A PROJECT REPORT

ON

"DESIGN AND DEVELOPMENT OF ELECTROMAGNETIC ENGINE"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
MECHANICAL ENGINEERING

BY

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UNDER THE GUIDANCE OF
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Plot No.2 & 3, Sector - 16,Near Thana Naka,
Khandagaon, New Panvel - 410206

2018-2019

AFFILIATED TO

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CERTIFICATE

This is certify that the project entitled

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submitted by

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Mechanical Engineering) at ***Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai*** under the University of MUMBAI. This work is done during year 2018-2019, under our guidance.

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Project I Approval for Bachelor of Engineering

This project entitled "**DESIGN AND DEVELOPMENT OF ELECTROMAGNETIC ENGINE"**by **ANSARI FUZAIL KHILAFAT NAHEED(13ME11), SYED AFSAR SHAH ANWAR SHAH MEHRUNISSA (18DMET01), SHEKH JAMIR SHEKH RAFIK SHEKH SURAIYA(17DME151), SHAIKH MOHAMMED IRFAN ABDUL KHALIQUE(17DME146)** is approved for the degree of ***Bachelor of Engineering in Department of Mechanical Engineering.***

Examiners

1. .....
2. .....

Supervisors

1. .....
2. .....

Chairman

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Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

With the diminishing fossil fuel resources and unabated increase in energy costs and environmental concerns, engines using alternate energy sources such as bio-fuel, solar power, wind power, electric power, stored power, etc. are being developed around the world. However, such engines have many limitations. Production of bio-fuel takes enormous resources and they still pollute the environment. They do not meet the ever increasing energy demand as well. Similarly, the solar power is not efficient. Added to all, the initial capital and subsequent maintenance costs for machines that use alternate energy sources are very high. Hence, in the absence of a viable alternative, until now, switching to new technology by changing from traditional Internal Combustion engines has been a challenge.

Keywords: FOSSIL FUEL, ENGNE, ENVIRONMENT, SOLAR.

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Chapter 1

Introduction

Today we are facing major problems of fuel crisis. As there is increase in the demand of vehicle, population is increasing day by day. But by survey of fuel availability we come to know that increase in demand doesn't fulfill by nature so there will be a big problem of fuel crisis. Next problem is pollution. The combustion inside the engine produces different gases (like CO_2, CO and other poisonous gases) which are further given out, which will get mix with environment and it leads to air pollution. Also we know that a conventional IC engine has many losses, so it gives very less efficiency i.e. of about 25-35% only. Also we know that the construction of an IC engine is very complicated.

Even though why we use an IC engine? Because we did not have any option. But by this project we can make substitution for conventional engine and which will be better solution over all mentioned problems. So we have taken this area as a project. Till today lot of research is going on for alternate fuels & maximum utilization of available. Magnetic reciprocating engine is the engine which runs on magnetic force developed by the permanent and electromagnet.

1.1 Purpose

Today we are facing following major problems regarding to IC engine. Fuel crisis, Pollution, Efficiency

1.2 Objective

The main purpose of this project is to improve the efficiency and reduce the problems of fuel crisis, pollution etc.

[1] To find substitute to IC engine:- because an IC engine is having less efficiency I,e about 25- 35% only

[2] Generate reciprocating motion using magnet:- By continuous attraction and repulsion to achieve the reciprocating motion of magnetic piston.

[3] To reduce pollution:- as IC engine has exhaust gas due to that pollution takes place. By our engine the exhaust is eliminated since no combustion is there. So we can say it as green engine.

[4] Save conventional fuel:- day by day the number of vehicles are increasing due to advancement as well as due to increase in population. As we know engine requires the petroleum fuels. But increased demand doesn't fulfill by nature because we have limited natural sources of fuels. So this engine doesn't require conventional fuel, so we can overcome the problem of fuel crisis.

Chapter 2

Literature Reviews

We did literature review for selected topic through research papers, internet data, reference books & journal.

Working principle of an IC engine:

Principle of working of the IC engine is basically has two type i.e. two stroke and four stroke. In case of four stroke engine cycle is completed in four strokes i.e. two revolutions of the crank shaft. There is one power stroke which will propel the further strokes and also provide the power to output shaft. Same as that of four stroke engine there is a single power stroke which propels the engine but cycle is completed in two strokes and one revolution of the crank shaft.[1]

Usually the power stroke is actuated by the combustion of the fuel inside the combustion chamber under compression i.e. under high pressure so that there is a blast which causes high pressure inside the combustion chamber. This pressure leads to push piston down which causes the reciprocating motion.

Problems regarding to IC engine:

1. Efficiency of the IC engine is very less near about 25-35% only.
2. Pollution is also big problem.
3. Fuel crisis.

Pure electromagnetic engine:

The construction of this engine is such that it consists of two electromagnets. One electromagnet is at extreme position and another one is at centre as show in fig. Both the electromagnets are supplied by AC supply. In order

to get reciprocating motions the polarity of electromagnets at extreme are having a timer ckt which changes the polarity after a certain time. Due to continuous changeling polarity there will be attraction and repulsion of central electromagnet resulting to the reciprocating motion. Here the changing of polarity of electromagnet depends on the time. Within that time the polarity of electromagnet is changed.

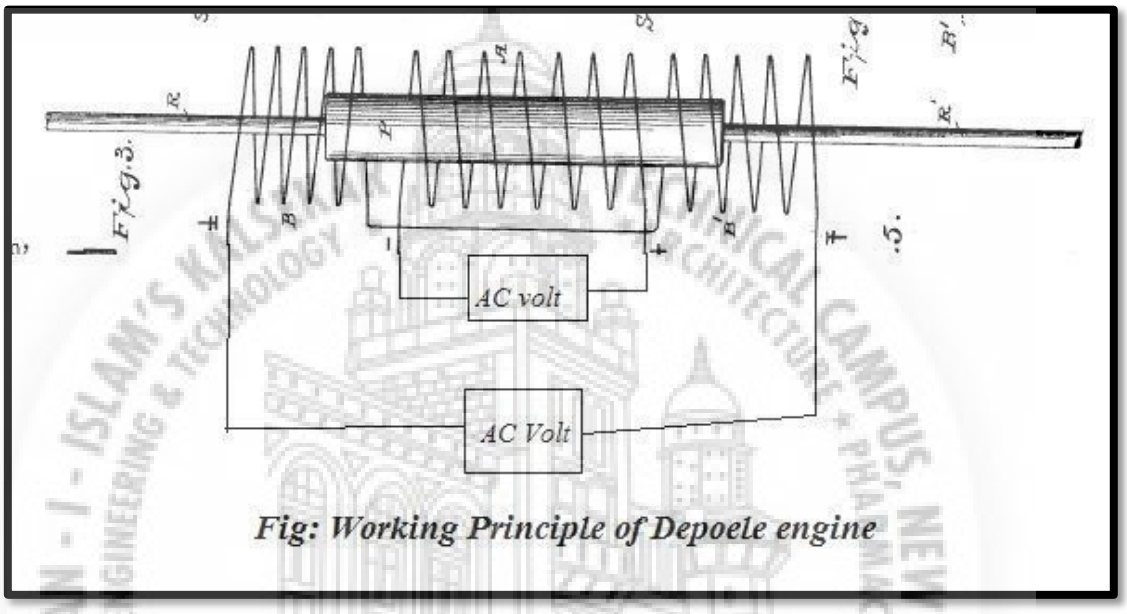


Fig: Working Principle of Depoele engine

Fig: 01: Depoele"s Engine

Limitations:

1 Due to initial inertia there will be oscillatory motion at starting instead of reciprocating. Also when load changes piston start to oscillate.

2 Use of all electromagnet instead of two permanent and one electromagnet increases energy required for magnetize the electromagnet.

Magnetic V engine:

The construction of this magnetic V engine is such that it looks like same as normal V engines but the valves in conventional V engine s replaced by electromagnets and the metallic piston is replaced by permanent magnetic piston. The working of this engine is again based on attraction and repulsion of the magnets only. But this engine is also has some certain limitations.

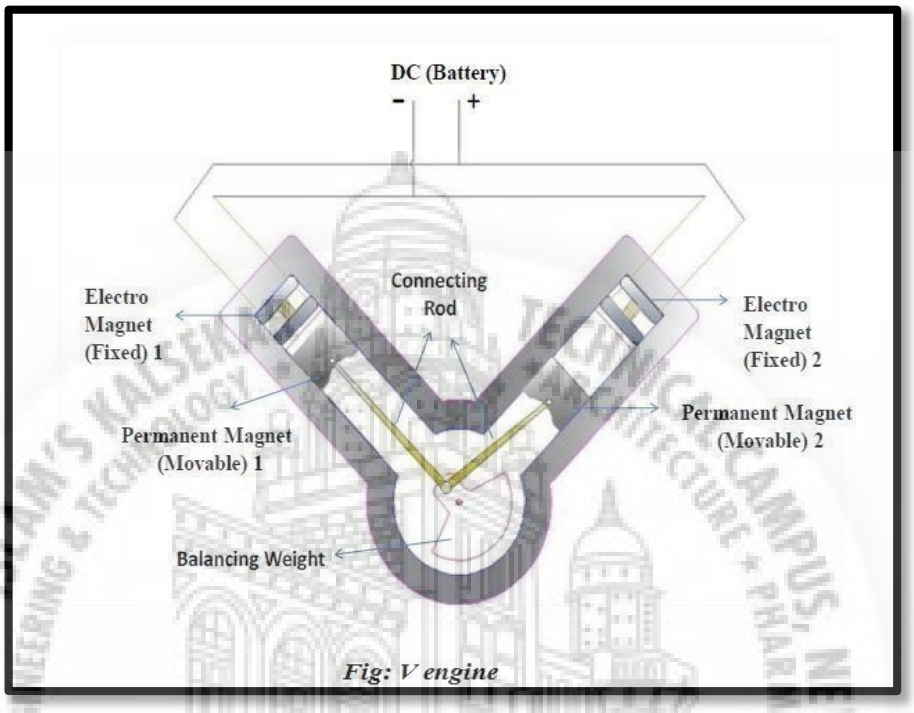


Fig 02: V engine

Limitation:

Due to initial inertia there will be oscillatory motion at starting instead of reciprocating. Also, when load changes piston starts to oscillate.

For this type engine whatever components will required and there principle of operation are mentioned below.

How Magnet Works:

The magnet is any object that has a magnetic field .It attracts ferrous objects like pieces of iron, nickel, steel and cobalt. The end of freely pivoted magnet will always point in the north south direction. The end that points in the north is called the north pole of the magnet and the end that points south is called the south pole of the magnet. It has been proven by experiments that like magnetic pole repel each other whereas unlike poles attract each other.

Types of electromagnet:

There are three types of Magnets:w

2.1 Temporary

2.2 Permanent

2.3 Electromagnet

a)Temporary Magnet:

There are magnets which acts as permanent magnet within strong magnetic field, but lose their properties when magnetic field disappears.

b)Permanent Magnet:

There are magnet which once magnetized they retain level of magnetism.

c)Electromagnet:

As electromagnet is tightly wound helical coil of wire with an iron core, acts as permanent magnet when current flows through wire. Out of these three magnets, permanent & electromagnet are suitable for power transmission.

Neodymium magnet (Nd2Fe14B):

Neodymium magnet is also known as Neo magnet. The most widely used type of rare earth magnet is permanent magnet made from alloy of neodymium, iron& boron. Neodymium magnet is the strongest type of permanent magnet.

Description-

The tetragonal Nd2Fe14B crystal structure has exceptionally high uniaxial magneto crystalline anisotropy. This lines compound potential to have high corecivity. The compound also has a high saturation magnetization & typically 1.3 teslas. Therefore as the maximum energy density is proportional J2.This magnetic phase has the potential for storing large amount of magnetic energy.

Magnetic properties:

Following are some of important properties which measure the strength of magnetic field. Neodymium magnets have much higher reminisce, much higher corecitivity. Neodymium is alloyed with Terbium and dysprosium in order to preserve its magnetic properties at higher temperature.

Physical and mechanical property neodymium

1) Permanence- 1 to 1.3
2) Correctivity (ma/m)- 0.875 to 1.99

3 Relative Permeability- 1.05
4 Curie temperature- 320.c
5 Density (g/cm3) – 7.3 to 7.5
6 Compressive strength (N/mm2) -1100
7 Tensile strength (N/mm2)-75

Introduction to Electromagnets:

Simply a simple metallic piece can become an electromagnet, if we just wound the metallic wire carrying electric current around that metallic piece. The direction of the magnetic flux is given by Fleming's left hand rule. By using the same principle we can make strong enough electromagnet as or stronger than permanent magnet. If we observe this principle of electromagnet is totally opposite to the electric generator. In electric generator we place metallic component in changing magnetic field.

Principle of Electromagnetism:

Electric current flowing through a wire wound around an iron nail creates a magnetic field, which caused an iron nail to become a temporary magnet. The nail can then be used to pick up paper clips. When the electric current is cut off, the nail loses its magnetic property and the paper clips fall off. The students will make an electromagnet that will attract a paper clip. They will then increase the strength of an electromagnet (improve on their initial design) so that it will attract an increased number of paper clips.

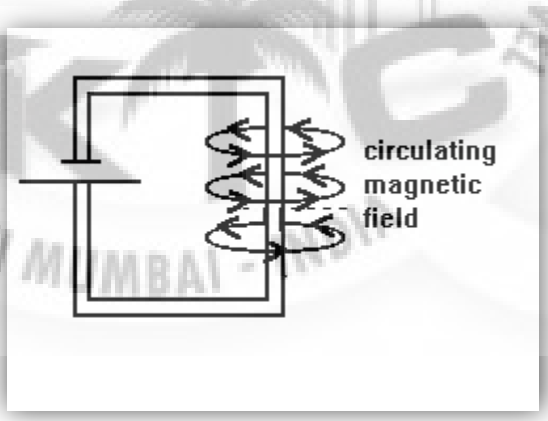


Fig.3 Conceptual Diagram of Electromagnet

When current is made to flow in a piece of wire it generates a circulating magnetic field about the wire. The direction of the circulating magnetic field depends on the direction of the flow of current through the wire. The electric current direction depends on the applied voltage's polarity. When a current-carrying wire is wound around a metal that can be magnetized, the magnetic field generated by the current magnetizes the metal. This is called electromagnet.

An electromagnet can be made by wrapping insulated copper wire around a nail. Attach a volt battery or power supply to the ends of the wire (be sure to strip the insulation away first) and note the nail's ability to act like a magnet (i.e., pick up paper clips, etc.) and to react to another magnet brought close to it.

Electromagnetic theories:-

1 Electric charges attract or repel one another with a force inversely proportional to the square of the distance between them; unlike charges attracts likes ones repel.

$F=Km_1m_2/d^2$

Where, m_1 & m_2 pole strength,

d distance between two

poles $K=1 / (4\pi \mu_1 \mu_o)$

μ_1=permeability of medium.

μ_0=permeability of air or vacuum.

2 Magnetic poles (or states of polarization at individual points) attract or repel on another in a similar way and always come in pairs; every North Pole is yoked to a south pole.

3 An electric current in a wire creates a circular magnetic field around the wire, its direction (clockwise or counter-clockwise) depending on that of the current.

4 A current is induced in a loop of wire when it is moved towards or away from a magnetic field, or a magnet is moved towards or away from it, the direction of current depending on that of the movement.

Chapter 3

Working Principle

PRINCIPLE OF OPERATION

This engine work on two basic principles,

1. Basic Principle of magnet:

Like poles repels each other and unlike poles attracts each other.

This will be the basic principle to achieve the reciprocations, where the magnet is successively attracted and repelled for achieving reciprocating action.

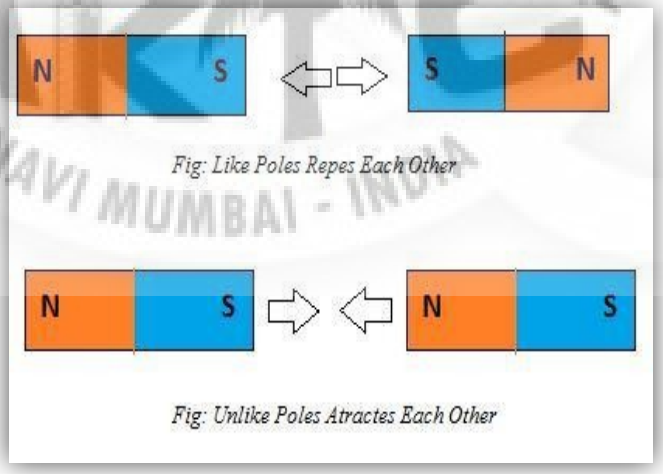


Fig 4) Law of magnet

2. Principle of Electromagnet:-

Electric current flowing through a wire wound around an iron nail creates a magnetic field, which caused an iron nail to become a temporary magnet. The nail can then be used to pick up paper clips. When the electric current is cut off, the nail loses its magnetic property and the paper clips fall off. The students will make an electromagnet that will attract a paper clip. They will then increase the strength of an electromagnet (improve on their initial design) so that it will attract an increased number of paper clips. The participants will also compare the properties of magnets and electromagnets.

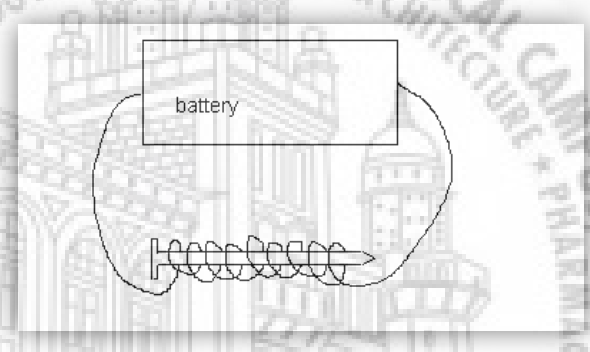


Fig.5) Electromagnet's Principle

For continues reciprocation it is required to change the polarity of the electromagnet. According to Fleming's Right hand rule as we changes the current direction in electromagnet the polarity will get change. To change the polarity we have to use a switching ckt which can be change the current direction after particular instance of time or at particular position of permanent magnet (i.e. either at TDC or BDC).

Chapter 4

Design And

Calculation

Conceptual diagram of magnetic reciprocating engine

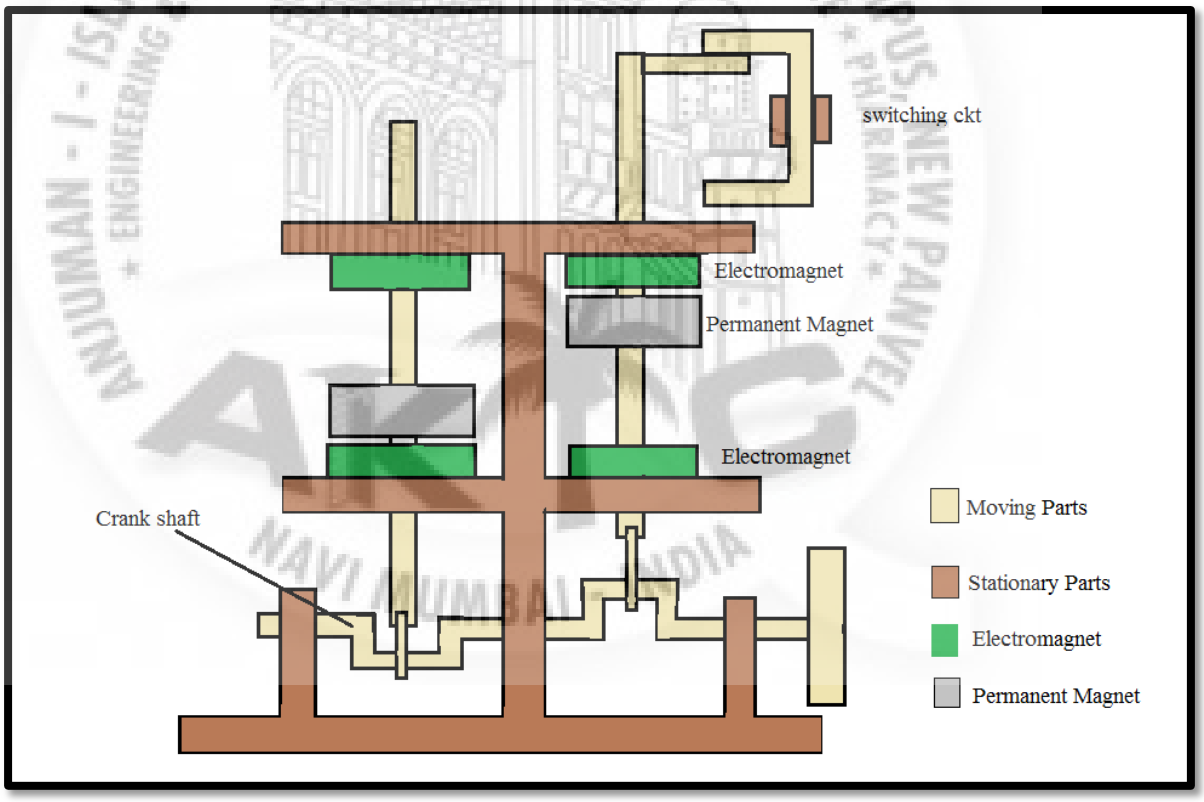


Fig 6) Conceptual Design

MRE WORKING:

The conceptual design of magnetic reciprocating engine is as shown in above fig. it consists of four electromagnets and two permanent magnets with high power (1200 Gauss). The frame and shafts are of nonmagnetic material where the effect of magnetic forces will be zero. Finally the non-magnetic shaft is connected to crankshaft at lower side with the help of connecting links. The reciprocating motion of the piston is achieved by continuously changing the polarity of electromagnet. To change the polarity of electromagnet we have to change the direction of current flowing through the electromagnet.The assembly of the CNC machine was a rather challenging task. We are grateful to our guide who helped us and arranged work place required for the task guided us throughout the whole assembly.

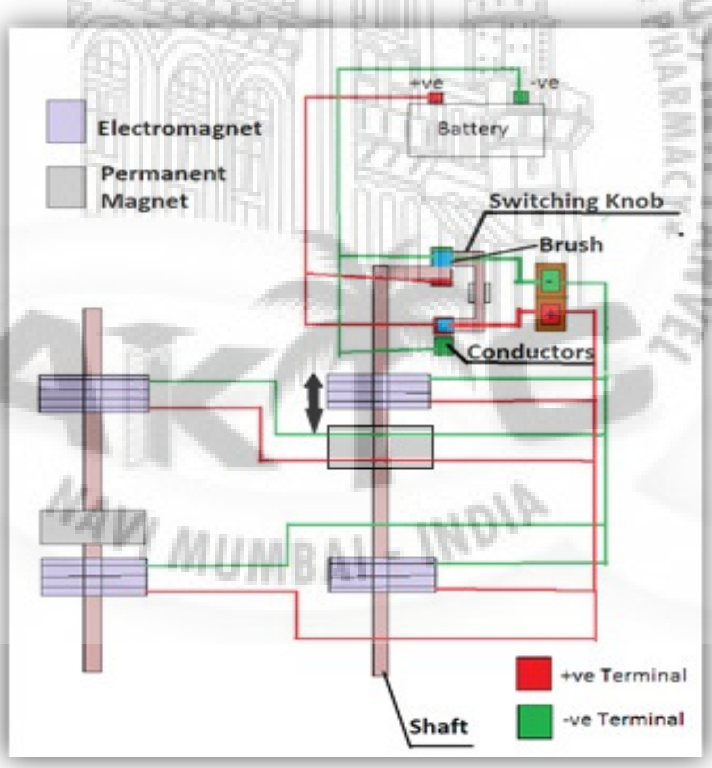


Fig. 7) Switching Circuit

Above fig shows the circuit diagram of the switching ckt. It is mainly consist of the switching knob. The switching knob is free to reciprocate along the conductor. The

blue point on the knob indicates the brushes while the red and green are the conductors. The brushes are further connected to the distributer from where the current is distributed to all the electromagnet. This switch will reduce all the complications regard to use of sensors and relays.

Initially we tried to use the sensors in order to change the polarity of four permanent magnets. Because for achieving the reciprocating motion the successive changing of polarity is necessary. But using light sensors will leads to increase the overall cost of the system. Also microcontroller requires certain types of coding which becomes very complicated, so for avoiding all such difficulties we designed an effective circuit to perform the work of sensors. The circuit contributes its work exactly same as sensors but relative to very less cost.

Design Consideration:-

Basically design is done for system and design for parts:

System Design:

In system design we have to consider following cases

Size according to area of the place where this engine is to be mounted.

Cooling of the electromagnet

8 In general the engine should be as compact as possible and also the electromagnet should be as cool as possible since the losses will increases with temperature. The design of the electromagnet without core itself reduces the size near about 40%. In case of magnetic engine it is to be used more conveniently for stationary applications. So the cooling of the electromagnet plays an important role at stationary condition. By considering the same we choose the open frame structure, so that air will circulates properly to produce cooling effect. Also the motion of the permanent magnet in free space causes the flow of air on electromagnet so it produces the more cooling effect.

In case on non-stationary applications if we place the engine tilt to front side by some angle then more area will come in contact with air, so it produces the more cooling effect.

4.1 Part Design:

Part design is explained in detail as below:

1. Power of permanent magnets:-

In order to get high power output the permanent magnet should be of high power. By searching on internet as well as in market we come to know that Neodium magnets are available with high power. The high power magnets are available in market which are having up to 200 kg lifting capacity. At student level it is very difficult to handle such high power magnets so we selected the Neodium magnet with 1.2kg lifting capacity (1200Guass).

2. Parameters of electromagnet:-

In order to achieve the reciprocating motion we should generate the continuous attraction and repulsion of magnetic piston. So there should be change in polarity of magnets. But it is not possible to change the polarity of permanent magnet. We can change the polarity of an electromagnet. So we selected four electromagnets for the two side engine. By studying in book we come to know that it is possible to attract and repeal the high power permanent magnet with low power electromagnets. So we made two electromagnets with 250 number of turns and rest two with 450 number of turns. While designing an electromagnet we have to consider following parameters such as:

a) Number of turns
b) Proper core material
c) Amount of current
d) Wire material (Copper or Aluminium)
e) Wire gauge (Gauge 20)

3. Shaft :-

The shaft will reciprocate within the magnetic fluxes so it should be of nonmagnetic material. As we are doing a model so there is no need to check for the stress developing in that shaft. The lower part of shaft is to be linked with crankshaft, so for coupling of shaft with link it requires to perform some machining processes. Hence the shaft should be of machinable material. Fiber shaft will fulfill all requirements.

The diameter of shaft is 14mm.and length is of 250mm and at one end diameter of 6mm over a length of 10mm in order to fit the links.

4. Flywheel:-

In case of magnetic engine each stroke is the power stroke, so flywheel does not perform any special task as in case of IC engine. So we cannot consider special design consideration in our case. We take a flywheel of 1 kg by trial and error method.

5. Stroke length:-

The stroke length is the distance between the TDC and BDC (I.e. the distance through which piston reciprocates). For calculating stroke length we should calculate the power of magnets and its effect at the each point along the stroke. In order to get the high speed the stroke length should be minimum. Force exerted by electromagnet on piston

$F = (N^2 I^2 K A)/2 G^2$.....(1)

Where,

F = Force of attraction or repulsion N = number of turns

I = Current flowing through coil K = Permeability of free space

A = Cross-sectional area of electromagnet

G = Least distance between electromagnet and permanent magnet From (1),

$F \propto 1/G^2$

I.e. Repulsive or attractive force is inversely proportional to the Square of

Distance between two magnets.

Hence the stroke length should be less as possible as.....(a)

Also,

$$P = 2\pi NT/60$$

And T = FxR

Where,

T = torque

F = Force of attraction or repulsion

R = Radius of crank = Half of

Stroke; Hence

T R (i.e. Stroke)

∴ P stroke length

I.e. power will be high as stroke length is high.....(b)

Hence by considering both cases (a) & (b) on the basis of trial we selected the stroke length of 40mm.

6. Frame Design

While considering the design of frame we have to choose the material which is of nonmagnetic material and also have enough strength to absorb the forces and vibration. Hence we divide the frame in two parts one with wooden material which has magnet & electromagnets assembled to it and another part having crank & link assembled is with any metallic material. Hence we choose IAS angles 20mm X 20mm X 2mm for frame.

7. Connecting Rod:

The length of the connecting rod is an important consideration. When the connecting rod is short as compared to the crank radius, it has greater angular swing, resulting in greater side thrust on the piston. In high-speed engines, the ratio of the length of the connecting rod to crank radius (L/R) is generally 4 or less. In low-speed engines, the (L/R) ratio varies from 4 & 5.Since the crank radius is 20 mm, the length should be L/R = 4

L = 4 x 20 = 80 mm OR L/R = 5 x 20 = 100 mm = Connecting Rod.

4.2 Sample Calculations : - Input voltage = 12 V

Input current = 5 A

Input Power = Voltage × Current = 12 × 5 = 60W Max.

Force exerted by electromagnet on piston

$$F1 = (N^2I^2KA)/2G^2$$

Where,

N = number of turns = 450

I = Current flowing through coil = 5 A

K = Permeability of free space = $4\pi \times 10\text{-}7$

A = Cross-sectional area of electromagnet

=20x35 mm2

G = Least distance between electromagnet and permanent magnet = 0.001 m

On substitution, we get

Max. Force F1 = 74.95N

Force exerted by permanent magnet Force

$$F2 = (B^2A)/2\mu0$$

Where, B = Flux density (T)

A = Cross-sectional area of magnet = 0.0942 m

$\mu0$= Permeability of free space = $4\pi \times 10\text{-}7$

Now flux density

B = 0.2547 T

Now substituting B in the equation of force, F2 = 24.67 Since,

force F1 and F2 are repulsive,

Total force F = F1 + F2

F = 99.62 N

Chapter 5

Part Drawings

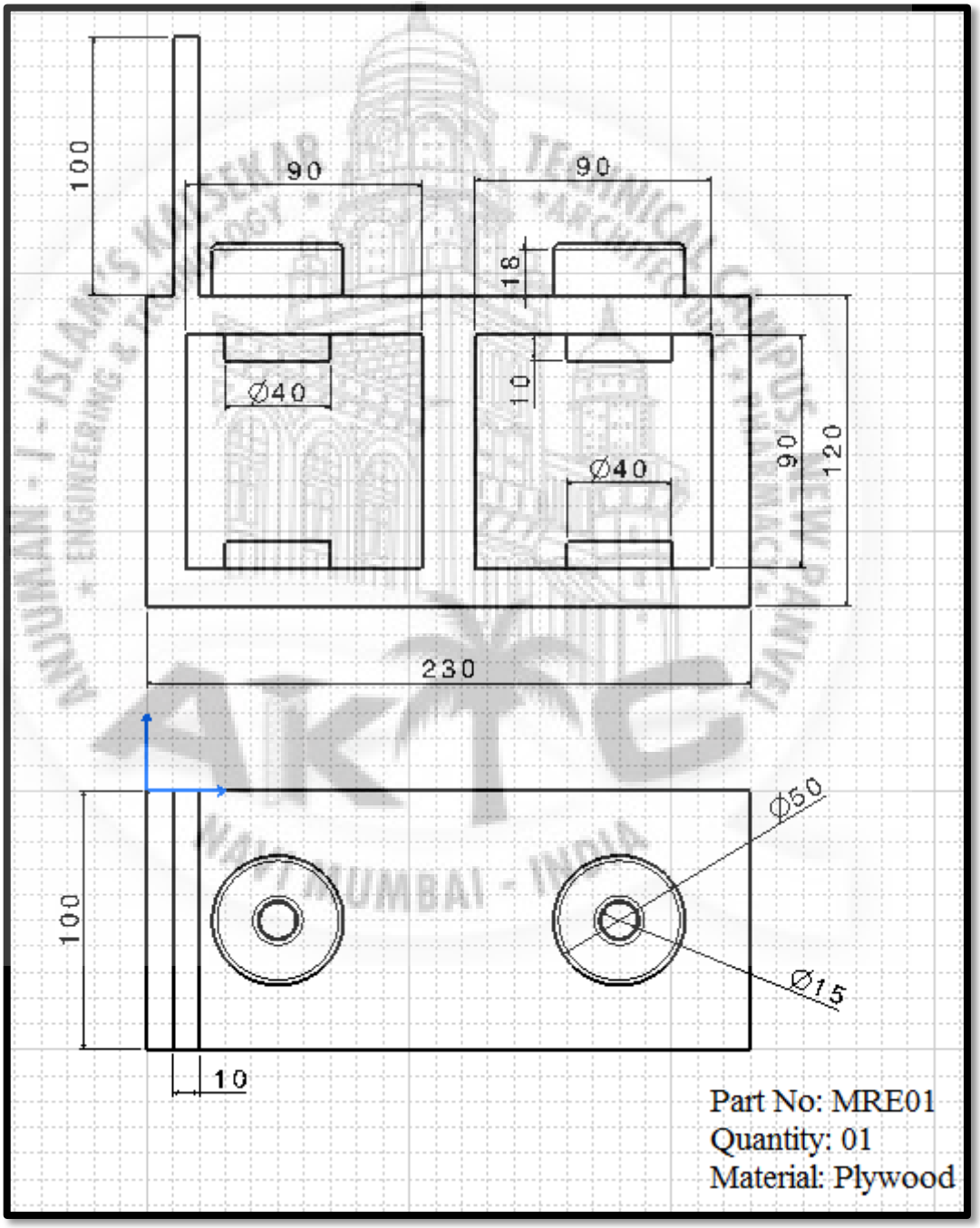
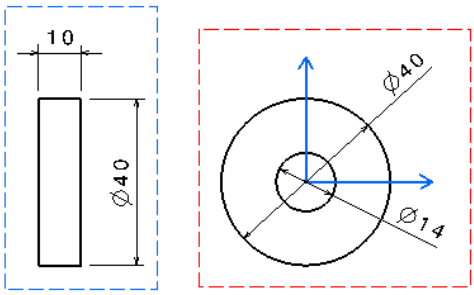


Fig 8) Top Frame



Part No: MRE02
Quantity: 04
Mterial: Wood

Fig 9) Wooden Bush

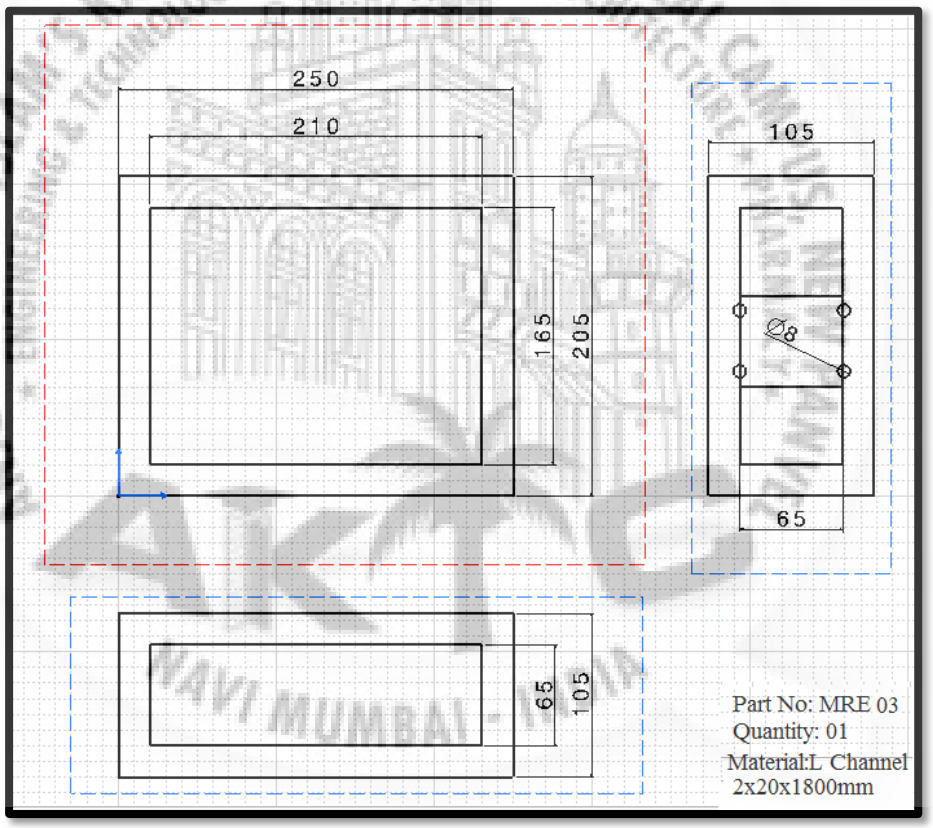


Fig10) Base Frame

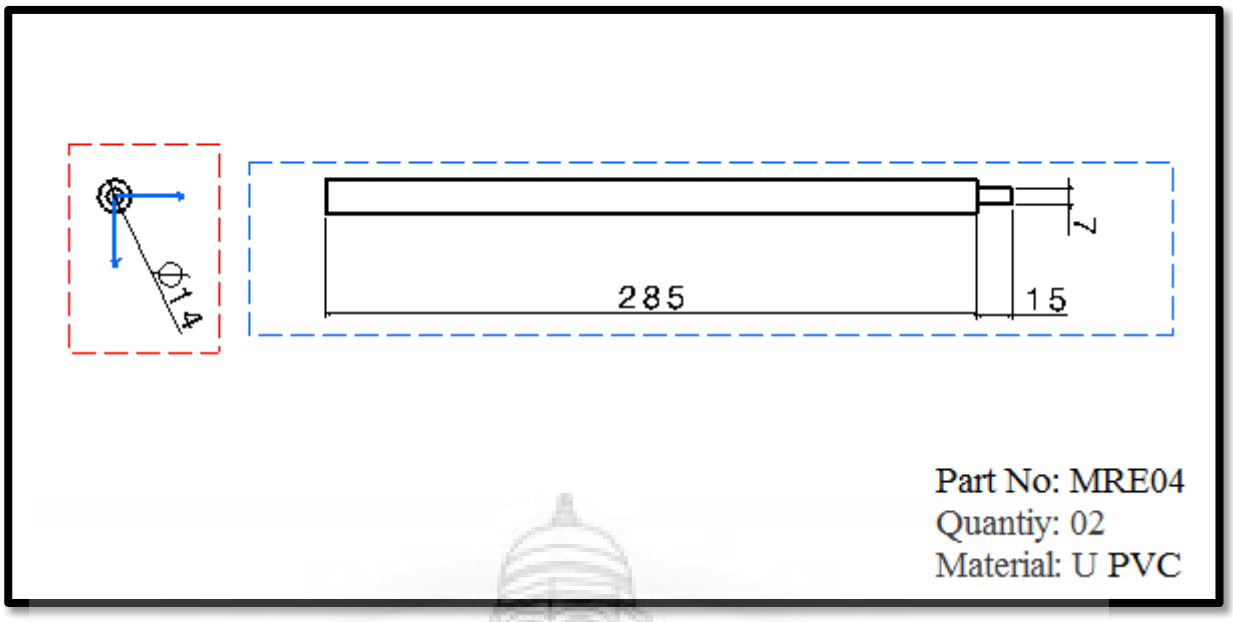


Fig 11) Shaft

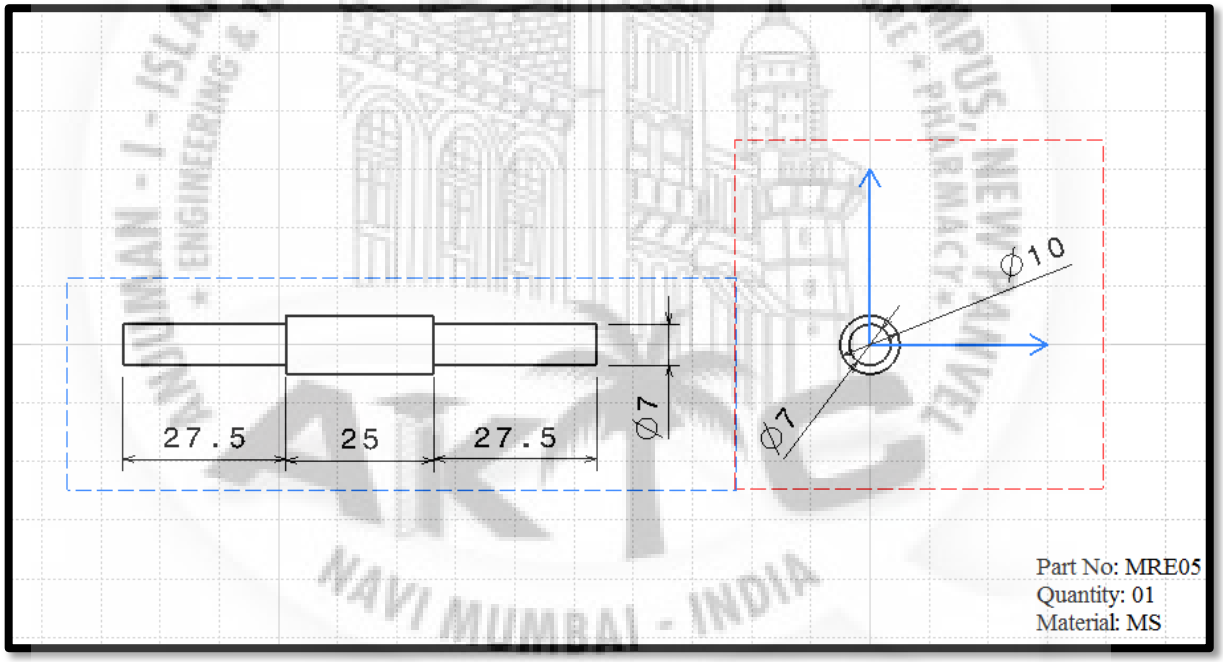


Fig 12) Crank Shaft

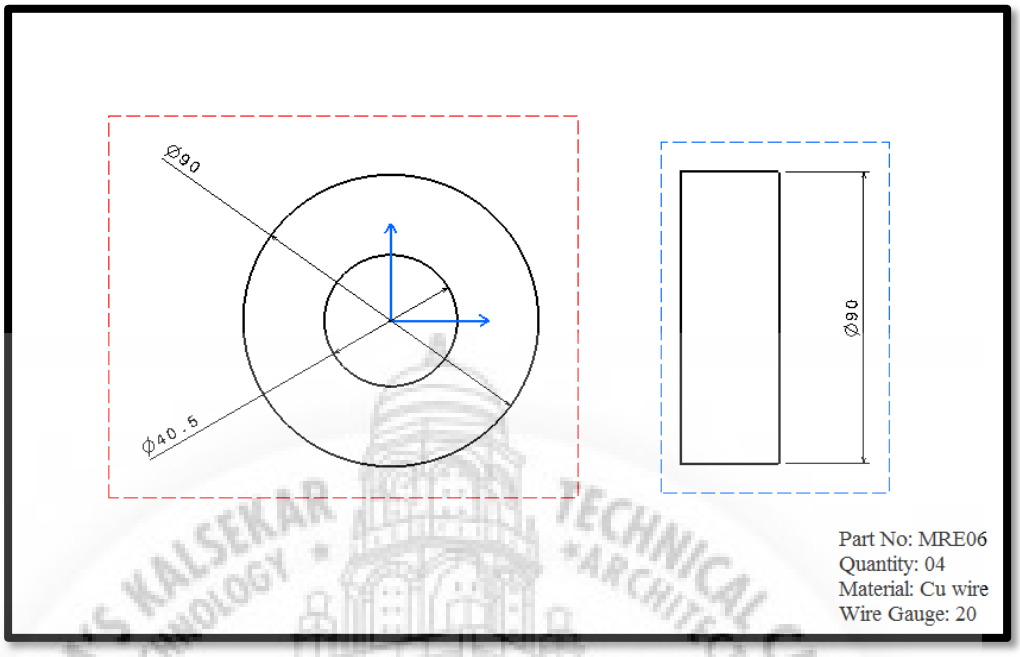


Fig 13) Electromagnet

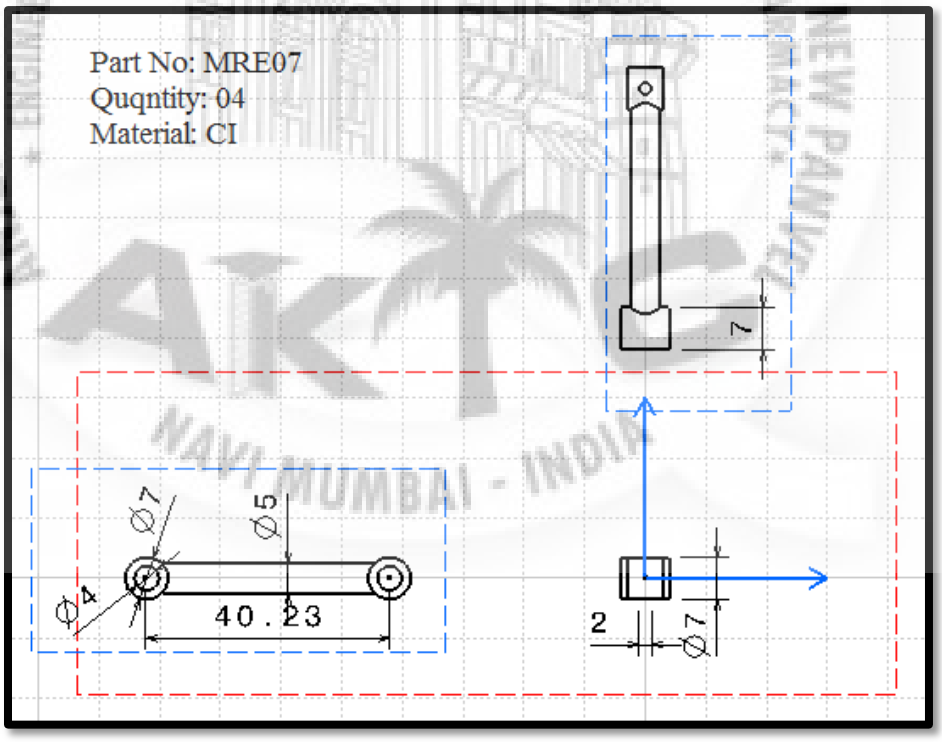


Fig 14) Connecting Rod

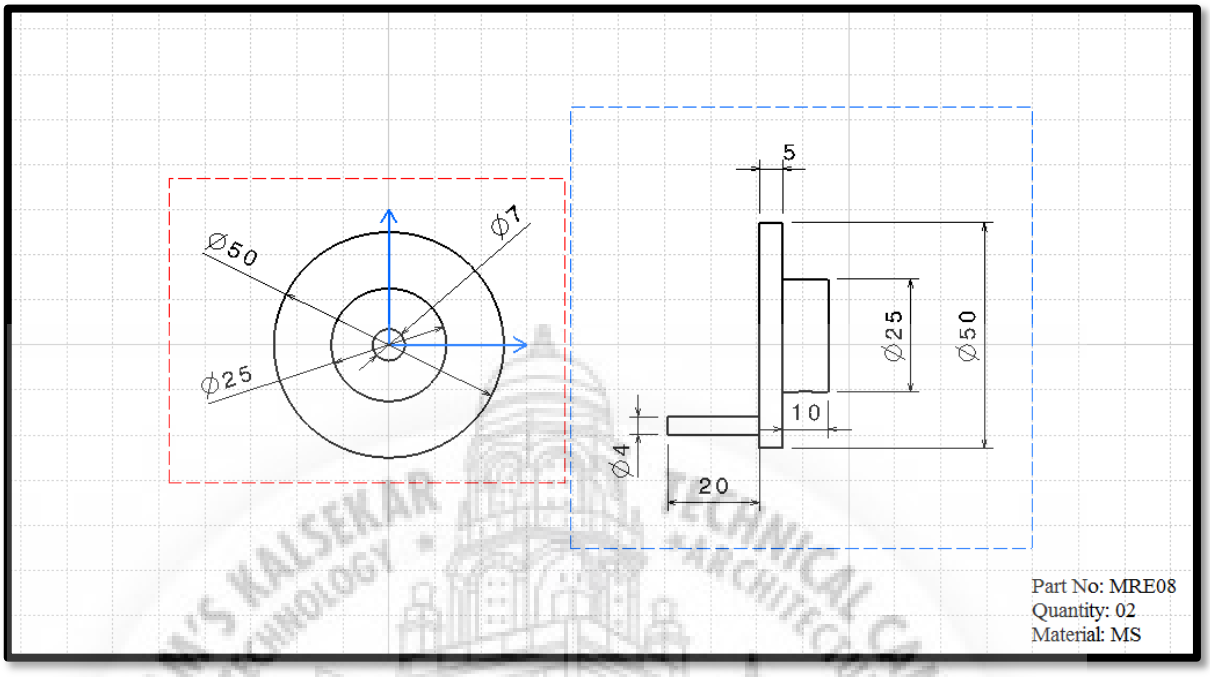

Ø50
Ø7
Ø25
5
Ø25
Ø50
10
Ø4
20
Part No: MRE08
Quantity: 02
Material: MS

Fig 15) Crank

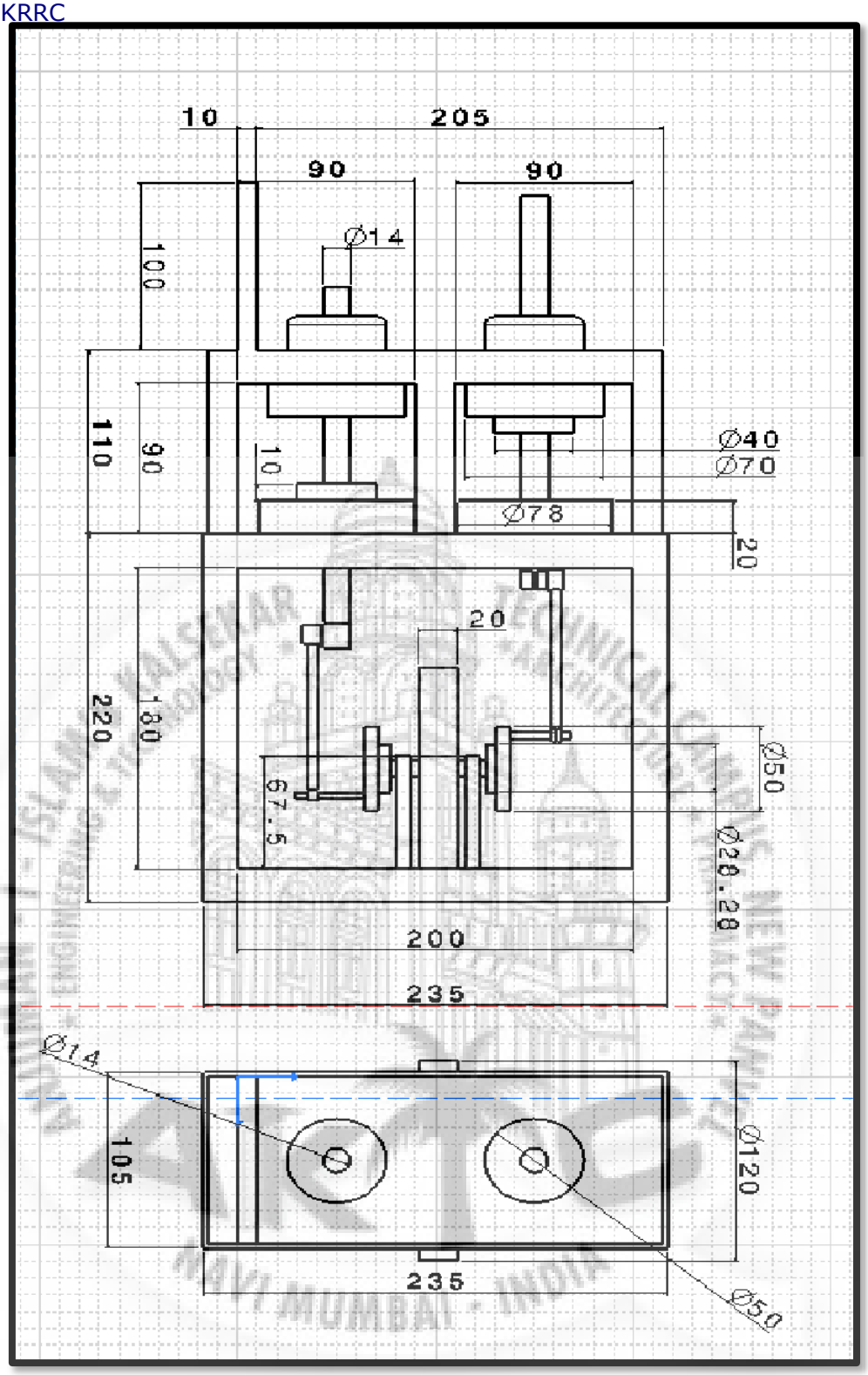


Fig 16) Assembly (Front & top View)

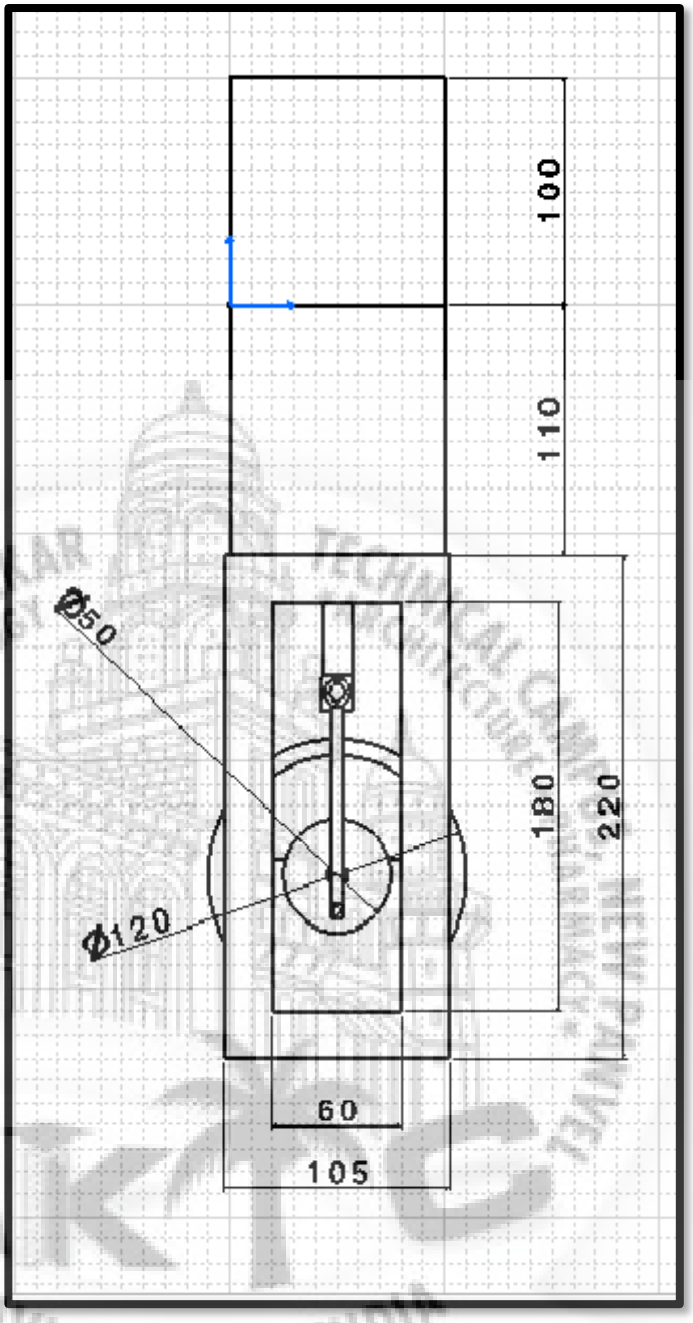


Fig 17) Assembly (Side View)

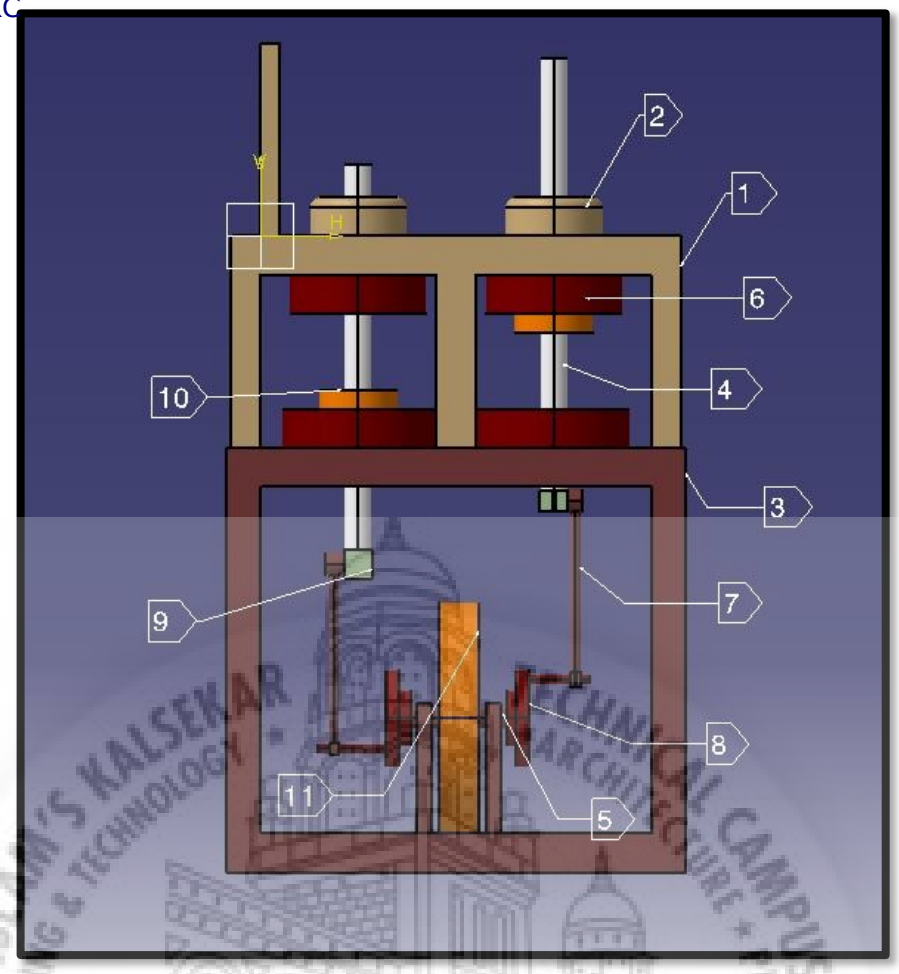


Fig 18) CATIA drawing of Engine

Sr. No.	Part No	Part Name	Material	Quantity
01	MRE01	Top Frame	Plywood	01
02	MRE02	Wooden Bush	Wood	04
03	MRE03	Base Frame	L channel (MS)	01
04	MRE04	Shaft	U PVC	02
05	MRE05	Crank Shaft	MS	01
06	MRE06	Electromagnet	Cu Wire	04
07	MRE07	Connecting Rod	CI	04
08	MRE08	Crank	MS	02
09	MRE09	Link Base	CI	02
10	MRE10	Magnet	Magnet	02
11	MRE11	Flywheel	CI	01

Table: 01) Part List

Chapter 6

Process Sheet

Part No: - MRE01

Raw Material: - Plywood

Part Name: - Upper Frame

Material Specification: -800x120x20mm

Quantity: - 01

Sr. No.	Operation	M/C Used	Tool	Jigs & Fixture	Measuring Instrument	Setting Time (Min)	M/C Time (Min)	Total Time (Min)
01	Marking	-	Marker	-	Measuring Tape	6	-	6
02	Cutting Of Plywood In 200x100x20mm Size (2 Pieces)	Hand Hack Saw	Hack Saw	Bench Vice	Measuring Tape	5	20	25
03	Cutting Of Plywood In 120x100x20mm Size (3 Pieces)	Hand Hack Saw	Hack Saw	Bench Vice	Measuring Tape	5	25	30
04	Fabrication Of Frame	Tough Bond, Nails	Hammer	-	-	4	15	19
Total Time						20	60	80

Table: 02) Process Sheet of Upper frame

Part No: - MRE02

Part Name: - Metallic Frame

Raw Material: - IAS Angles

Material Specification:

20x20x2mm

Quantity: -01

Sr. No.	Operation	M/C Used	Tool	Jigs & Fixture	Measuring Instrument	Setting Time (Min)	M/C Time (Min)	Total Time (Min)
01	Marking	-	Marker	-	Measuring Tape	6	-	6
02	Cutting As Per Marking	Cutting Machine	Ceramic Cutter	Holding Vice	-	4	8	12
03	Filling	-	Metal File	Bench Vice	-	4	10	14
04	Welding	Arc Welding M/C	MS Filler Rod	-	-	10	20	30
05	Filling To Remove Burr Of Weld	-	Metal File	Bench Vice	-	4	8	12
Total Time						28	46	74

Table: 03) Process Sheet of Metallic frame

Part No: - MRE03

Raw Material: - Cu Wire

Part Name: - Electromagnet

Material Specification: -1.5kg; 20gauge

Quantity: -04

Sr. No.	Operation	M/C Used	Tool	Jigs & Fixture	Measuring Instrument	Setting Time (Min)	M/C Time (Min)	Total Time (Min)
01	Winding Of Electromagnet	Wood Working Lathe M/C	Centers	Wooden Fixture	-	10	60	70
02	Removing The Electromagnet	-	Hack Saw	-	-	2	3	5
Total Time						12	63	75

Table: 04) Process Sheet of Electromagnet

Chapter 7

Cost Analysis

BILL OF MATERIAL:

Sr. No.	Part No	Part Name	Material	Quantity
01	MRE01	Top Frame	Plywood	1 (800x120x20)
02	MRE03	Base Frame	IAS angles	1800mm
03	MRE04	Shaft	U PVC	02
04	MRE05	Crank Shaft	MS	01
05	MRE06	Electromagnet	Cu Wire	1.5 kg
06	MRE07	Connecting Rod	CI	04
07	MRE08	Crank	MS	02
08	MRE10	Magnet	Magnet	02
09	MRE11	Flywheel	CI	01

Table: 05) Bill of Material

COST OF RAW MATERIAL:

Following table gives the cost of raw material and cost of part to be bought out part:

Sr. No.	Material	Specifications	Cost of Material (Rs.)
01	Plywood	800x120x20	250
03	IAS Angles (20x20x2mm)	1800mm	300
04	Cu wire	1.5 kg	1100
Total Cost			**1650**

Table 06) Cost of Raw Material

COST OF PURCHASED PART:

Sr. No.	Part	Quantity	Cost (Rs.)
01	Shaft	02	200
02	Crank Shaft	02	100
03	Connecting Rod	04	800
04	Crank	02	180
05	Magnet	02	1600
06	Flywheel	01	150
07	Nails, Screw, Bolts	-	50
Total cost			**3080 Rs.**

Table 07) Cost of Bought Out Part

Total Cost = Raw Material Cost + Cost of Bought Out Part

= 1650 + 3080

= 4730 Rs.

Chapter 8

Conclusion and Future Scope

8.1 Conclusion

Very less amount of electric power is required to magnetize the electromagnets and these electromagnets can supply the sufficient amount of power continuously.

Efficiency of the system is higher than conventional systems available. On the other hand this mechanism is pollution free & has no bad environmental impact. Here, it is proved that it can produce sufficient amount of power. It is very much acceptable in environmental aspects. Hence it can be the substitute for the IC engine.

8.2 Future Scope

1. By combining it with the solar energy we can make it totally ecofriendly.
2. We can use the permanent magnets of high power in order to get high speed and high torque.
3. Also by increasing number of turns of electromagnet we can increase the torque of engine.

Chapter 9

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