

MAGNETIC PISTON OPERATED ENGINE

Sumit Dhangar¹, Ajinkya Korane², Durgesh Barve³

^{1,2,3}UG, Mechanical, University of Pune (India)

ABSTRACT

In modern science and technology there is a demand in fossil fuels. Nowadays scientists are searching for an alternative fuels. This project is one of the main power sources for the automobile engines. This project is to describe the construction and design of a V-type magnetic piston engine, which operate with the help of electromagnetic 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, two permanent magnet and two electro magnet. Electro magnets are mounted on the cylinder head and the permanent magnets are mounted on the piston head. Here not using spark plug and valve arrangement. Electro magnet contains copper windings. Electro magnets are 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 power splitter, timer and relay switch arrangement. [2]

Keywords: Crank Shaft, Electromagnet, Mechanism, Permanent Magnet, Reciprocating

I. INTRODUCTION

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. 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. Magnetism is the basic principle of working for an electromagnetic engine. The general property of magnet i.e. attraction and repulsion forces is converted into mechanical work. A magnet has two poles. A north pole and a south pole. When like poles are brought near each other they repel and attract when like poles are brought together. This principle is being used in the electromagnetic engine.

In this engine, the cylinder head is an electromagnet and a permanent magnet is attached to the piston head. When the electromagnet is charged, it attracts or repels the magnet, thus pushing the piston downwards or upwards thereby rotating the crankshaft. This is how power is generated in the electromagnetic engine. It utilizes only repulsive force that allows the field to dissipate completely, and have no restrictive effects on the rising piston. The electromagnetic engine should ideally perform exactly the same as the internal combustion engine. The power of the engine is controlled by the strength of the field and the strength of the field is controlled by the amount of windings and the current that is being passed through it. If the current is increased the power generated by the engine also

increases accordingly. The current that is used to charge the electromagnet is taken from a DC source like a lead acid battery.

The main advantages of electromagnetic engine are that it is pollution free. Also it is easy to design an electromagnetic engine because there are no complicated parts. Since the engine doesn't have combustion, valves, water cooling system, fuel pump, fuel lines, air and fuel filters and inlet and exhaust manifolds etc. can be eliminated from the engine. The main challenge faced in designing an electromagnetic engine is that it has to be as efficient as an internal combustion engine.[3]

II. WORKING PRINCIPLE

The working of the electromagnetic engine is based on the principle of magnetism. A magnet has two poles a north pole and a south pole. Magnetism is a class of physical phenomenon that includes forces exerted by magnets on other magnets. By principle of magnetism, when like poles of a magnet is brought together they repel away from each other. When unlike poles are brought near each other they attract. This is same for the case of an electromagnet and a permanent magnet too. So the idea is to modify the piston head and cylinder head into magnets so that force can be generated between them.

This working of the electromagnetic engine is based on attraction & repulsive force of the magnet. The 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. The coil is connected through the battery, the copper coil is energized to produced the magnetic field the piston in side of the large power Neodymium Iron Boron magnets, the piston moved upper and lower the fly wheel connected through the piston link the copper coil energized the piston move 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.[1]

III. NEED OF THE TECHNOLOGY

Today fossil fuels are widely used as a source of energy in various different fields like power plants, internal & external combustion engines, as heat source in manufacturing industries, etc. But its stock is very limited and due to this tremendous use, fossil fuels are depleting at faster rate. So, in this world of energy crisis, it is inevitable to develop alternative technologies to use renewable energy sources, so that fossil fuels can be conserved. One of the major fields in which fossil fuels are used is Internal Combustion Engine. An alternative of IC Engine is "*MAGNETIC POWERED ENGINE*". It is an engine which will use magnetic flux density to run the engine.

IV. PERMANENT MAGNETS

These are the most common type of magnets that we know and interact with in our daily lives. e.g.; The magnets on our refrigerators. These magnets are permanent in the sense that once they have been magnetized they retain a certain degree of magnetism. Permanent magnets are generally made of ferromagnetic material. Such material consists of atoms and molecules that each have a magnetic field and are positioned to reinforce each other.

V. CLASSIFICATION

Permanent Magnets can be classified into four types based on their composition:

1. Neodymium Iron Boron (NdFeB or NIB)
2. Samarium Cobalt (SmCo)
3. Alnico
4. Ceramic or Ferrite

NIB and SmCo are the strongest types of magnets and are very difficult to demagnetize. They are also known as rare earth magnets since their compounds come from the rare earth or Lanthanoid series of elements in the periodic table. The 1970s and 80s saw the development of these magnets. Alnico is a compound made of ALuminium, Nickel and Cobalt. Alnico magnets are commonly used magnets and first became popular around the 1940s. Alnico magnets are not as strong as NIB and SmCo and can be easily demagnetized. This magnet is however, least affected by temperature. This is also the reason why bar magnets and horseshoes have to be taken care of to prevent them from losing their magnetic properties. Ceramic or Ferrite magnets are the most popular today. They were first developed in the 1960's. These are fairly strong magnets but their magnetic strength varies greatly with variations in temperature. Permanent Magnets can also be classified into Injection Molded and Flexible magnets. Injection molded magnets are a composite of various types of resin and magnetic powders, allowing parts of complex shapes to be manufactured by injection molding. The physical and magnetic properties of the product depend on the raw materials, but are generally lower in magnetic strength and resemble plastics in their physical properties. Flexible magnets are similar to injection molded magnets, using a flexible resin or binder such as vinyl, and produced in flat strips or sheets. These magnets are lower in magnetic strength but can be very flexible, depending on the binder used.

VI. SHAPE & CONFIGURATION

Permanent magnets can be made into any shape imaginable. They can be made into round bars, rectangles, horseshoes, donuts, rings, disks and other custom shapes. While the shape of the magnet is important aesthetically and sometimes for experimentation, how the magnet is magnetized is equally important. For example: A ring magnet can be magnetized S on the inside and N on the outside, or N on one edge and S on the other, or N on the top side and S on the bottom. Depending on the end usage, the shape and configuration vary.

VII. DEMAGNETIZATION

Permanent magnets can be demagnetized in the following ways: - Heat - Heating a magnet until it is red hot, makes the magnetic properties to fail - Contact with another magnet - Stroking one magnet with another in a random fashion, will demagnetize the magnet being stroked. - Hammering or jarring will loosen the magnet's atoms from their magnetic attraction

VIII. TEMPORARY MAGNETS

Temporary magnets are those that simply act like permanent magnets when they are within a strong magnetic field. Unlike permanent magnets however, they lose their magnetism when the field disappears. Paperclips, iron nails and other similar items are examples of temporary magnets. Temporary magnets are used in telephones and electric motors amongst other things.

XI. ELECTROMAGNETS

Had it not been for electromagnets we would have been deprived of many luxuries and necessities in life including computers, television and telephones. Electromagnets are extremely strong magnets. They are produced by placing a metal core (usually an iron alloy) inside a coil of wire carrying an electric current. The electricity in the current produces a magnetic field. The strength of the magnet is directly proportional to the strength of the current and the number of coils of wire. Its polarity depends on the direction of flow of current. While the current flows, the core behaves like a magnet. However, as soon as the current stops, the core is demagnetized. Electromagnets are most useful when a magnet must be switched on and off as in large cranes used to lift cables and rods in construction.[5]

X. EQUATIONS**DESIGN**

Input voltage = 36 V

Input current = 1 A

Input Power = Voltage $\times$ Current

= 36×1

= 36W

Max. Force exerted by electromagnet on piston

$$F_1 = (N^2 I^2 K A) / 2G$$

Where, N = number of turns = 1000

I = Current flowing through coil = 1 A

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

A = Cross-sectional area of electromagnet (radius r = 0.0175 m)

G = Least distance between electromagnet and permanent magnet = 0.005 m

On substitution, we get Max. Force

$$F_1 = 24.18 \text{ N}$$

Force exerted by permanent magnet Force

$$F_2 = (B^2 A) / 2\mu_0$$

Where, B = Flux density (T)

A = Cross-sectional area of magnet (radius r = 0.0125 m)

μ_0 = Permeability of free space = $4\pi \times 10^{-7}$

Now flux density

$$B = \frac{B_r}{2} \times \left[\frac{(D+z)}{(R^2 + (D+z)^2)^{0.5}} - \frac{z}{(R^2 + z^2)^{0.5}} \right]$$

Where, B_r = Remanence field = 1.21 T

z = distance from a pole face = 0.005 m

D = thickness of magnet = 0.012 m

R = semi-diameter of the magnet = 0.0125 m

On substitution we get flux density,

$B = 0.2547$ T Now substituting B in the equation of force,

$F_2 = 12.67$ N Since, force F_1 and F_2 are repulsive,

$$\text{Total force } F = F_1 + F_2$$

$$F = 36.85 \text{ N}$$

Torque $T = F \times r$

Where F = total force on piston r = crank radius = 0.01m

Torque $T = 0.3685$ N-m

Mass of Fly wheel

$$\omega = (2\pi N)/60, \text{ where } N = \text{speed} = 200 \text{ rpm}$$

Therefore $\omega = 20.94$ rad/s

Energy stored on flywheel

$$E = T \times \theta$$

Where T = torque

θ = Angle of rotation = $180^\circ = \pi$ radians

On substitution we get energy stored $E = 1.157$ J

Also

$$\text{Output power } E = 0.5 \times I \times \omega^2$$

Where, I = moment of inertia of flywheel ω = angular velocity

On substitution we get moment of inertia,

$$I = 5.277 \times 10^{-7} \text{ Kg-m}^2$$

Moment of inertia,

$$I = 0.5 \times m \times r^2$$

Where, m = mass of fly wheel r = radius of fly wheel = 0.07 m

On substitution,

$$\text{We get } m = 2.154 \text{ Kg } P = (2\pi NT)/60$$

Where, N = speed = 200 rpm

T = Torque = 0.3685 N-m

On substitution, we get

$$\text{Output power } P = 7.718 \text{ W}$$

Efficiency = (Output/Input) $\times 100$

$$= (7.718/36) \times 100$$

Therefore, Efficiency = 21.44 %

XI. FIGURES

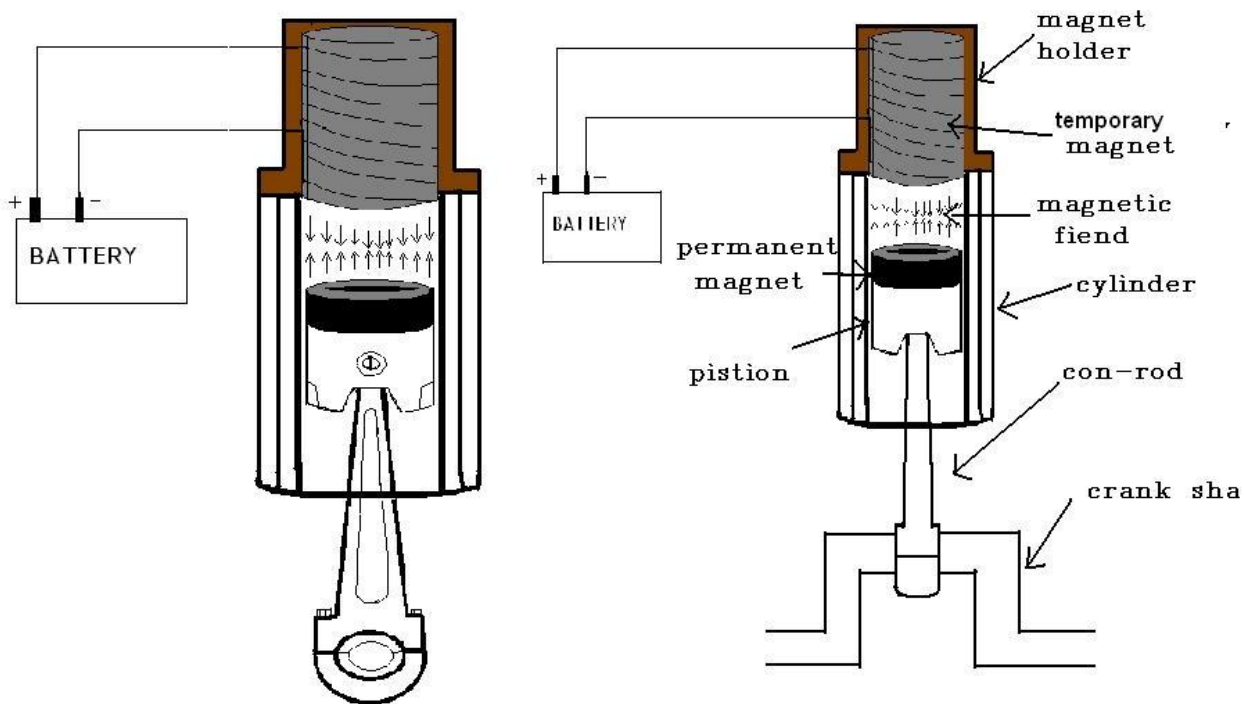


Diagram of Magnetic Piston Operated Engine

XII. CONCLUSION

Design and working of magnetic piston engine is different from other engine. The Principle of Operation of Electromagnetic Engine is Different than that of Internal Combustion Engine. The 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 it is 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 electro magnet is main alternative fuel and it is 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. Thus is the future of Automobile Industries.

13. REFERENCES

- [1]. <http://en.wikipedia.org/wiki/Magnet>.
- [2]. http://en.wikipedia.org/wiki/Neodymium_magnet.

- [3]. Abil Joseph Eapen, Aby Eshow Varughese theory on **electromagnetic** engine.
- [4]. www.aaronia.com
- [5]. www.rare-earth-magnets.com.
- [6]. www.kjmagnetics.com .
- [7]. www.howmagnetswork.com
- [8]. www.ecotricity.co.uk
- [9]. www.cia.gov
- [10]. www.endmemo.com