

Experimentation of Electromagnetic Engine

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Abstract— Engine is the main source of power for an Automobile, usually being an internal combustion (IC) engine where combustion takes place & produces heat which converts into mechanical energy. Considering the current condition of increase in population and global warming, an internal combustion engine has a lot of demerits like increasing fuel prices, depleting fossil fuels, increasing pollution, etc. A lot of alternative for fossil fuels like CNG and LPG and even alternatives for internal combustion engine such as electric vehicles have been used. These alternative has some limitations like high initial cost, low efficiency etc. Here we have introduced a mechanism which has more load carrying & running capacity than electrical vehicles and also makes zero emission or pollution as compared to conventional vehicles. The working principle of the engine is the magnetic force principle, i.e. magnetic repulsion between the same poles of two different magnets. When similar poles of two different magnets come in contact with each other they repel each other. This phenomenon of repulsion is used in this engine to create linear motion of the piston.

Key words: Electromagnet, Permanent Magnet, Repulsion, Combustion Engine, Pollution

I. INTRODUCTION

Automobile industry is completely depends on internal combustion engine using petrol and diesel because of its reliability and ease of availability but with 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.

Nowadays scientists are searching for an alternative fuels. This project can be one of the main power sources for the automobile engines. This project is to describe the construction and design of a electromagnetic engine, which operate with the help of magnetic force. This mechanism is entirely different from normal IC engine mechanism. It works with electromagnetic effect and repulsion of magnetic force instead of fossil fuels. It consists of, a permanent magnet and a electro magnet. Electro magnet is mounted on the cylinder head and the Permanent magnet is mounted on the piston head. Here we are not using spark plug and valve arrangement. Electro magnet contains copper windings. Electro magnet is getting power supply from the battery by suitable voltage. The piston contains permanent magnet moves from TDC to BDC and BDC to TDC which will result, convert reciprocating motion into rotary motion of crank shaft. Power supply from battery to the electro magnets are

controlled by micro controller with help of, contact breaker circuit and relay arrangement.

A. Problem Definition

Our conventional engines which runs on fuels i.e. fossil fuels which comes from a non-renewable resources. The world's oil supply is limited resource. Different organizations have different duration, but they all agree that oil will end. Fossil fuel remains the top global energy source and the fuel of choice for transportation. Demand for oil is projected to rise because of increasing commercial transportation activity.

To avoid this serious social and economic implications a global decline in oil production could entail, the 2005 Hirsch report emphasized the need to find the alternatives, at least ten to twenty years before the peak, and to phase out the use of petroleum over that time. Such mitigation could include energy conservation, fuel substitution, and the use of unconventional oil. Because mitigation can reduce the use of traditional petroleum sources. The less we use the longer it will last. There are a lot of alternatives being developed like electric vehicles, hybrid vehicles, hydrogen vehicles etc. but these alternatives have their own limitations like the requirement of the battery is high as well as the cost of the battery is also high, there are very few charging point for electric vehicles, also it takes a lot of time to recharge an electric vehicles etc. In case of hybrid vehicles though it is very economical and very less fossil fuel dependent but still the power created is less also it is very expensive and the maintenance cost is very high than electric vehicles.

The electromagnet engine as compared to other alternatives will require less power from power source and can regenerate more power as compared to others and it may end the need of fossil fuel in transportation and power generation.

B. Scope of Project

The basic idea is to design an engine which can be used as alternative for combustion engine. It can be pollution free, more cost effective than electric or hybrid vehicles which are used as alternative for conventional engines. As the fossil fuels are already depleting and which is resulting into unstable costing of the fuels available in this situation this electromagnetic engine will have less operating cost. It can also be used to replace the conventional engine and the same vehicle can be reused with some minor tuning.

C. Objectives of the project

- To develop a prototype engine which works on the principle of magnetism.
- To design an engine which will not depend on fossil fuels.
- To design an engine which will have no effect on the climate.
- To design an engine with low operating cost.

- To design an engine that is light in weight as compared to conventional engine.

II. BASIC THEORY

A. Combustion Engine

The Combustion Engine is used to convert Fossil Fuels (Gasoline, Diesel, and Natural Gas) into horsepower. The Combustion Engine takes the Fossil Fuels and converts it to Mechanical Energy. The Fossil Fuel is brought into a combustion chamber. In the combustion chamber the fuel is ignited, creating a small explosion. This explosion pushes down on a piston and turns a crankshaft. The gases from the explosion are exhausted out of the engine and the process is repeated.

The crankshaft is the reason why the Combustion Engine is good at making horsepower. The Mechanical Advantage from the crankshaft increases the energy from the combustion process and converts that energy into Mechanical Energy for vehicles or electricity production.

1) Advantages

- 1) Large amount of Horse Power
- 2) Higher Efficiency is achievable over wide load range
- 3) Relatively Low initial cost

2) Disadvantages

- 1) Produces Carbon Dioxide gas
- 2) Uses Fossil Fuels
- 3) Increasing fuel prices

B. Electric Engine

The Electric Engine converts electricity into Magnetic Energy then into Mechanical Energy. The electromagnets are placed around a permanent magnet that magnetic force turns a shaft. The engine uses electricity from generators or batteries. The engine produces NO carbon dioxide gas when using batteries. The engine produces carbon dioxide when using a Combustion Engine with a generator.

The Electric Engine cannot replace the Combustion Engine with the horsepower and torque.

The Electromagnetic Reciprocating Engine uses less energy for horsepower than the Combustion Engine. This is because the electric engine turns a shaft and the Electromagnetic Reciprocating Engine turns a crankshaft.

1) Advantages

- 1) NO fossil fuel required
- 2) NO emission of harmful gases
- 3) Low maintenance required

2) Disadvantages

- 1) Uses Fossil Fuel from electricity
- 2) Less driving range
- 3) Very few recharge point
- 4) Need long time to recharge batteries
- 5) High initial cost

C. Hybrid Engine

The Hybrid Engine is the Combustion Engine and the Electric Engine working together in one vehicle. The Combustion Engine is the main source of propulsion but is supplemented by an Electric Engine. The Hybrid Engine is used for small vehicle propulsion because the amount of electricity required for Electric Engine increases with the size of the vehicle.

Batteries and a generator attached to the Hybrid Engine cannot be size to fit in the standard vehicles. The Combustion Engine converts Chemical Energy to Mechanical Energy and the Electric Engine converts electricity into Magnetic Energy into Mechanical Energy. The engine uses Fossil Fuel for the Combustion Engine and electricity from a generator and batteries. The byproducts of the engine are carbon dioxide gas from the burning of the Fossil Fuels. The limitation of the engine is the Electric Engine.

The future of the Hybrid Engine is limited because it does not offer high fuel mileage and it does not offer an end to dependency of Oil and reduce or end carbon dioxide production.

1) Advantages

- 1) Fuel efficient
- 2) Economical
- 3) Less dependent on fossil fuel

2) Disadvantages

- 1) Though it is less dependent on it but still it requires fossil fuels
- 2) Produces Carbon Dioxide gas
- 3) High initial cost
- 4) High maintenance cost

III. IMPLEMENTATION & METHODOLOGY

A. Working Principle

This engine will be working on the principle of magnetic repulsion between two magnets. This electromagnetic engine will be consisting of two magnets, one of them will be Electromagnet and other one a Permanent Magnet. Permanent Magnet will act as piston and Electromagnet will be located at the top of the cylinder instead of spark plug and valve arrangement in IC Engines. In this way this engine will not be containing any spark plug and fuel injection system. The Electromagnet will be energized by a battery source of suitable voltage and the polarities of electromagnet will be set in such a way that it will repel the permanent magnet i.e. piston from TDC to BDC, which will result in the rotary motion of crank shaft. When the piston is at BDC the supply of Electromagnet is discontinued, the permanent magnet which was repelled to BDC will come back to its initial position i.e. TDC. This procedure completes one revolution of crank shaft.

For the purpose of demonstration the initial work will be carried out using a variable power supply which will convert AC power supply to DC supply and the current and voltage can be altered according to the requirements. This supply will pass through a Relay which will act as a switch for the supply which will be governed by an contact breaker circuit which will supply the current by sensing position of the piston, with the use of the variable power supply the current and voltage supply to the electromagnet can be controlled. As the magnetic force that will be used to turn the crankshaft, this crankshaft will increase the energy using mechanical advantage and send that mechanical energy to two places, the part of the energy as electricity, by turning an alternator, back to the battery and electromagnets and part of the energy i.e. mechanical energy using a shaft which can turn either a generator or a transmission.

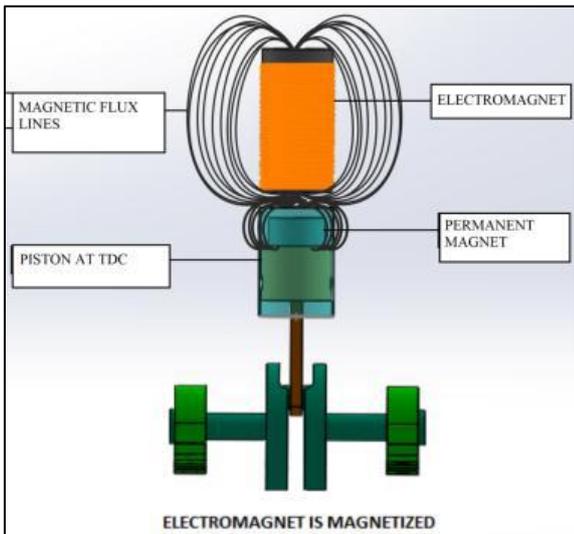


Fig. 3.1: Electromagnet When Magnetized
(1st Stroke)

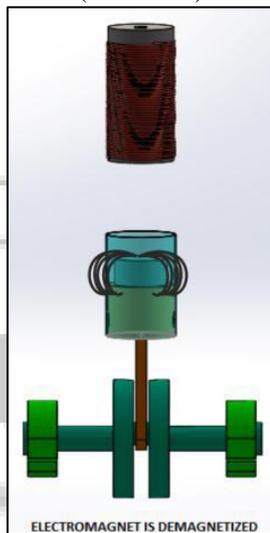


Fig. 3.2: Electromagnet When Demagnetized
(2nd Stroke)



Fig. 3.3: Project Setup

B. Components

1) Electromagnet

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

of one or more turns. A completed coil assembly with one or more set of coils and taps is often called the windings.

The main advantage of an electromagnet over a permanent magnet is that the magnetic field can be rapidly manipulated over a wide range by controlling the amount of electric current. However, a continuous supply of electrical energy is required to maintain the field.

2) Permanent Magnet

Permanent magnet is an object made from material that is magnetized and creates its own persistent magnetic field. Main way the permanent magnet created is by heating ferromagnetic material to a key high temperature. The temperature is specific to each kind of metal, but has the effect of fixing and aligning the domains of the magnet in the permanent position.

There are basically four types of permanent magnets that are used widely those are Neodymium iron boron, Samarium cobalt, Alnico, Ceramic or ferrite. Amongst which Neodymium is a rare earth metal and a special material, combined with iron and boron it creates the strongest permanent magnet, the special combination of NdFeB leads to a high adhesive force which ferrite magnets and other permanent magnets of same dimensions cannot give. Also they can be produced in various shapes as required.

3) Piston

It will be fitted with a very strong Neodymium magnet. The remaining part of a piston is non-magnetic material like aluminium alloy. For the arrangement of permanent magnet proper machining will be done on the piston head. One end of hollow case will be fitted with a powerful permanent magnet made of neodymium iron-boron (NdFeB). This piston head will act as one attracting and repulsing end of the complete magnetic repulsion mechanism and other end will be the electromagnet that will be fitted on the cylinder head.

4) Cylinder Block

Engine or cylinder block is the basic structure of the engine below the cylinder head it has various functions but most commonly it acts as a guide for the reciprocating piston. Cylinder block has a slightly complex structure as it has to various other parts of the engine.

In this case as for the purpose of demonstration there is no complex mechanism there we will be using a cylindrical seamless pipe made up of steel to act as a guide for the reciprocating piston. As steel does not have magnetic properties so it has been choosed our various other materials available in the market and as it can be easily machined for obtaining a smooth surface at the inner side of the cylinder to minimize the friction between piston and cylinder.

5) Connecting Rod

Connecting rod is used to transmit reciprocating motion of piston into rotary motion of crankshaft. It can be used of any material like cast iron or aluminium. It can taken from conventional engine. So the connecting rod is same as that of an internal combustion engine. Hence no modification is required.

6) Crankshaft

Crankshaft takes the power output from the engine and gives to the final drive. It can be used from conventional engine. So the crankshaft is same as the Internal Combustion engine. We can use magnetic or non-magnetic material for crankshaft.

7) Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The relay used for the demonstration model is 5 volt 10 ampere DC this relay switches when 5 volt is provided across it.

8) Frame

The frame for holding all the components of the demonstration model is made up of stainless steel material to minimize its effect on the magnetic field of the permanent magnet as well as of the electromagnet. The frame is designed such that the crankshaft has its position fixed on the frame and with the help of pedestrian bearing it is allowed to rotate freely. The guide for the piston is made up of steel seamless pipe properly machined to get a smooth internal surface for the piston to move freely with minimum resistance, the guide is mounted in such way that it's position can be moved up and down according to the position of the electromagnet so that the distance between the permanent magnet and the electromagnet can be set precisely to obtain the desired force.

IV. RESULTS

As the design and working of this electromagnetic engine is different than that of an internal combustion engine. This electromagnetic engine has various advantages over the internal combustion engines. The main advantage is, no fuel is being used in the engine. This results in no pollution which is very desirable in the present day situation. As there is no combustion taking place inside the cylinder there is only very little heat generation which eliminates the requirement of the cooling system and as magnetic energy is used the need for air filter, fuel tank, supply system, fuel filter, fuel injector, fuel pump etc are neglected and the design of the engine can be made simple. So this engine can be more economic and free from air pollution. Magnet is one of the prime power source used for many application. By the demand of fossil fuels expecting that electromagnet can be an alternative fuel and it may be very much useful for coming generation. Power to be produced at shaft of the engine is much more than the power to be consumed by electromagnet to repel permanent magnet. Thus electromagnetic engine gives Green energy, as no harmful by-product is emitted in surrounding atmosphere.

For the analysis, the design of the electromagnetic engine a 100 cc combustion engine was considered and the power required for the combustion engine to work at idling was considered as 8 percent the power created at idling was then considered as basic power that will be required to run an electromagnetic engine at idling this basic parameter was used to design an electromagnet with consideration of the power supply that can be provided. The analytical result of the calculation proves that the engine is capable of providing more horse power than combustion engine of the same range.

As this engine avoids the other losses like friction and inertia of the moving parts itself.

VOLTAGE	CURRENT	RPM
18	3	230
	4	264
	5	340
24	3	340
	4	467
	5	490
30	3	440
	4	470
	5	490

Table 4.1: Observation Table

V. LIMITATIONS OF THE EXPERIMENT

- Permanent Magnets loose efficiency with time and hence electro-magnets have to be incorporated
- Though we have a working prototype of the model suggested but few design changes still can be incorporated to increase the efficiency of the system as a whole.
- As the complete working of the engine depends upon the permanent magnet and electromagnet the initial costing of the engine will be high

VI. CONCLUSION

The Electromagnetic engine developed is an attempt to curb the pollution generated by present Internal Combustion Engines. We have successfully demonstrated the concept of using electromagnetics to produce crank shaft rotation in an Internal Combustion Engine model. The research conducted is an example that the present internal combustion engines can be modified and made eco-friendly by using the suggested concept. Though the research conducted in this report is not adequate to be commercially applied but we believe that with adequate funding and further research this project could be taken further to develop the first ever commercially usable electromagnetic engine. The electromagnetic engine designed is totally different from motor, because the working principle of both are different as well as the power consumption is also very less in electromagnetic engine. The only power consumed is the power consumed by electromagnet. Electromagnet used here is to repel the permanent magnet. There are no other power consuming components. Movement of magnet doesn't induce back electromotive force in windings of electromagnet and hence nothing happens similar to electric motor here. Power to be produced at shaft of the engine is much more than the power to be consumed by electromagnet to repel permanent magnet.

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