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Prototype Implementation of Electromagnetic Piston

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Abstract: The presented paper is an electromagnetic piston that works on the basis of magnetic attraction and repulsion. The piston consists of an electromagnet placed between two permanent magnets of same polarity. The permanent magnets, being of same polarity, are held apart due to repulsive forces. When the electromagnet is energized, the magnets are attracted and hence move towards each other. When the excitation is removed, the electromagnet reverts to its original state, and hence the permanent magnets repel and move away from each other. When the electromagnet is energized and de-energized alternatively, the magnets move towards and away from each other, contributing to the reciprocating movement of the piston.

Keywords: Electromagnet, engine, piston, repulsion.

I. INTRODUCTION

IC engines are widely used nowadays in vehicles. Regardless of the technology used, let it be SI or CI, the losses associated with these engines are tremendous. Only a small portion of the energy obtained by the combustion of fuel is utilized in the engine. Also, the gases formed by the combustion of fuels cause air pollution and are responsible for many respiratory diseases in humans. These problems can be answered by implementing an alternate system in engines. In the presented project, the force obtained by the combustion of fuel is replaced by the forces due to magnetic attraction and repulsion. A major difference in this system from the IC system is that electrical energy is utilized instead of fossil fuels. The energy from a DC source is used to alternatively magnetize and demagnetize an electromagnet. This electromagnet is placed between two normally repelling permanent magnets. The electromagnet when magnetized attracts the two magnets towards it. The alternating magnetization and demagnetization ensures the reciprocating motion of the permanent magnet. A crankshaft is used to convert the reciprocating motion into rotary motion.

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 phenomena 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 together they attract. This is same for the case of an electromagnet and a permanent magnet also. So the idea is to place an electromagnet between two repelling permanent magnets. When excited, the electromagnet attracts the permanent magnets, and when demagnetized, the permanent magnets repel.

The electromagnetic piston operates by taking electricity from a battery source, converting it to magnetic energy using electromagnets and converting that kinetic energy to mechanical energy using the crankshaft. The electricity stored in a battery is the primary energy source. The energy is send to electromagnets which turn that electricity into magnetic energy or magnetic force. This magnetic force is further used to turn the crankshaft. The crankshaft will increase the energy using mechanical advantage. This energy can be send either to a shaft to turn the generator or to automobiles.

III. CONSTRUCTION

The block diagram description of the prototype is shown in the below fig3.1:

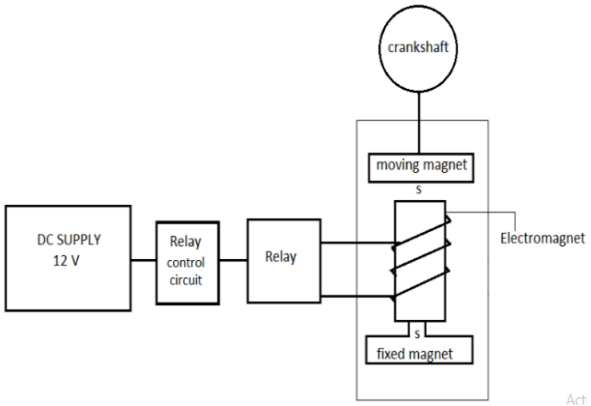

Fig3.1: Electromagnetic piston

A. Supply Source

A 12V DC is used as the supply source. For this purpose, a 12V lead-acid battery is used. Lead-acid battery is used in cases where high values of load current is necessary.

B. Relay

A relay is an electrically operated switch. Current flowing

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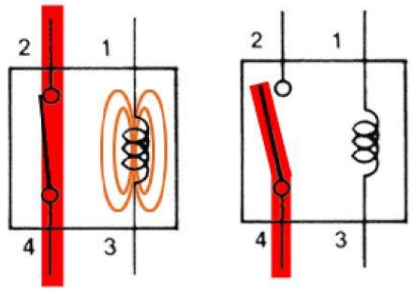
through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts.



De-energized relay Energized relay

As per the figure shown above the working of the relay can be explaind as, when a voltage is applied in to pin 1,the electromagnet activates, causing amagnetic field to be developed, which goes on to close the pins 2 and 4 causing a closed circuit. When there is no voltage on pin 1, there will be no electromagnetic force and thus no magnetic field.Thus the switches remain open.

In this prototype a 12V, 10A single pole single throw relay is used to switch the DC supply on and off. A square pulse is obtained as the result of this switching.

C. Relay Control Circuit

A 555 IC Timer acting as an astable multivibrator is used to control the relay. The 555 IC is an integrated circuit used in a variety of timer, pulse generator and oscillator application. The 555 can be used to provide time delays, as an oscillator, and as a flip-flop element. The potentiometer of the circuit can be varied to a required value so as to control the frequency of the output square pulse. This square pulse is provided to the electromagnet so as to magnetize and demagnetize it alternatively.

The simulation of the circuit is done to ensure the result. The circuit diagram of the control circuit is shown in the fig.3.2.

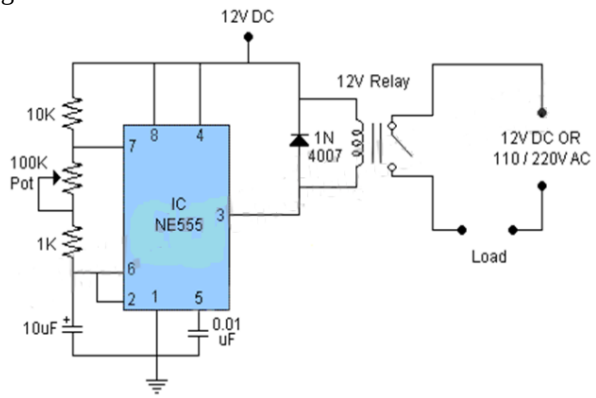


Fig3.2: Relay control circuit

D. Permanent Magnet

A neodymium magnet, the most widely used type of rare earth magnet is used in this prototype. It is made from an alloy of neodymium, iron, and boron to form the Nd2Fe14B tetragonal crystalline structure. It has the highest magnetic flux density (12,800gauss), coercive magnetic field strength (12,300oersted), and overall energy density (40). It has the lowest maximum operating temperature and Curie temperature, at 150 degrees Celsius and 310 degree Celsius, respectively, and temperature coefficient of -0.12.

In this prototype two speaker magnets of automobiles are used as permanent magnets. They are placed in such a manner that it produces a repulsive force between them.

E. Electromagnet

An electromagnet is a type of magnet in which the magnetic field is produced by an electric current. The magnetic field disappears when the current is turned off. Electromagnets consist of a large number of a large number of closely spaced turns of wire that creates the magnetic field. The wire turns are often wound around a magnetic core made from a ferromagnetic material such as iron .The magnetic core concentrates the magnetic flux and makes a more powerful magnet.

The main advantage of an electromagnet over a permanent magnet is that the magnetic field can be quickly changed by controlling the amount of electric current in the winding. However unlike the permanent magnet that needs no power, an electromagnet requires a continuous supply of current to maintain the electric field.

In this prototype an electromagnet of 500 turns copper wire of 26-gauge is used. An iron core is provided to amplify the electromagnetic properties.

F. Crankshaft

A crankshaft is also called crank. It is used to convert the reciprocating motion of the piston into rotary motion. In order to convert the motion the crankshaft has crank pins, additional bearing surfaces whose axis is offset from that of the crank. In this prototype the crankshaft is made from the wood. It is designed for the single cylinder.

IV. CONCLUSION

The prototype of an electromagnetic engine which works on the principle of magnetism was successfully designed and fabricated. Experimental analysis was successfully performed on the prototype. The results obtained from the experiment are as follows. Prototype of an engine which works on the principle of magnetism was successfully manufactured. It uses electricity as its input. No fuel is consumed, which was the primary goal.

The prototype creates no pollution and is eco-friendly. The prototype is a two stroke engine. Only the repulsive force between the magnet and electromagnet is used for power generation. Acceleration is done by controlling the timer which controls the relay.

The electromagnetic engine has numerous advantages over conventional IC engines. A significant advantage is that the electromagnetic engine does not require fossil fuels. Hence this engine does not contribute to air pollution. Since no combustion of fuel takes place inside the engine, the heat generated is significantly lower. So an elaborate cooling system is not required. Also, there is no need for components like carburetor, fuel pump, spark plug, air filter, etc. making the design of the engine comparatively simpler.

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However, the electromagnetic engine suffers a major drawback in the fact that the initial cost of the engine is high. Also the use of permanent magnets adds a further challenge in that as time progresses, the strength of the magnet decreases, requiring the magnet to be replaced. Also, the design of the engine has to be carried out keeping in mind the number of turns of the coils of the electromagnet and the thickness of the wire used.

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