Solenoid Engine
Tanish Patel¹, Mohit Unecha², Deven Sanghavi³
UG Student¹, ², ³
Department of Mechanical Engineering
Maharashtra Institute of Technology, Pune, India

Abstract:
In an automobile, Engine is a main power source in which by combustion of fuel takes place and heat energy is produced and is converted into mechanical energy. Due to combustion of fuel harmful gasses are released which causes air pollution. In these day’s electric vehicles are being developed. Here we prefer electromagnetic engine for generation of power. This paper deals with reduce use of major fossil fuel and use of renewable sources as much as possible to reduce pollution and better energy saving for future using solenoid engine. By using electromagnetic engine pollution of air is overcome and operation can be eco-friendly. The current challenges is make them more e cient and convenient to reduce cost. In this engine the friction of engine parts is less over the IC engine. So life of electromagnetic engine is more. Solenoid works as electromagnet when current supplied to it. Engine works without any fuel and no pollution in atmosphere such in case of fuel engine. Coil magnetism is used to attract the plunger. spark distributor is used to actuate electromagnet according to position of piston in cylinder rather than sensors and micro controller. So, The reciprocating motion can be converted into rotary motion and used for di erent applications.

Keywords: CATIA V5, Electromagnetic engine, Pro E, Radial engine, Spark distributor, Solenoid.

1. INTRODUCTION

In automobile engine is as main power source in which by combustion heat is produced and chemical energy is converts into mechanical energy. but due to combustion harmful gasses are produced which causes of air pollution. now a day’s electric bikes are developed. but they have less load carrying capacity and not suitable for long run. In order to tackle this problem, we have designed and fabricated a radial solenoid engine, this engine works on principle of electromagnetism. As the name indicates this has 5 solenoids or pistons” which power the engine. In a solenoid engine the electrical energy is converted into mechanical energy, which does not result in the emission of harmful cases that is there in the case of a petrol or diesel engine. Coil magnetism is used to attract the plunger. spark distributor is used to actuate electromagnet according to position of piston in cylinder rather than sensors and micro controller.

2. STRUCTURE DESIGN

The pentagonal shape keeps the same versatility as the round oven structure, With possibility to be inserted into a corner position, Without ever giving up the advantage of having a classic covering on all sides of the corner. For structure designing we use PRO E software to obtain 3D view and dimensions for proper design. The pentagonal shape keeps the same versatility as the round oven structure, With possibility to be inserted into a corner position, Without ever giving up the advantage of having a classic covering on all sides of the corner. The main advantage of pentagonal is at 72 and the plunger movement require for movement from one plunger to another is 72 rather than 90 required in case of square size design. This engine follows simple mechanism of attraction, The attraction of coils is in order of rst coil-third coilfifth coil- second coil- fourth coil. This structure is used because it can generate lot of power with simple arrangement because of pistons radiates outer from a common centre point. For structure design we use Pro E and for Plunger design we use CATIA V5 software.

Figure.1. Structure design PRO E
3. PRINCIPLE AND CONSTRUCTION

In today’s world most of the engines that are being used are petroleum-based engines which converts chemical energy into mechanical energy. These engines are mainly either petrol or diesel engines are conventional engines, Which release greenhouse gases when converting the chemical energy to mechanical energy. These fumes which are emitted are highly undesirable as they cause a lot of pollution which leads to global warming and adversely affects the health of us humans. In order to tackle this problem, We have designed and fabricated a radial solenoid engine, This engine works on principle of electromagnetism. As the name indicates this has 5 solenoids or "pistons" which power the engine. In a solenoid engine the electrical energy is converted into mechanical energy. Which does not result in the emission of harmful gases that is there in the case of a petrol or diesel engine.

4. WORKING

When supplies current through coil then due to electromagnetism generates magnetic field around hat coil due to that the rod inside get repel or attract based on direction of current. To give movement from one plunger to other plunger attraction can use simple distributor rather than arduino and micro controller. The main movement of plunger attracts is in order of First coil-third coil- third coil { 4th coil { second Coil { fourth Coil and further this 1-3-5-2-4 cycle follows for rotation. This works in the same way a spark distributor on a combustion engine would have worked, except it’s actually providing the power to actuate the solenoids instead of providing just an ignition spark. By applying variable supply to the distributor we can vary the speed of attraction of each plunger meanwhile the speed of rotation varies. The spark distributor provides jerk to move attraction of coil from rst coil to third coil and vice versa so that it rotates in circular motion. The efficiency of engine is decided by timing of spark into spark distributor. The arrangement completely depends upon the configuration used in designing the electromagnetic engine.

5. COMPONENT AND MATERIAL USED

5.1 BATTERY

Battery is used to give electrical supply to induction coil and as main power source. Also to get variable by supplying spark distributor. Battery can charge with a Dynamo/ Alternator like an automobile.

5.2 SOLENOID COIL

Solenoid coil is consist of number of turns of copper wire wound on iron or former piece. Coil works as electromagnet when the current is owing through it. The turns ratio depends on applied voltage, the more current coil becomes more strong electromagnet.

5.3 SWITCH

There is a switch between solenoid coil and battery supply for connecting and disconnecting supply and for control constant current supply to coil.

5.4 RHEOSTAT

It is placed between the distributor with number of studs. This will works as accelerator. With the decreasing value of resistance the more amount of current is owing through distributor and speed of movement is increases.

5.5 SPARK DISTRIBUTOR

The main function of distributor is to provide speed variation. The distributor is also used in automobile, but its function is
somewhat different in this engine. As the spark is increased at the spark distributor the value of movement is increases.

Figure 5. Spark distributor

6. STRUCTURE ASSEMBLY

For pentagonal structure design we use high density bre wood material and assemble the sections of part as per the design structure in PRO E.

Figure 6. Engine Assembly

7. CALCULATIONS

These calculations are done on exemplary basis

Input voltage = 24 V  
Input current = 4 A  
Input Power = Voltage * Current = 96W Max. Force exerted by electromagnet on piston F1 = (N2I2KA)/2G2

Where, N = number of turns = 200  
I = Current owing through coil = 4 A  
R = Specific resistance  
K = Permeability of free space = 4 10 7  
A = Cross-sectional area of electromagnet  
B = Flux density

F2 = Force exerted by permanent magnet force

=(B2A)/2 Where,  
B = Flux density  
A = Cross-sectional area of magnet (radius r = 0.0125 m)  
K = Permeability of free space = 4 107

from American standard wire gauge Diameter for 28 gauge Is 0.0126

A =π2  
=(0.0063)2  
=3.1415*0.00039  
=0.0124mm .  
= 1.24 * 10 4 m(1)

R = l=A  
[ Where l= 1.67810.6 f or copper]  
=(1.678 * 10 6 396:30)=(1.24 10 4) =591.3662*10 2  
=5.91362 ohm (2)

V=IR  
I=V/R  
=24/ 5.913  
4.5885 (3)

B= I=2 d  
[ Where ;= 4 10 7]  
=[(4 10 7) 4:05885=[2 :03785 10 3]  
=4.0584*10 4  
=21.44* 10 4W b=m2  
=2.144 mWb/m2(4)

= BA  
=2.144*103 (1:1245 10 4)  
=19.066 W b(5)

for 50 mm height,  
H = NI/L [; HL=NI]  
=200*4.069/10.043  
=813.8/10.043 =81.03156 A/m (6)

r = 1/R  
=1/5.8982  
=0.1695 AT/Wb (7)

On substitution, we get Max. Force F1 = 37.97 N Now substituting B in the equation of force, F 2 = 0.2849 N

Since,  
force F 1 and F 2 are repulsive, Total force F,  
F=F1+F2F=38.25N

Torque T = F * r  
r = crank radius  
= 0.02m  
Torque, T = 0.765 N-m  
P= (2 NT)=60  
Where, N = speed = 200 rpm  
T = Torque = 0.765Nm

On substitution, we get,

Output power P = 16.02 W  
Efficiency is given by,  
= (Output=Input) 100 = (16.02/96) * 100 Therefore,  
= 16.68%
8. MERITS OF SOLENOID ENGINE

There is no effect on atmosphere because electromagnetic engine cause no atmospheric pollution.

It required less maintenance compared to IC engine. It provide alternative to the fossil fuels.

It is lighter in weight than an Internal combustion engine.

It provide more efficiency with lesser torque. It is compact in design.

Operation is less noisy.

9. CONCLUSION AND FUTURE SCOPE

This work presents the pentagonal engine structure. We got 16.68 % in this engine. In future, For more power and torque output we can design the structure with more sectional design like V8 or V12 engine with more efficient power outage. due to use of this and this type of system use of non-renewable resources is somewhat reduced and energy for future can be conserve. Even if this phenomenon is utilized for other purposes as done in an conventional Combustion Engine we are limited to today’s technological advancements to further up the efficiency, however this model shows great promise for the future where today’s limitations are overcome by new innovations.

10. REFERENCES

[1]. Leland W. Giord; "reciprocating electromagnetic engine"; US 5457349 A

[2]. Kiniski Z; "Rotary-to-reciprocating device"; US 3811058A

[3]. Amarnath Jayaprakash, Balaji, G., Bala Subramanian; "Studies on Electromagnetic Engine"

[4]. Druva Kumar, L1, Jathin, P; "Future Energy Rede ned By Magnetics"

[5]. B. L. Thereja Electrical Technology, Volume II, pp.866 to 886 and Electro Droid software for Magnetic Coil Calculations