

Electromagnetic Engine

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Abstract—This paper presents the idea of electromagnetic engine. It is the modification of conventional internal combustion engine. With the increase in consumption and reducing supply, fossil fuels are on the verge of extinction. The paper proposes to use electromagnetic principle for running the engine. The concept is to use electromagnetic force to drive the piston and produce power. As the magnetic field is produced by supplying current to the solenoid, the piston reciprocates. The reciprocating motion is converted into rotational motion and power is stored in the flywheel.

Index Terms—Electromagnet, Permanent Magnet, Piston, Reciprocating

I. INTRODUCTION

Today there is need of alternate fuel for day today life. Fuel prices are increasing rapidly and environment get polluted from the emission of hazardous gases from fuel sources. Shortage of the fuel is expected from consumption. Hence there is need to reduce the emission of gases like CO, SO₂, NO_x, which are hazardous to nature[1].

With reduced fossil fuel resources and increase in energy costs and environmental concerns, engines use 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 disadvantages. Production of bio-fuel takes vast resources and they still pollute the environment. Similarly, the solar power is not efficient. Added to all, the initial capital and subsequent maintenance costs for machines that use alternative energy sources are very high. Hence, in the absence of a viable alternative, as of now, switching to new technology by changing from traditional Internal Combustion engines has been a great challenge. Magnetism is the basic principle of working for an electromagnetic engine. The general property of magnet i.e. repulsion and attraction forces is converted into mechanical work. A magnet has two poles, a north pole and a south pole. When two like poles are brought together they repel each other and when unlike poles are brought together they attract. This principle is being used in the electromagnetic engine [2].

In this engine, the cylinder head is an electromagnet and the piston head is attached with a permanent magnet. When the electromagnet is charged, it attracts or repels the magnet, in this process it pushes the piston

downwards or upwards where in it rotates 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 resistive 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 merits of electromagnetic engine are that it is pollution free. 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 and so many other parts that are complicated in an IC engine can be disregarded while constructing an Electromagnetic engine. The main challenge faced in designing an electromagnetic engine is that it has to be as efficient as an internal combustion engine [3].

The main objective of this project is to develop pollution free engine which fulfill the fuel requirement. The working principle of electromagnetic engine is based on magnetic attraction and repulsion phenomenon i.e. magnetic repulsion between same pole and attraction between different poles. This principle moves piston Top dead centre to Bottom dead centre and vice versa. The Electromagnetic Reciprocating Engine uses Magnetic Energy to turn a crankshaft. The Magnetic Energy is used to move the Magnetic Chamber in a linear motion, that motion is converted into a rotating motion by a crankshaft. That crankshaft converts that motion into horsepower and torque with efficiency by using half strokes. The crankshaft is used to turn an alternator which produces the electricity for the electromagnets in the Magnetic Chamber. The Magnetic Energy is produced by the electromagnets which are powered by electricity from an attached battery. The crankshaft can be connected to a transmission for vehicles [4].

In a world there are several climatic changes due to the overproduction of carbon dioxide through the burning of Fossil Fuels; and an over dependence on Oil, which has made the world subservient to a few countries, we face an

almost insurmountable problem that screams for a solution. The Electromagnetic Reciprocating Engine is environmental friendly solution [5].

II. EXPERIMENTAL DETAILS

A. Cylinder

Electromagnetic engine uses only magnets for its operation. The cylinder prevents unwanted magnetic field and other losses. Further cylinder material itself should not have the properties of attraction and repulsion hence it should not disturb the movement of the piston. As a solution to the above issues, the cylinder must be only made up of nonmagnetic materials such as stainless steel, fiber, titanium or similar materials of high resistivity and low electrical conductivity.

The cylinder of an electromagnetic engine is a simple cylindrical 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 a product to manufacture. 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.

B. Piston:

The hollow piston casing is made up of non-magnetic stainless steel, titanium or similar materials which are of high resistivity and low electrical conductivity. Alternatively, piston casing can also be made up of non-metallic, thermal resistant materials can be made by integrating both non-magnetic and non-metallic materials. One end of the hollow case is fitted with a powerful permanent magnet made of neodymium iron-boron (NdFeB), samarium-cobalt (SmCo) or similar high field strength magnetic materials. The permanent magnet acts as the core of the piston. The flat surface (which is also the pole of the magnet) of the piston that is nearer to the pole of the electromagnet is called the magnetic head of the piston or piston head. The flat surface of the piston head may be completely exposed or it may be covered by a thin layer of non-magnetic material of sufficient thickness. The other end of the piston case connects to the piston rod which in turn connects to the crankshaft. The crankshaft and the piston rod convert the linear reciprocating movement of the piston to the circular movement. When rotated one-half revolution the stress in the fibres originally above the neutral axis of the specimen are reversed from compression to tension for equal intensity. Upon completing the revolution, the stresses are again reversed, so that during one complete revolution the test specimen passes through a complete cycle flexural stress.

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. The connecting rod used in this engine is M10 bolt. The material of the connecting rod is cast iron. As the magnetic fields are contained inside the cylinder, the connecting rod will not be affected much. The connecting rod is same as that of an Internal Combustion engine.

D. Flywheel:

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

E. 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 referred to as a turn or a winding, and a coil consists of one or more turns. For use in an electronic circuit, electrical connection terminals called taps are often connected to a coil. This Coils are often coated with varnish or wrapped with insulating tape to provide additional insulation and secure them in place. A completed coil assembly with one or more set of coils and taps is often called the windings.

F. Battery:

Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid (H_2SO_4). 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. lead acid cells are being used in a series combination of three batteries of 12-V each.

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. The main intention is to modify the piston head and cylinder head into magnets so that force can be generated between them.

The working of the electromagnetic engine is based on attraction and repulsive force of the magnet. The engine

greatly resembles the working of a two-stroke engine. Consider a piston is located in the lower position, as shown in Fig. 1 that is the BDC, the coil is connected through the battery, and the copper coil is energized to produce the magnetic field.

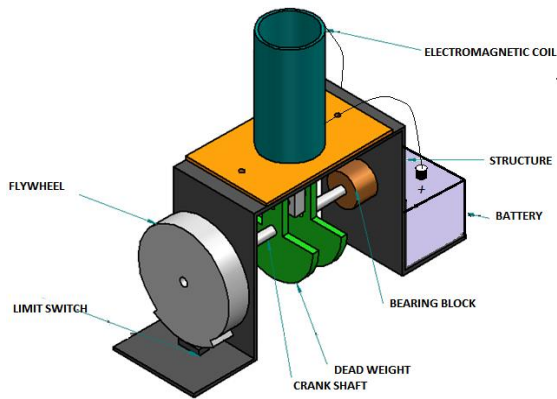


Fig 1: Layout of Electromagnetic Engine

The piston of the Neodymium Iron Boron magnets gets attracted by the electromagnet hence moving the piston from BDC to TDC and hence rotate the fly wheel connected to crankshaft link. While one piston move from BDC to TDC the electromagnet gets de-energized and other electromagnet gets energized and hence resulting the flywheel in completion of full stroke.

The Fig. 1 shows the layout of Electromagnetic Engine. The whole setup is set on a frame. The piston cylinder arrangement is connected to crank shaft with the help of Connecting rod, which is connected to flywheel. The permanent magnet is placed at the top of the piston and electromagnet is set at top most position of the cylinder, which produces magnetic field in the system by using the battery. The battery is connected to electromagnet.

IV. RESULTS AND DISCUSSION

After comparing force(F), current(A), power input(W), efficiency(%), the following results can be obtained:

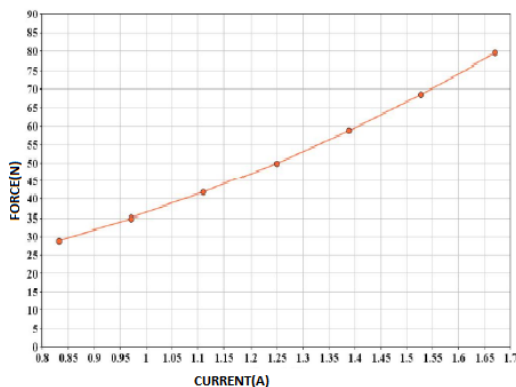


Fig. 2: Variation of Force with Current [3]

The figure shown in Fig. 2, the Force (N) and Current(A) relation. As the current varies the force acting also varies

accordingly. This shows that the current supplied is proportional to the force acting..

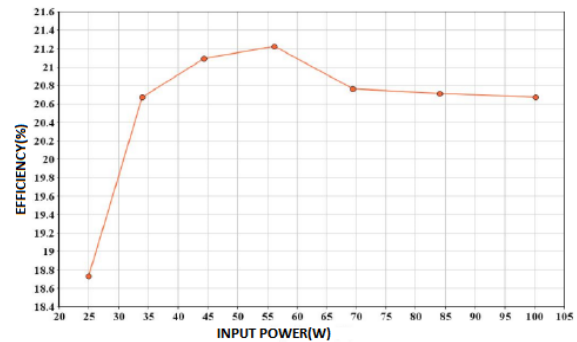


Fig.3: Variation of efficiency with Power input [5]

The efficiency (%) vs the power input (P) is shown below in Fig. 3. As seen, the efficiency increases as the power input increases up to a particular point, then it drops down drastically. This shows that, if the power input is maintained at a particular value, maximum efficiency can be obtained.

V. ADVANTAGES AND DISADVANTAGES

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. This eliminates the need for a cooling system. As magnetic energy is being used the need for air filter, fuel tank, supply system, fuel filter, fuel injector, fuel pump, valves etc. are eliminated and the design of the engine is made simple. The disadvantage of the electromagnetic engine is its high initial cost. The electromagnet and permanent magnet can be very costly. The engine is not as flexible as the internal combustion engine. The power source is battery. The number of batteries will vary according to the requirement. In high power engines, the number of batteries will increase which may increase the total weight of vehicle and consume a lot of space.

VI. CONCLUSIONS

- i. The electromagnetic engine is expected to consume less power than conventional engines.
- ii. As the input power supplied increases the efficiency will increase, but at a certain input power it will be maximum and goes down from peak value of efficiency.
- iii. The efficiency obtained will be less than theoretical efficiency because of magnetic flux losses.

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