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MAGNETIC REPULSION ENGINE

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***Abstract*- Fossil fuel production is expected to diminish halt as near as forty years from now. Time to start really digging in and getting other renewable energy source into mainstream of use. In a long way in finding solution to future fuel needs the answer surely lies in alternative source.**

The term "alternative" presupposes a set of undesirable energy technologies against which "alternative energies" are contrasted. As such, the list of energy technologies excluded is an indicator of which problems the alternative technologies are intended to address. Controversies regarding dominant sources of energy and their alternatives have a long history. The nature of what was regarded alternative energy sources has changed considerably over time, and today, because of the variety of energy choices and differing goals of their advocates, defining some energy types as "alternative" is highly controversial

The present project is a design of an automated magnetic engine which runs with a power of permanent magnet. The engine is to be designed in such a way that in holds the magnetic power for its reciprocation. In this project the performance of a magnetic engine is to be analysis and compare with an existing petrol engine.

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[1]. 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[2].

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 then 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[3].

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 8main challenge faced in designing an electromagnetic engine is that it has to be as efficient as an internal combustion engine.

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[4].

II. TYPES OF EXISTING ENGINE

2.1. Gas Engines

As in the familiar automobile engine, the low-compression gas engine mixes fuel and air outside the cylinder, before compression.[5] If natural gas is burned, a mixing valve may replace the carburetor used with liquid fuel[6].

The gas fuel is proportioned to the air to produce a nearly perfect mixture; that is, just enough air to burn the gas completely. This mixture flows into the cylinder and is compressed. Near the end of compression, an electric spark ignites the inflammable mixture, which burns rapidly. Cylinder pressure rises rapidly and acts on the piston to move it down on its power stroke.

Since compressing a gas raises its temperature, the mixture may get hot enough to self-ignite before the end of compression. Such pre-ignition causes loss of power, and compression pressure must be limited in this type of engine. To do this, compression ratio becomes a major factor in establishing what the cylinder compression pressure will be. Cylinder volume at the beginning of a stroke, divided by its volume at the end, is the compression ratio. Pressure at the end of compression is roughly proportional to the ratio; in general, the higher the compression ratio[7], the higher will be the maximum pressure reached during combustion. Also, the higher the expansion ratio, which in most engines corresponds to the compression ratio, the more efficient the engine.

Although it is desirable to have a high compression ratio, the nature of the fuel imposes limits in engines where a nearly perfect mixture is compressed. With natural gas, for example, the compression ratio might run about 5:1, for a compression pressure of about 120 psi. Also, pre-ignition might become a limiting factor[8].

2.2. Diesel Engines

In contrast to engines in which fuel and air mix before compression are those in which only air is compressed and fuel enters near the end of compression. In the diesel, prime example of this class, heat of compression is used to ignite the fuel.

In a typical diesel engine, air is compressed to about 450 psig, which brings its temperature up to about 1000F. When finely atomized oil is sprayed into this heated air, it ignites and burns. In the diesel, therefore, the high compression ratio necessary for reliable ignition means inherently high efficiency[9].

Because, in practice, compression ratio above those needed for ignition do not improve overall efficiency much, it is customary to go no higher. Pressure and temperature resulting from a given compression ratio depend on engine speed, cylinder size, and other design factors. Typical compression pressures in diesels range from 450 to 600 psig or more, with small, high-speed engines generally having higher compression pressures than larger units.

2.3. Dual-Fuel Engines

Since natural gas has about the same heating value per pound as does fuel oil, if a diesel were operated at the same output on natural gas instead of on oil, the cylinder would be charged with a weight of gas about equal to that of the oil. Thus, a lean mixture would result. In fact, the mixture would be so lean that it would not self-ignite at the temperature reached by the end of compression[10].

In dual-fuel engines, therefore, a small quantity of oil (called pilot oil) is injected near the end of compression. It is ignited by the compressed mixture and burns like the oil fuel injected into a standard diesel. Its burning supplies enough heat to ignite the gas/air mixture. For precise control of the pilot oil, a separate set of fuel pumps and nozzle is added[11].

Because the quantity of air admitted to cylinders remains the same at all loads, the fuel/air mixture tends to become extremely lean at partial loads - so lean as to lead to incomplete combustion and poor fuel economy. To maintain a desirable mixture ratio, most dual-fuel designs include some means of reducing the air quantity at partial loads.

2.4. High-Compression Gas Engines

When operation is solely on gas, it is desirable to gain the good fuel economy of high compression without the cost of pilot oil. By using higher intensity ignition systems and slightly richer mixtures with lower compression ratios than in duel-fuel engines, today's gas engines can yield performance close to that of duel-fuel units, without pilot fuel[12].

2.5. Neodymium Magnet in Engine

Placing two cylindrical neodymium magnet in engine. According to our concept, one of the magnet is replaced as piston which is fixed and another magnet in cylinder head which is made to rotate Clearance between two magnets are maintained.Thus when both magnets are in north pole(N-N), it repel each other and similarly when both magnets are in opposite direction(N-S), it attracts, According to the magnetic field applied, the piston actuate. Here magnet is replaced using epoxy high grade resin[13].

Epoxy Resins are thermosetting resins, which cure by internally generated heat. Epoxy systems consist of two parts, resin and hardener. When mixed together,

the resin and hardener activate, causing a chemical reaction, which cures (hardens) the material. Epoxy resins generally have greater bonding and physical strength than do polyester resins. Most epoxies are slower in curing, and more unforgiving in relation to proportions of resins and hardener than polyesters. Superior adhesion is important in critical applications and when "glassing" or gluing surfaces – such as steel, redwood, cedar, oak and teak – as well as other non-porous surfaces[14]. Evercoat Epoxy resins are superior to polyester resins in that they impart exceptional strength in stress areas. Epoxies will adhere to surfaces where polyesters may ruin them. Examples of areas where epoxy resins products must be used are redwood, hardwoods, styrofoam, some plastic surfaces, and metal. They are generally higher in cost than polyester resins.[15] Epoxy resins may be mixed with various fillers to thicken them for special applications. In working with epoxies, the resin to hardener ratio is very important and should never be adjusted in an attempt to slow down or speed up the curing process.

III. 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[16]. 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 [17]wheel.

IV.COMPONENTS AND THEIR MATERIALS

4.1. Cylinder

Cylinder is the part of the engine inside which the piston moves up and down. Unlike a conventional IC engine, there is no need of any fuel or air for the operation of this magnetic engine. So the design of the cylinder is quiet easy since there is no need for fuel and air intake, spark plug, etc. The temperature inside the cylinder during the running conditions is also quiet low, which means that no fins are required. Thus, the cylinder is a simple cube like structure with a bore in the middle for the piston. The cylinder is made of Aluminum which is nonmagnetic, light weight and strong material[18]

.

4.2. Piston

The piston that we have used is similar to the ones used in IC engines. Piston is made out of aluminum as well because the NdFeB magnet has to be attached on top of the piston head which shouldn't get attracted by the piston itself[19]

Fig 1: Piston with magnet in top face

The small end of the connecting rod is connected to the hollow side of the piston and the big end is connected to the crankshaft. The crankshaft is connected to the flywheel. The crank shaft, connecting rod and piston put together convert the linear reciprocation into rotating motion of the flywheel.

4.3. Flywheel

Flywheel is also made up of aluminum. It converts the reciprocating energy into rotating energy. It helps regulate the engine's rotation, maintaining it at a steady speed. They can resist changes in rotational speeds since they have a significant moment of inertia. The flywheel acts as a reservoir that stores the rotational energy[20].

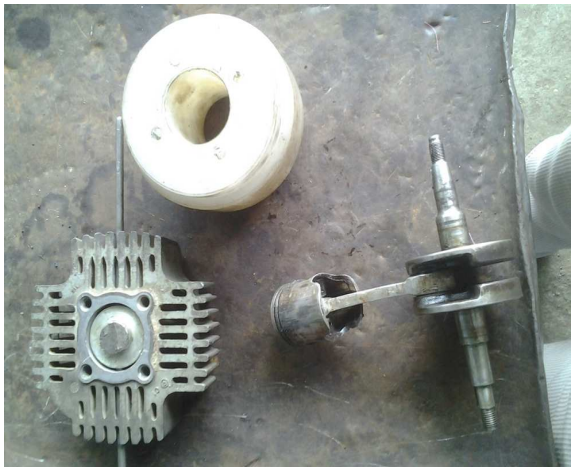

Fig 2- Piston arrangement with in cylinder and crank

4.4. Electromagnet

A coil is formed using insulated solid copper wire which is wound around a core. When electricity is passed through this coil, the coil gets energized and a magnetic field is generated. A winding is usually referred as one loop of the copper wire around the core.It is always better to coat the coils with varnish or wrap them with insulating tape as they provide enhance their insulating properties[21].

4.5. Relay

Relay is an instrument similar to a switch that is operated electrically. A magnetic field is created when the current flows through the coil which brings the lever into contact by attracting them. Just like any switch, relays also have two positions that is on and off[22].

4.6. Battery

We are using the Lead-Acid Battery in this engine for supplying the electrical power required.

V. EQUATIONS

5.1. DESIGN

Input voltage = 36 V
Input current = 1 A
Input Power = Voltage × Current = 36 × 1 = 36W
Max.
Force exerted by electromagnet on piston
F1 = (N2I2KA)/2G
where,
N = number of turns = 1000
I = Current flowing through coil = 1 A
K = Permeability of free space = 4π×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 F1 = 24.18 N
Force exerted by permanent magnet Force
F2 = (B2A)/2μ0

Where,
B = Flux density (T)
A = Cross-sectional area of magnet (radius r = 0.0125 m)
μ0= Permeability of free space = 4π×10-7

Now flux density
B = Br/2 × [(D + z)/ (R2 + (D + z) 2)0.5 – z/ (R2 + z2)0.5]

Where,
Br = 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,
F2 = 12.67 N

Since, force F1 and F2 are repulsive,

Total force F = F1 + F2 F = 36.85 N
Torque T = F × r

Where
F = total force on piston
r = crank radius = 0.01m
Torque T = 0.3685 N-m

Mass of Fly wheel ω = (2πN)/60,

where
N = speed = 200rpm
Therefore ω = 20.94 rad/s

Energy stored on flywheel E = T × θ

Where,
T = torque

θ = Angle of rotation = 180o = π radians

On substitution we get energy stored

E = 1.157 J

Also 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,

$I = 5.277 \times 10\text{-}7$ Kg-m2

Moment of inertia, $I = 0.5 \times m \times r2$
Where,
m = mass of fly wheel
r = radius of fly wheel = 0.07 m

On substitution,
We get
m = 2.154 Kg
$P = (2\pi NT)/60$
Where,
N = speed = 200 rpm
T = Torque = 0.3685 N-m

On ubstitution, we get Output power
P = 7.718 W
Efficiency = (Output/Input) × 100
= (7.718/36) × 100
Therefore, Efficiency = 21.44 %

VI. ASSEMBLE OF MAGNETIC ENGINE

VII. RESULTS AND DISCUSSION

- ✓ The prototype of the magnetic engine was successfully designed and fabricated.
- ✓ It is driven with the help of magnetic energy and electricity only. So, no fuel consumption is required.
- ✓ It creates no pollution and is eco-friendly.
- ✓ This engine produces power once in every two stroke of the piston.
- ✓ We obtained a maximum efficiency of 38.824% for an input power of 21.6W.
- ✓ We can achieve better efficiency and power output of the engine if the following corrections are made:
- ✓ The windings are hand wound with the help of lathe machine. This leads to increase in air gap which leads to weaker magnetic field.
- ✓ Laminate the windings.
- ✓ Relay offers resistance which results in lesser force.
- ✓ The fabrication is not very precise and might have some misalignments.

VIII.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.

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