



DESIGN AND FABRICATION OF ELECTROMAGNETIC ENGINE

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Abstract

Now a days IC engine plays a vital role in market of automobiles. The demand for fuel has increased so need of other energy has become necessary. The main concept of this project is the zero point fuel consumption. The magnetic force principle is the basic requirement to work for electromagnetic engine. The general property of magnet that is attraction and repulsion forces are converted into mechanical work. The magnetic driven engine derives its power from magnet power and constant magnetic energy is converted into mechanical energy. The useful output is rotating motions and the application is based on electromagnetic engine which varies from different field.

The electromagnetic engine should be ideally perform exactly the same as that of internal combustion engine. The engine, the strength of the field is controlled by the amount of windings. This design applies the power every fourth stroke same as normal does now. It utilizes only the repulsive force that allows field to dissipate completely, and have no restrictive effects on the rising piston. The main advantages of electromagnetic engine are that it is pollution free and internal parts like valves and cam-followers, can be avoided. Also no manifolds are required since there is no fuel flow. The challenges faced in designing an electromagnetic engine is that it has to be as efficient as an internal combustion engine.

Index Terms: Electromagnet, Permanent Magnet, Efficiency, attraction and repulsion, mechanical power.

I. INTRODUCTION

In today's modern World, it is practically impossible to imagine a life without IC Engines, which is one of the greatest man made inventions. IC Engines are primarily used in automobiles, which is a major mode of transportation to mankind. IC engines work mainly on gasoline and diesel which are derived from fossil fuels. The demand of automobiles keeps increasing as the Population increases. With this increase, the rate of fossil fuel consumption also increases. This creates a situation that brings up a need to switch to alternative sources of fuel to produce the power similar to that of IC engines. The challenge is not to create an engine that operates on an alternate fuel but to produce higher efficiencies. The next source of energy that strikes our minds is definitely electrical energy. Now-a-days, we can see automobiles that operate fully on electrical energy or a hybrid vehicle that operates both on electrical energy and an IC Engine. Speaking of electrical energy, it is quite hard to store large amounts. Thus a method has to be developed that uses electrical energy in combination to produce better efficient engines. Government has taken many a steps to reduce the vehicular emission by setting emission standards. However, evolution of scientific methods for emission inventory is crucial. Therefore, analysis is done on the emissions from various vehicles by using IVE model. The quality of air in developing countries like India has reached a horrifyingly low level. Modal analysis to estimate a vehicular emission to showcase the temporal emission of vehicles

[1]. Pistons and the cylinders of a conventional IC Engine are replaced by the permanent magnet pistons and non-ferromagnetic materials respectively which led to the invention of electromagnetic reciprocating engine by Sherman S. Blalock [2]. Multi-cylinder electro mechanical engine for the automotive that consists of the cylinders containing samarium cobalt type of magnets in pistons located at right angle to the pistons [3]. Growth in this field has led to the invention of Maps Engines which are incorporated with various equipment and machineries whose application are in fields such as aircraft engine, ship engine, locomotive engine and lawn mower [4].

II. ELECTROMAGNETISM

Leland W.Gifford discussed about electromagnetically driven reciprocating engine in his invention. Reciprocating pistons are sliding mounted in a cylinder and linked to a rotatable crankshaft. Fixed magnets, preferably of the samarium cobalt alloy type are mounted in the piston to intermittently attract and repel sequentially energized electromagnets which are mounted in the cylinder walls. Capacitor discharge circuit used as a power source of electromagnet which is used for directing electrical energy to the electromagnets. A computerized control means regulates the timing of discharge of the capacitor and thus the timing of energizing the electromagnets [5]

Houtman P. Siregar et. al discussed about the materials for core of electromagnetic fuel saver are made of plain carbon steel and copper. Diameters of the wire winding, which is used in the research, are 0.25 mm and 0.35 mm. Speed of engine, and number of coils which is coiled in a winding core of the fuel saver are chosen as the testing variables. From this work is obtained that the performance of the electromagnetic fuel saver which use copper core is better than the electromagnetic fuel saver [6].

Kannan et al discussed about Yamaha R15 bike 149.8 cc cylinder is made up of DiASil which an all-aluminium cylinder is made possible by an exclusive Yamaha aluminium forging technology. As it uses a 20% silicon-aluminium alloy, it has excellent heat

dissipation qualities and reduces the engine weight at the same time. Therefore the user should not have to go for a costly maintenance like sleeve replacements after riding say some 20,000 kilometres. Another advantage of DiASil cylinder is that the rider gets improved fuel economy. As cylinder, piston and surrounding parts are all made of aluminium, cooling is quick and efficient [7].

The Neodymium magnets can provide the significant size and weight reduction and performance of enhancement over the sintered and, particularly, bonded ferrite permanent magnets, moreover, provides these benefits at reasonable cost. Primarily for these reasons, these magnets are now used in the wide and growing range of computer peripheral, office automation, and consumer electronic applications and now constitute the fastest growing segment of a permanent magnet market.

III. DESIGN OF ENGINE COMPONENTS

A. Cylinder:

Cylinder of an electromagnetic engine is the simple rectangular block with a blind hole in it. The temperature within the electromagnetic engine cylinder is very low and so no fins are needed for heat transfer. This makes the cylinder easily manufacturable. Also the cylinder is made of aluminium, a non-magnetic material which limits the magnetic field within the boundaries of cylinder periphery. Usage of aluminium material makes the engine lighter unlike the cast-iron cylinder used in internal combustion engine.

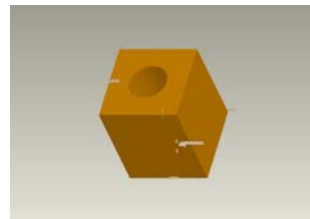


Fig 1: Cylinder

B. Piston:

The piston is the reciprocating part of an engine. The permanent magnet attached in the piston and the electro magnet attached in the cylinder creates a magnetic force which drives the crank shaft with the help of the connecting rod. At the piston top, few grooves are cut to accommodate the piston rings and the bands left

between the grooves are known as lands.



Fig 2: Piston

C. *Connecting rod:*

In a reciprocating engine, the connecting rod is used to connect the piston to the crankshaft. It converts the linear motion or reciprocating motion of the piston to the circular motion of the crankshaft.



Fig 3: Connecting rod

D. *Fly wheel:*

The Flywheel is made up of mild steel, it is used to convert a reciprocating energy into rotational energy. It regulates the engine's rotation to makes its operation at a steady speed. Flywheel have a significant moment of inertia and thus resist changes it rotational speed. A amount of the energy stored in the flywheel is proportional to square of its rotational speed. Energy is transferred to the flywheel by applying torque to it. It is used to store rotational kinetic energy.

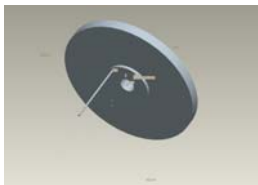


Fig 4: Fly wheel

E. *Electromagnetic coil:*

Electromagnetic coil is formed when an insulated solid copper wire is curled around the core or form to create the inductor or electromagnet. When electricity is passed through a coil, it generates the magnetic field. One loop of the wire are usually referred to as a turn or winding, and a coil consists of one or

more turns. Coils are often coated with a varnish or wrapped with insulating tape to provide additional insulation and secure them in place. Completed coil assembly with one or more set of coils and taps is often called windings.

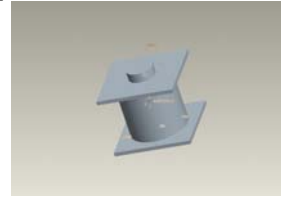


Fig 5: Eletromagnetic coil

F. *Permanent magnet (NdFeB):*

Most powerful 'rare-earth' permanent magnet composition is known to mankind, our specialty. This formulation is a relatively modern, first became commercially available in 1984. NdFeB magnets have highest B_s & B_r of any magnet formula, and also have very high H_c. However they are very brittle, and hard to machine and sensitive to corrosion and high temperatures. It is used in home, workshop, pickup truck, laboratory, wind turbine, starship and etc.

NdFeB (NEODYMIUM-IRON-BORON)

| | |
|-------------------|-------------------|
| Grade | : N35 |
| Remanence | : 1130-1170 Tesla |
| Coactivity | : >868KA/m |
| Curie temperature | : 310 C |

G. *Relay switch:*

Relay is an electrically operated switch. The current flowing through the coil of a relay creates the magnetic field which attracts the lever and changes the switch contacts in it. The coil current can be used to on or off the relays have two switch positions and most have double throw switch contacts as shown in figure 6.

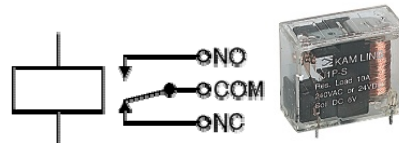


Fig 6: Relay switch

H. *Timer 555 IC:*

555 timer IC is an integrated circuit chip used in the variety of timer, pulse generation, and oscillator applications. The 555 can be used to provide the time delays, it can also acts as an oscillator, and as a flip-flop element. This was introduced in 1972 by Signetics, the 555 is

still in widespread in use, thanks to its ease of use, low price, and good stability.

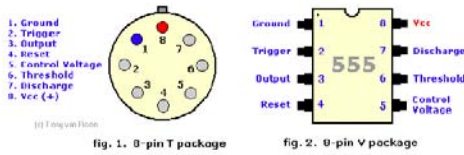


Fig 7: Timer 555 IC

I. Lead acid battery:

The lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid (H₂SO₄). In the application of battery power to start the engine in an auto mobile, for example, the load current to the starter motor is typically 200 to 400A One cell has a nominal output of 2.1V, but lead-acid cells are frequently used in a series combination of three for a 6V battery and six for a 12V battery.

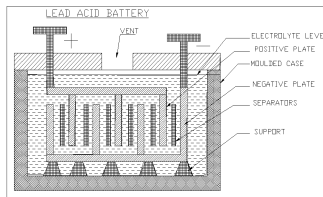


Fig 8. Lead acid battery

IV. WORKING PRINCIPLE

This is based on attraction & repulsive force of the magnet. The working of the magnetic engine greatly resembles the working of a two-stroke engine. To start, let us begin from the situation, when piston is located in the lower position.

A coil is connected through a battery and the copper coil is energized to produce a magnetic field a piston in the side of the large power Neodymium Iron Boron magnets and the piston moved upper and lower the fly wheel connected through the piston link the copper coil energized the piston moves upward and copper coil is de-energized the piston move to downward. With the help of relay and control unit. The continuous process through piston is move to (up and down) with also rotated the fly wheel. Electromagnetic engines are working with the principle of interaction between the Magnetic fields.

The Permanent magnet is fixed in a piston and iron material is connected to the copper coil. So that the iron material is converted into an electro magnet when the power supply is

given to it. When piston is located in the lower position, the coil is connected through the battery. The copper coil is energized to produce the magnetic field. With the help of relay and control unit, when the copper coil energized the piston move upward and copper coil is de-energized the piston move downward. The continuous process through which the piston is move (up and down) and it also rotates the fly wheel.

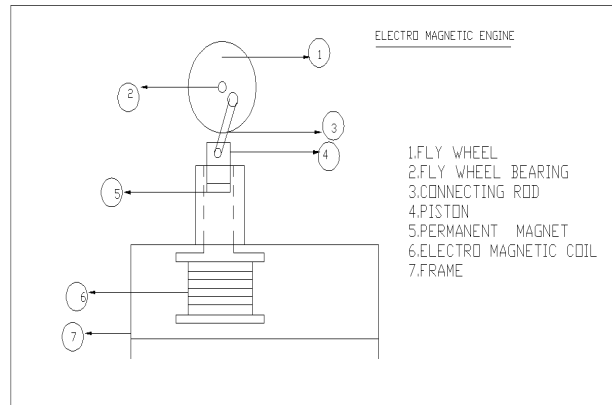


Fig 9: Arrangement of eletromagnetic engine

V. DESIGN CALCULATIONS

| Component | Material | Diameter(mm) | Height(mm) | Length(mm) |
|---------------------|------------------------------|--------------|------------|------------|
| Piston | Aluminium | 35 | 50 | |
| Cylinder | Aluminium | 36 | 90 | |
| Connecting Rod | Mild Steel | | | 90 |
| Permanent Magnet | Neodymium | 25 | 13 | |
| Electro Magnet | Copper | 36 | 12 | |
| Fly Wheel | Mild Steel | 140 | 10 | |
| Electro Magnet Coil | Number of turns - 1000 turns | | | |

(i) Input power = voltage x current
= V x A

(ii) Electromagnetic force = (N² x I² x K x A) / (2 x G²)

N = the number of turns in the solenoid
I = the current, in amperes (A), running through the solenoid
A = the cross-sectional area, in meters-squared, of the solenoid magnet
G = the distance, in meters, between the magnet and the piece of metal.
K = $4 \times 3.14 \times 10^{-7}$ (a constant).
(iii) Torque = force x radius
(iv) Power = $(2 \times 3.14 \times N \times T)/60$

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VI. CONCLUSION

The proposed electromagnetic engine uses electric power to run which is cleaner and cheaper than fossil fuels. In an internal combustion engine the problem of heating is there but for the proposed engine there is no such problem.

The proposed model introduces electromagnetic engine which uses a property of an electromagnet. Whenever the direction of the current entering the windings is changed, it changes the polarity of its poles. The proposed engine has been made in comparison with a 70 cc conventional internal combustion engine.

In order to design an engine with a high power rating this idea can be extended in various models of internal combustion engines such as boxer engine, multi-piston- single-shaft engine.

By the small modification in design the engine can be modified to generate more power, thereby improving its efficiency. So that it can be used in commercial vehicles.

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