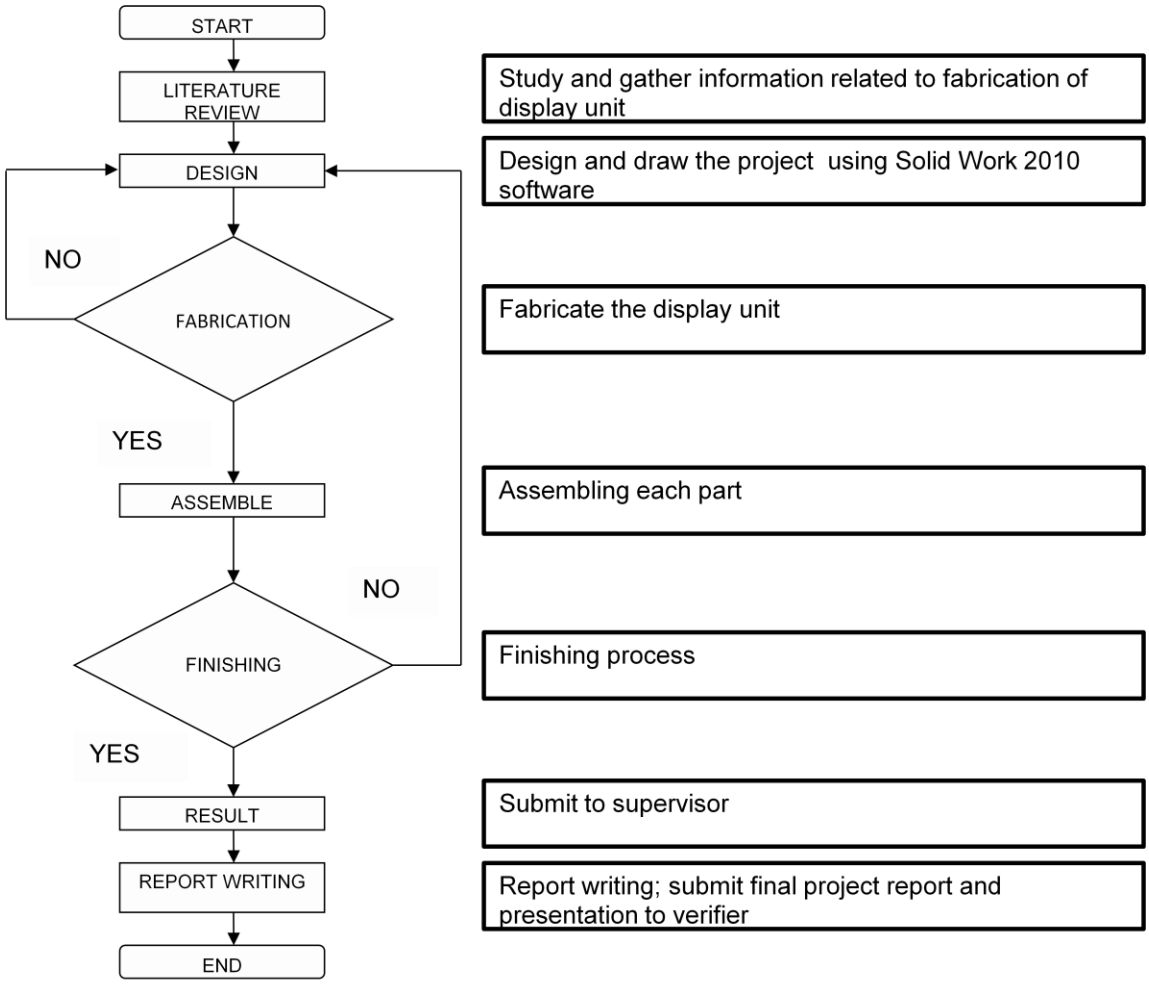

Table 3.1: Flow chart

3.2 YAMAHA FZ 150i

Engine used for this project is 4 stroke engine Yamaha Fzi 150. The Yamaha FZ150i is a small capacity naked bike made by Yamaha Motor. It was launched in Malaysia on January 2008 at First World Hotel, Genting Highlands as the first completely knocked down (CKD) bike to be fuel-injected in Malaysian motorcycle market.

3.2.1 Yamaha FZ 150i Specification

Overall length x width x height: 2,000 x 705 x 1,035 mm

Seat Height: 770 mm

Wheel base: 1,282 mm

Minimum Ground Clearance: 167 mm

Dry weight/ Curb weight: 114 kg

Fuel oil capacity: 12.0 litres

Engine: 150 cc, liquid cooled 4-stroke, SOHC, single cylinder

Clutch type: Wet, multiple-disc

Transmission: constant mesh 5-speed

Cooling system: Liquid

Brake: front / rear Single disc brake / Drum Brake

3.3 DESIGN

The Design of the display unit must be compliance to several aspects. The design consideration must be done carefully so the design can be fabricated and the parts are all functioning. The aspects that must be considered in designing the display unit for the engine are:

3.3.1 Strength: Must have certain strength to ensure that it can load heavy items.

3.3.2 Ergonomic Factors: The display unit must be user friendly as easy to see and convenience.

3.3.3 Suit to environment: The display unit must be suitable with the area to be shown.

3.4 DRAWING

The drawings are divided into two categories, which are:

3.4.1 Sketching: All the ideas for the trolley fabrication are sketched on the paper first, to ensure that idea selection and be made after this, and

3.4.2 Concept 1

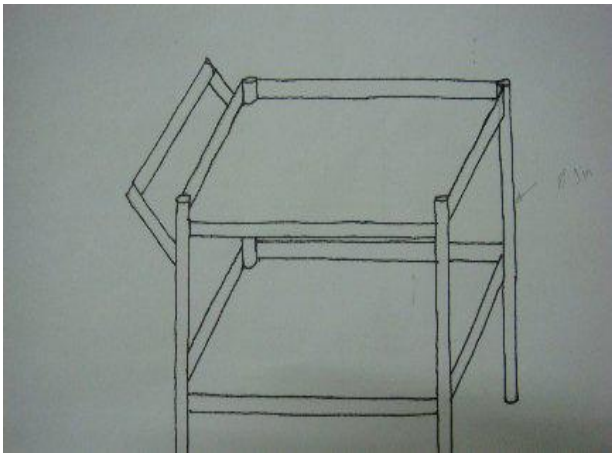

Figure 3.1: 1st concept

This type of design is very lightweight and easy to fabricate because the design is square shape. Other than that it doesn't need a lot of material but no feature that can protect the engine part.

3.4.3 Concept 2

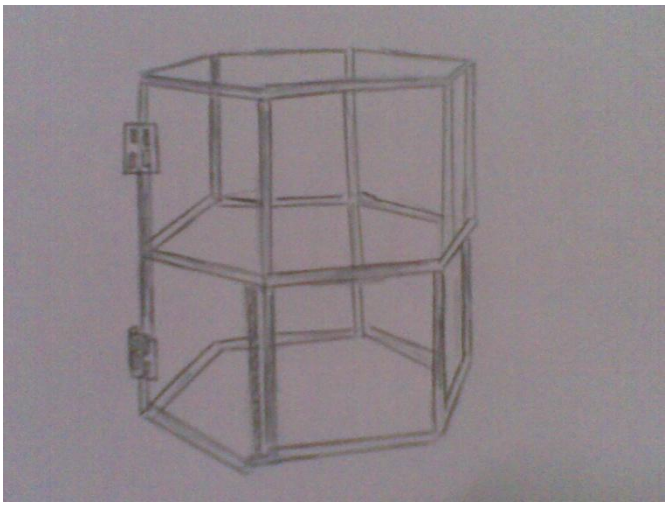

Figure 3.2: 2nd concept

It is good in strength as it has to withstand the weight of engine component. Besides that, more space to place the component or part of engine. However the size is too big and it is a bit hard to be fabricated because the design is hexagonal.

3.4.4 Concept 3

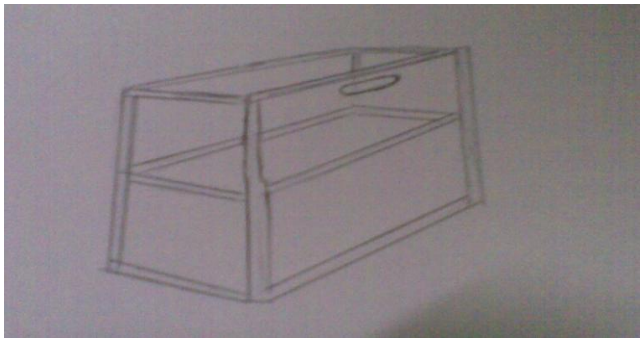

Figure 3.3: 3rd concept

This design is easy to fabricate but difficult to find the method to hang the component of engine.

3.4.5 Concept 4

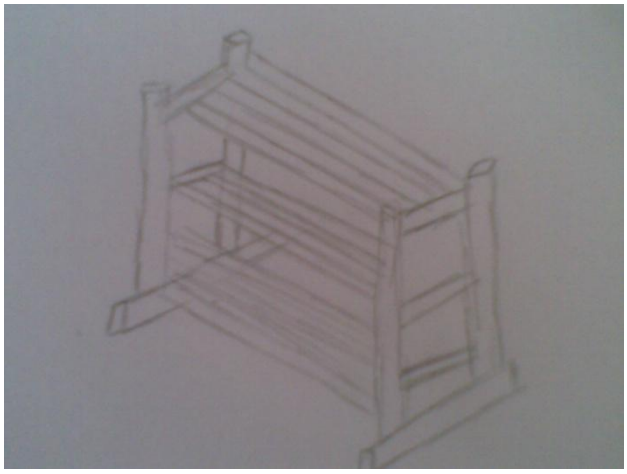

Figure 3.4: 4th concept

Easy to fabricate and has a lot of arrangement of steel to support the engine component. This design also more easier to hang the components of the engine.

3.5 SELECT FINAL DESIGN

After the design concept, the best design was studied to relate it with criteria selection. Then make decision which design is the best. For this project, design concept 4 is the best after considering the criteria selection.

Table below is used to select which design is the best:

Screening method

CRITERIA	CONCEPT			
	A	B	C	D
Easy to manufacture	+	+	+	+
Easy to use	+	0	-	+
Portability	+	-	0	+
Function	0	0	-	+
Shape	-	0	0	0
Strength	0	+	-	+
∑+	3	2	1	5
∑0	2	3	2	1
∑-	1	1	3	0
Net score	2	-1	-2	5
Ranking	2	3	4	1

Table 3.2: Screening method

"0": same as "-" : worse than "+" : better than

Concept design 4 has the higher net score than the other concept. So, this concept had been chosen to be final concept and will be fabricate.

3.7 SOLIDWORK DRAWING

After a design has been selected, the next step in the designing process in dimensioning. The dimensioning is base on relevant dimensions. After dimensioning, the engineering drawing of the design is drawn using Solidworks software, at this stage solid modelling method is used. Part by part solid modelling created according to the dimension done before, after all part created, the 3D model is assembled with each other base on the design.

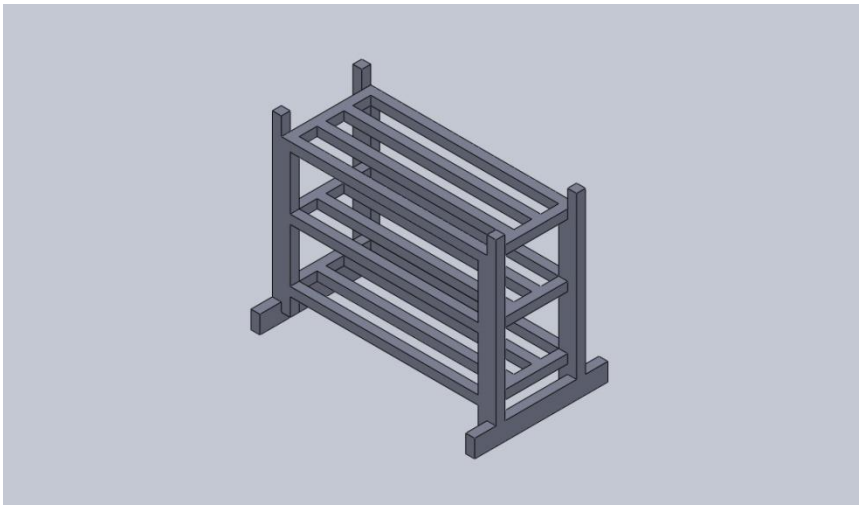

Figure 3.5: Solidwork Drawing

This design show that the final idea of the basic part for display unit using hollow square bar steel. In addition, I need to add base for wheel so that this display unit may move easily.

3.7 DESIGN OF ENGINE LAYOUT

3.7.1 Upper layer

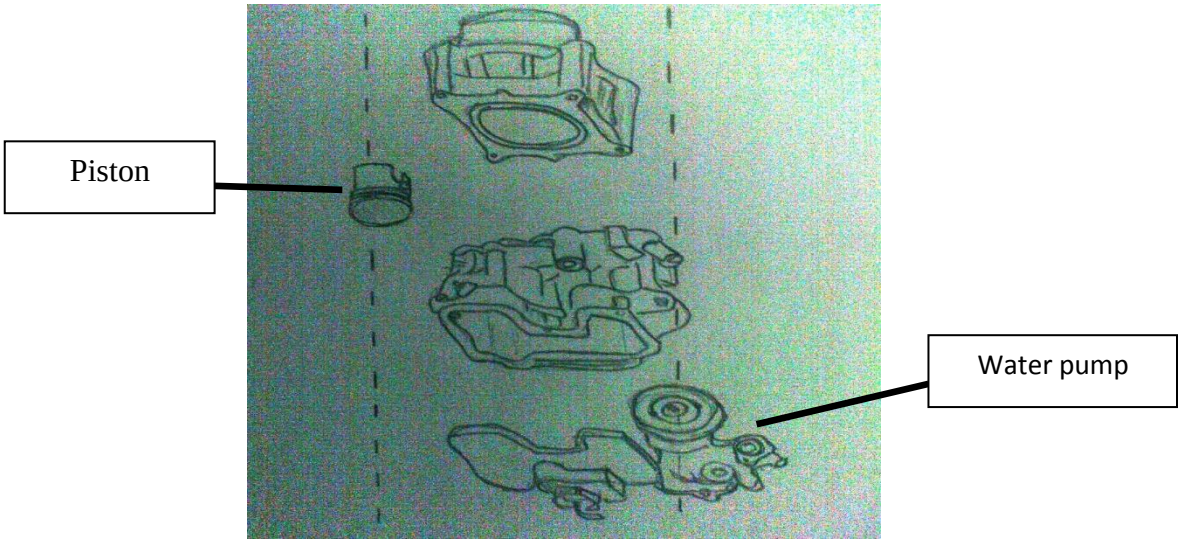

Figure 3.6: Layout sketching for upper layer

3.7.2 Middle layer

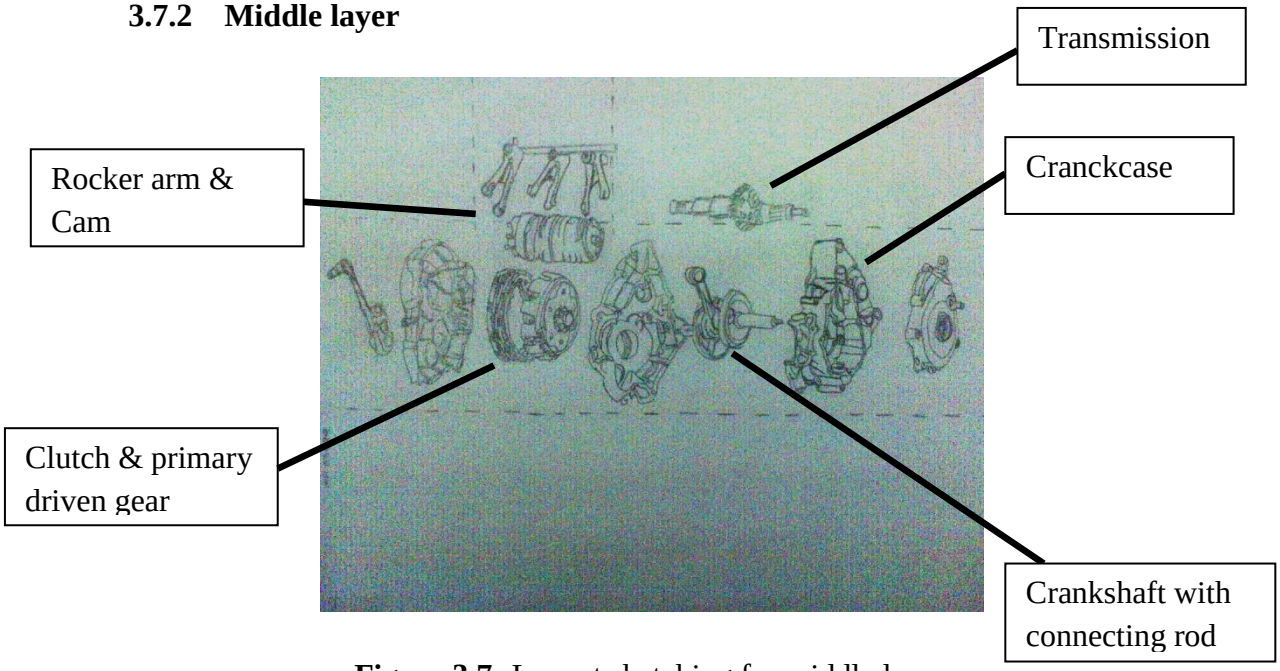

Figure 3.7: Layout sketching for middle layer

3.7.3 Bottom layer

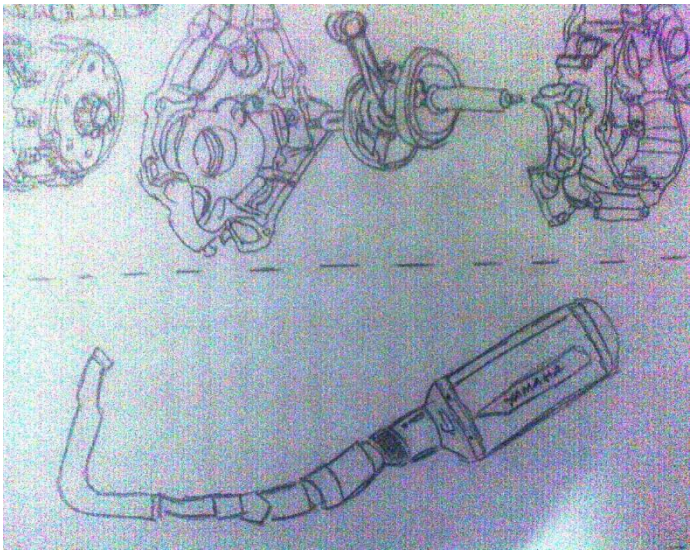

Figure 3.8: Exhaust that was located at the bottom support structure

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

The purpose of this chapter is to discuss the results after the fabrication of this product. This chapter also will discuss the flow of fabrication process of the product. Lastly, this chapter will also discuss about some the problems of the product and the way to improve it.

4.2 FABRICATION PROCESS

In order to make the design come reality, fabrication process needs to be done first. The fabrication process starts from dimensioning the raw material until I finish as a desire product. The processes that involve are:

4.2.1 Getting material

Figure 4.1 introduces the material have in UMP mechanical laboratory. This rack have more types of steel like L- shape sheet, rectangular hollow steel, rectangular steel, and etc.

Figure 4.1: Material

4.2.2 Measuring and marking

After get the material, acrylic need to be measure and mark for the cover of the display unit. The equipment used in this process is measuring tape and maker pen.

Figure 4.2: Acrylic need to be measure and mark

4.2.3 Acrylic cutting process

Figure 4.3 introduce the process cutting the acrylic with hand saw after measurement and marking process.

Figure 4.3: Cutting using hand saw

4.2.4 Drilling

After assemble all the basic part of the display unit, I need to make a few hole at the acrylic and a few section of hollow square bar. The purpose is to attach the acrylic as a housing of the display unit. Before make a hole, I need to mark a few section then drill with hammer drill for riveting process.

4.2.5 Grinding and painting the support structure

For this process, any rough surface to give smooth and safe surface. After the grinding process I need to paint the basic part to prevent it from expose to the corrosion.

Figure 4.4: Grinding rough surface

Figure 4.5: method of painting

4.2.6 System arrangement

After painting process was done, the process that I need to do is arrangement of engine system. There are a few problems during this process such as, a lot of engine component was missing and very difficult to hang a few small component.

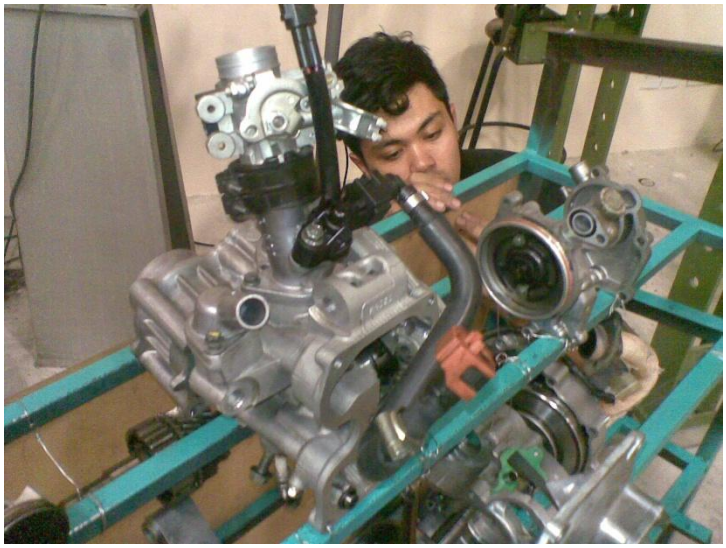

Figure 4.6: Arrangement of component

4.3 PROJECT PROBLEMS

4.3.1 Literature review

That is lack of product of display unit of engine, and very difficult to find the display unit of engine in exploded view through internet or other source, it's hard for student to get the idea and make a reference.

4.3.2 Designing and drawing

It is very difficult to make a 3D drawing because lack of skill in using Solidwork software, and it took a lot of time to study and make a correction when do the drawing.

4.3.3 Material preparation

In faculty central store, there are limited resources on type of material. Therefore, I have to change my first plan, and have to reduce the size of the basic part of display unit. I also have to reuse the steel from my old project because the lack of amount of material in store.

4.4 FINAL PRODUCT

The final products in several views are shown in the figure below:

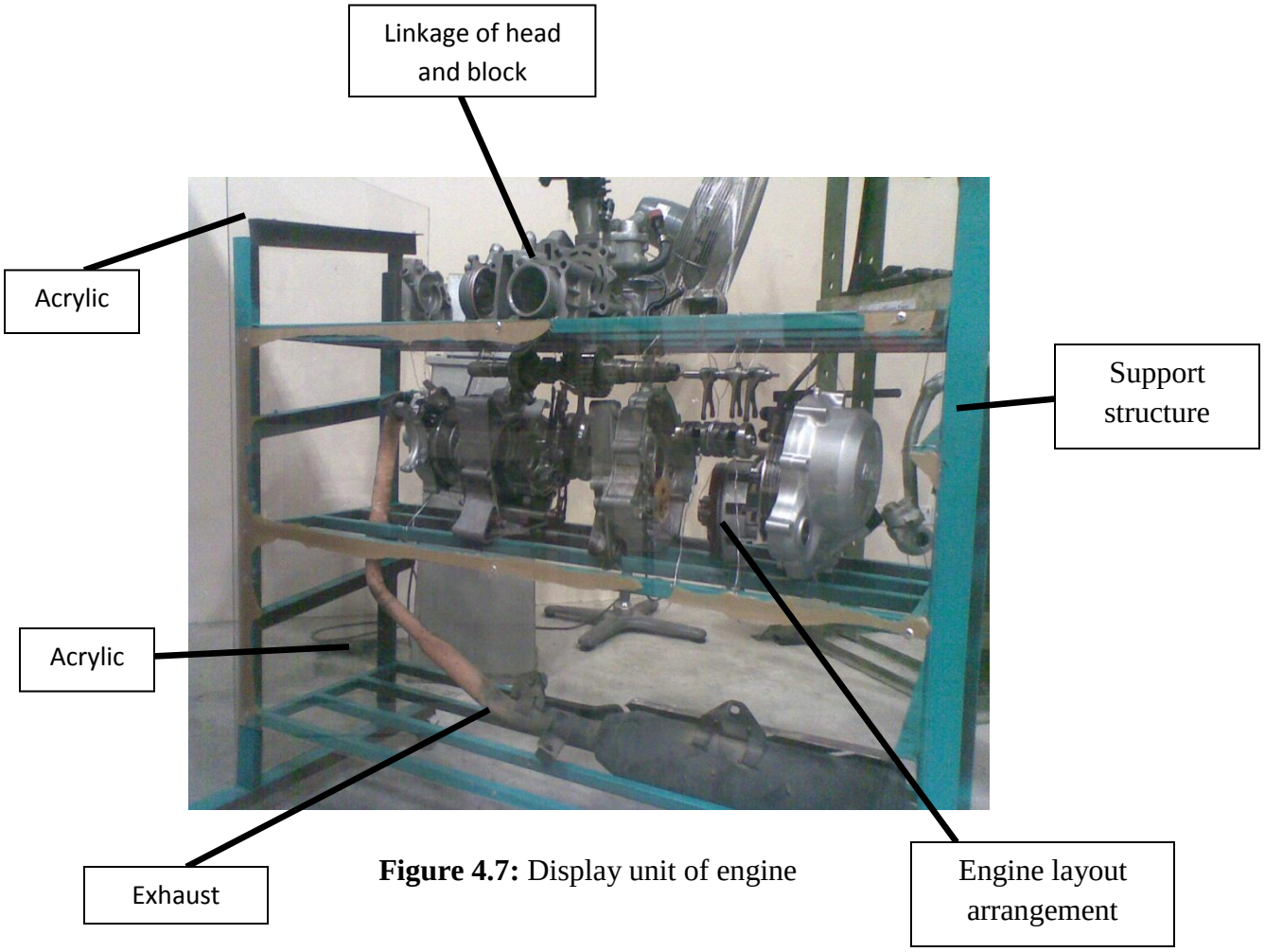

Figure 4.7: Display unit of engine

Figure 4.8: Engine layout

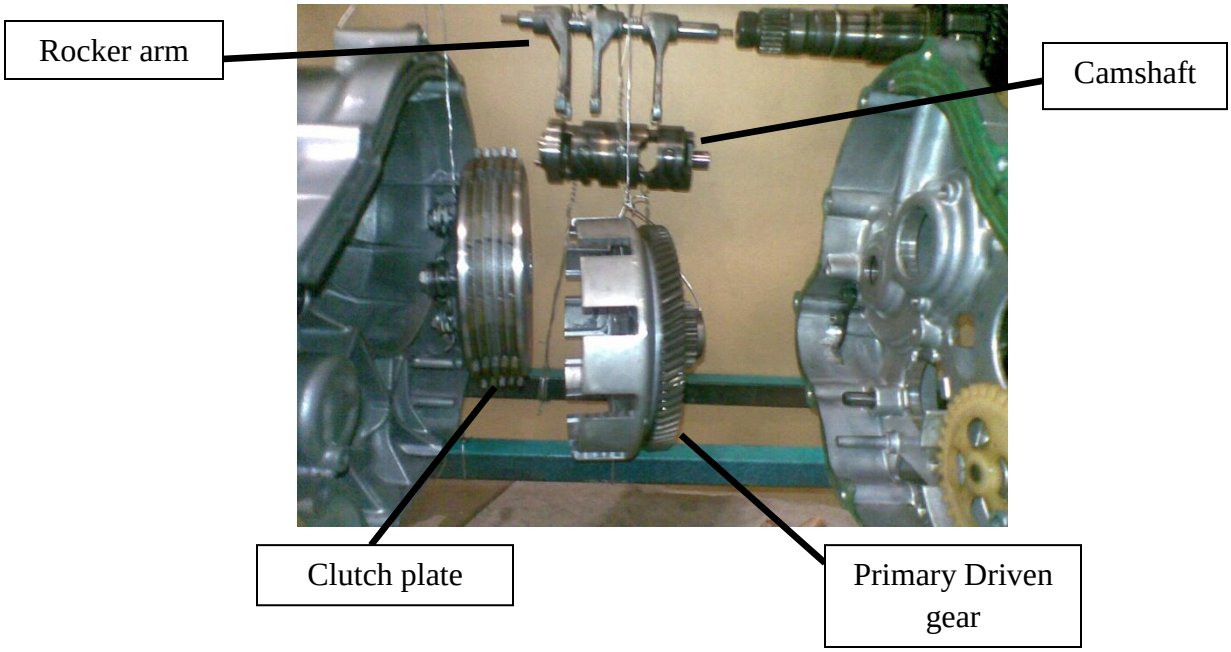

Figure 4.9: Component & name

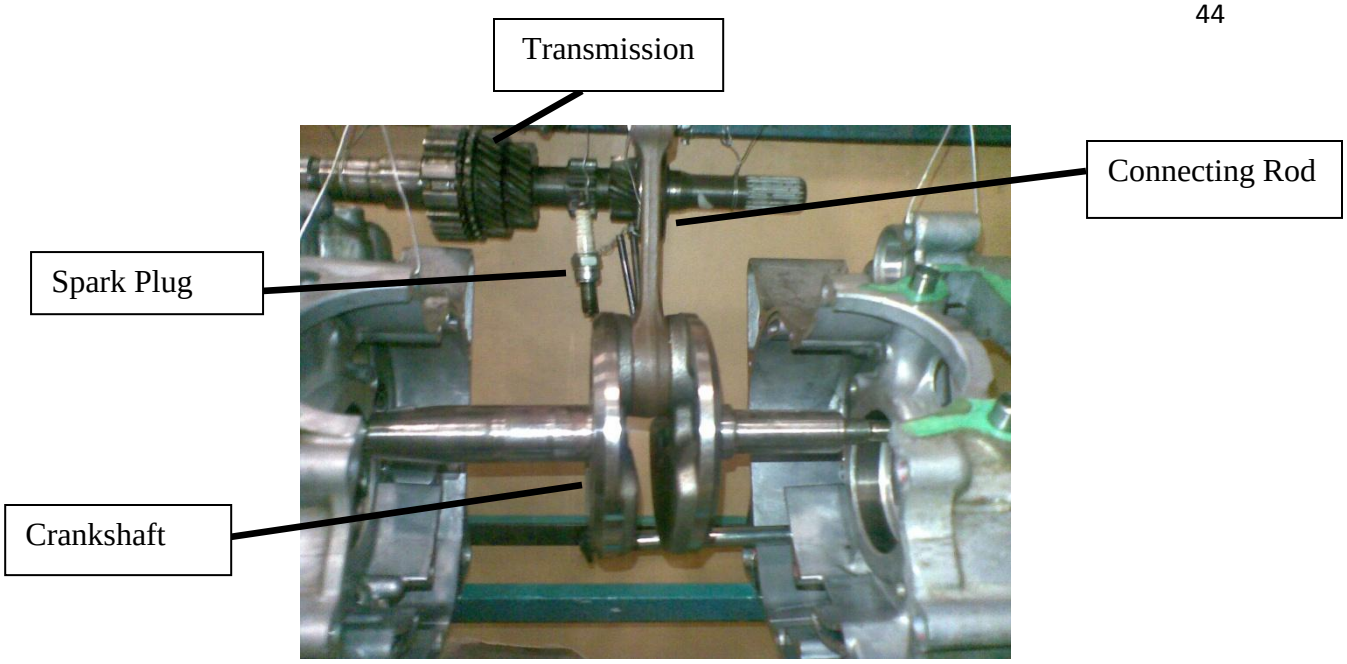

Figure 4.10: Component & name

Figure 4.11: Component & name

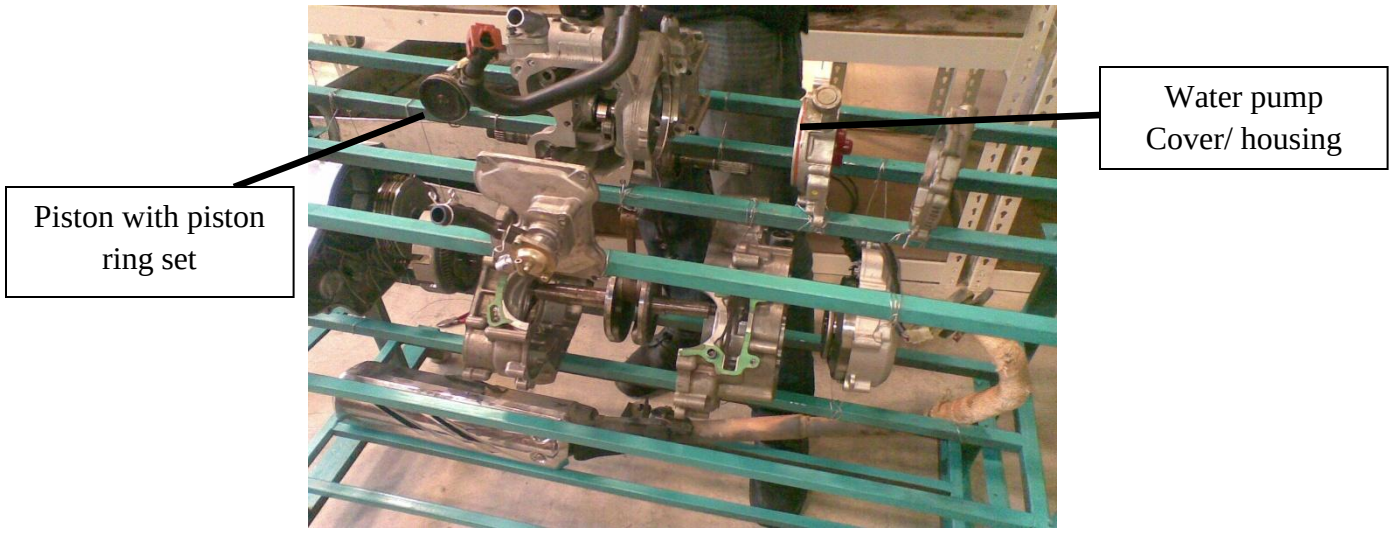

Figure 4.12: Component & name

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

This chapter is about the problem encounter before, during and after the project. This chapter also will discuss about conclusion of the project. Problem that will be discussed here is the entire problem encountered in every task in the project.

For the conclusion the project is achieves the objectives. The basic parts of the display unit were drawn using Solidwork 2010 software. The fabrication of each part are important to ensure dimension accuracy to avoid problem when assembly process. Fabrication process is using welding, drilling, and cutting machine. The last step in scope of work is assembling. In this scope we just need assemble each part.

The drawing and fabrication process is complete. The assembling process is quite satisfactory. Every part can assemble. The hollow square steel was exposed to the air and water, so the method use is painting use to prevent from corrosion.

Lastly, with the fabrication of this display unit, it will make easier for teaching and make people familiar with the engine component and may recognize well the important part.

5.2 RECOMMENDATION

This part is about the aspects will be added to this project to produce a better product. For the recommendation for this project firstly make a better design and use a strength material for basic part.

Other than that, make an improvement for the display unit by added lighting features and add more component of the engine in the display unit. To make the display unit look well-organized, we must arrange all of engine component in order and more systematic. Moreover, add the label for each part, so that people may recognize easily the shape and the name of components.

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