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Design and Fabrication of V4 Solenoid Engine

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ABSTRACT

In the present automobile industry Engine is the main source of energy and majority of these engines are internal combustion engines (I.C engines). Which uses fossil fuels like petrol, diesel, and CNG as the main fuel source. These fuels are combusted in an engine which releases heat energy which in-turn converts mechanical energy. The combustion of these releses harmful gases into the atmosphere which causes pollution and all well as adverse effects on the living beings. As the fossil fuels are non-renewable energy resources and we can have exhausted in the near future, currently electric cars are the best alternatives for a conventional I.C engines. Electricity is the souce of energy with almost zero emission of pollutants. The objective of project is to design and fabricate a V4 solenoid engine which uses principle of electromagnetism to convert electrical energy in to mechanical energy and thus power the vehicle.

KEYWORDS: Engine, I.C Engine, fossil fuels, solenoid engine and electromagnetism

1. INTRODUCTION

An engine is a machine that converts a source of energy into a physical work. Engine can be used if we need something to be moved around. We have multiple types of Engines not all of them are made same and have different working principles. The best way to differentiate between engines is by type of energy and for the use of power [1]

The Engines can be classified in to following types, they are:

- Thermal Engines
  1. I.C Engines 2. E.C Engines
- Electrical Engine

Electrical Engine:

An Electrical Engine is a machine which converts electrical energy into mechanical energy. The electric Motor is run by the magnetic field, where the electric current in a wire winding generate force in the form of torque applied on the motor shaft. The electrical engines can be run through D.C sources i.e. batteries or by A.C sources such as power grid

Solenoid:

Solenoid is an Electromagnet which producea a Controlled Eletric field. The purpose of the solenoid is to generate magnetic field. A solenoid is a cylindrical shaped conductive wire wound in the shape of a helical, when electricity passes through the solenoid it produces Electro magenetic field due to the principle of e.m.f. The Term solenoid was introduced in 1823 by Andre-Marie Ampere.

Solenoid provide magnetic focusing of television camera tubes such as vidicons and also electrons in vaccum. The solenoids surround nearly the whole length of the tube [2]

Many of the students have done the work on the V8 cylinders and single cylinder solenoid engine. [3] [4]. There were only papers reported on the 4-cylinder solenoid engine. So, this project proposed to fabricate 4 cylinder solenoid engine.

Solenoid Magnetic Flux density can be given as:

$$B = \mu 0 \frac{NI}{L}$$

Where,

B = Solenoid Magnetic Flux density

$\mu 0$ = Magnetic Constant

N = Number of turns

I = Current

L = length of the solenoid

2. REALATED WORK

Many of the oil dependent businesses are looking to end them, due to de-winding oil supplies there is demand for increasing along the cost. This issue can be resolved by the help of electrical engines. By using electrical engines fuel cost can be eliminated and oil reservoirs can be saved for the future generations

LITERATURE REVIEW

1. Bradeesh suresh et.al – In this project they fabricated a single cylinder solenoid engine by the solenoid propulsion and used to supply the power by the lead acid battery which is recharged by the alternator [5]

2. K.Srinivas et.al – In this project they fabricated a zero pollution emission engine. In modern science and technology has been taken many positive steps for emission control like using fossil fuels. So, then instead of using this fuels, technology brings electrical bikes and cars. By using these electrical vehicles, running cost will be less and 100% emission free. For more power and running capacity they introduced a mechanism for more load carrying capacity[6]

3. Title: 8-Stroke Solenoid Engine and its Efficiency

Author: Vikas Kumar1, Amandeep Singh2, Keshav Kumar Jha3

Year of publication: International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 08 Issue: 06 | June 2021.

Observation: In this research, their aim is to design 8 stroke solenoid engine which works on the electromagnetism principle and to calculate its efficiency. Based upon their analysis they concluded that the potential difference is dropped by the gap produced between winding which is caused by repeated use of the engine and they also stated that a solenoid engine does not require any cooling system. [7]

4. Title: Design, Analysis and Manufacturing of a V8 - Solenoid Engine

Author: Ruthwik Aki1, N. V. Dharma Teja2, K. S. V. Phanindra3,Setty Siddhartha4

Year of publication: International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV8IS080227 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by: www.ijert.org Vol. 8 Issue 08, August-2019.

Observation: In this paper, they focused on the design, analysis, and manufacturing of the v-8 solenoid engine. Based upon their calculations they determine the efficiency of the engine i.e., 21.44% and they concluded that these engines are limited to some extent but it has a lot of future scopes because it does not require any fuels to produce power. [8]

5. Title: Mini Solenoid Engine

Author: 1Mohammed Sirajuddin (Roll No:317132920038), 2A.Murali Krishna (Roll No: 317132920001), 3B.Srinivas Naidu (Roll No: 317132920021) , 4B.Ajay Babu(Roll No; 317132920016), 5R.Vasanth Bhargav (Roll No: 317132920056), 6Dr. S RamanaBabu

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Observation: In this project, the solenoid engine is made of brass and they tested the working of the mini solenoid engine and they concluded that the solenoid engine has better efficiency as compared with Internal combustion engines and mainly they identified that in solenoid engines the main issue is winding of electromagnet loosened and leads to increase in the gap between the winding and reduces the effective generation of magnetic flux. [9]

3. PROPOSED WORK

MODELLING

The dimesnsions for the solenoid engine is taken from the GrabCAD. Based upon the reference dimensions the design of the solenoid engine is carried in SOLIDWORKS

COMPONENTS	LENGTH(mm)	DIAMETER(mm)
Crankshaft	170	15
Cylinder	40	25
Connecting rod	90	-
Side Member	130	-

Table 1: Dimensions of the Components

The Main Components used in this Solenoid Engine are:

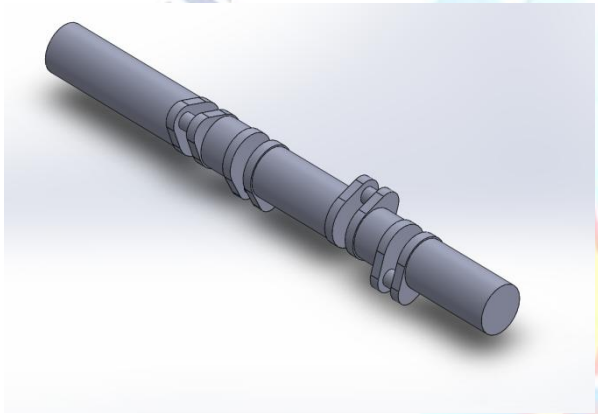

Figure 1: Crank Shaft

Figure 2: Cylinder

Figure 3: Connecting rod

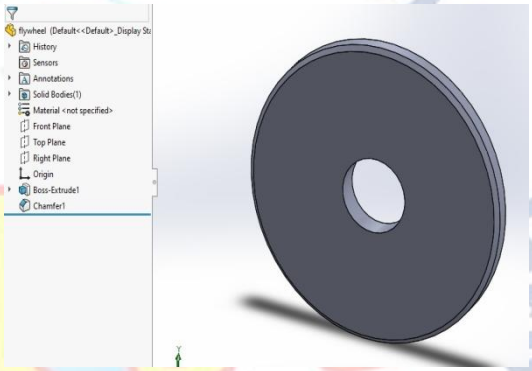

Figure 5: FlyWheel

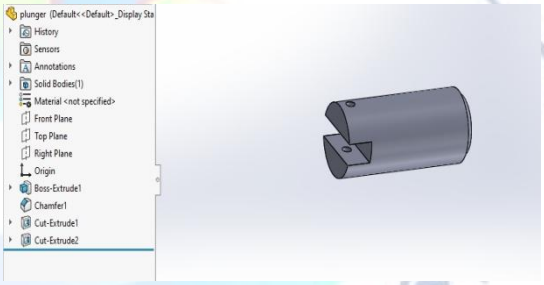

Figure 6: Plunger

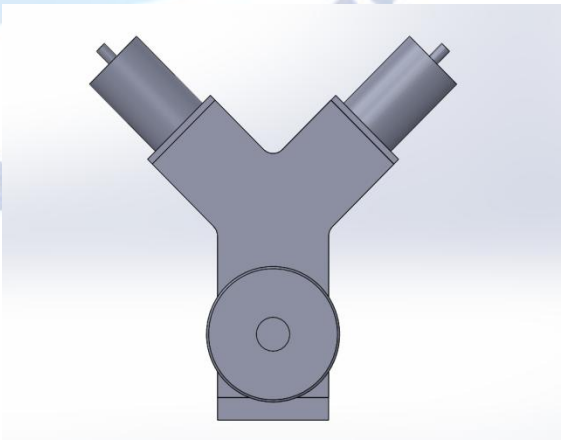

Figure 7: Front View of the Engine

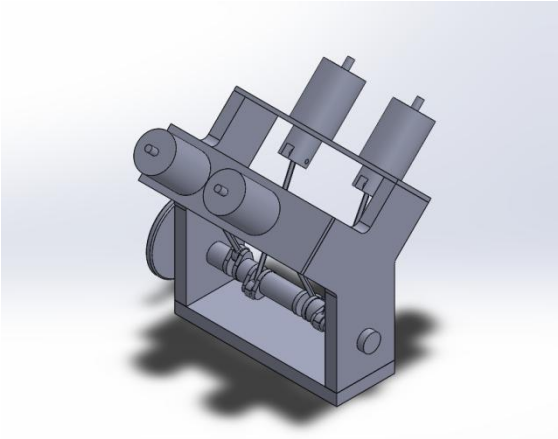

Figure 8: Final Assembly of the V4 Solenoid engine

MATERIALS REQUIRED:

- ACP sheet
- Fiber reaper pieces
- Fisher plugs, screws (1.5″ 2 and 3⁄4″ 4)
- Insulated copper wire
- 26 gauge 30 m
- 2 syringes GI (galvanized iron) rod 12-30 cm
- Copper wire 18-30 cm
- Cylindrical magnets and wood wheel

TOOLS REQUIRED:

- Angle grinder
- Drilling machine
- Drill bit (4 mm and 6 mm)
- Cigar lighter
- Screwdriver and player

ASSEMBLY OF THE ENGINE:

- At the initial Stage of the project we are selecting the Mildsteel sheet for outer frame of the engine. Inorder to achieve stronger outerframe of the engine
- Based on upon the GrabCAD reference dimensions the solenoid engine is designed in solid works
- Fabrication of solenoid engine is based on the design output from the solidworks and fabrication involves some machining process like lathecutting, drilling, inner threading, milling etc
- Inorder to get good surface finish of the solenoid engine surface grinding is performed on the fabricated model
- After designing the body of the engine, the copper winding is wounded to the cylinder
- After that inorder to complete the engine, all the parts are assembled (i.e. crankshaft, connectingrod, piston, and plunger). And necessary power connections are connected to the engine inorder to active the solenoided winding to run the Engine.

Figure 9: Outer Frame with some parts

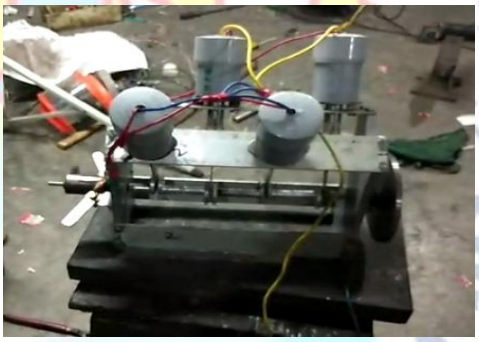

Figure 10: Final Assembly of the V4 solenoid Engine

CALCULATIONS AND TESTING FOR OUTPUT POWER AND EFFICIENCY:

With help of a voltmeter and Ammeter Input current and voltage are calculated as follows.

Input voltage = 36 V Input current = 1 A

Input Power = Voltage Ã— Current = 36 Ã— 1 = 36W

Max. Force exerted by electromagnet on piston F1 = (N2 I 2KA)/2G2

Where, N = number of turns = 1000

I = Current flowing through coil = 1 A
K = Permeability of free space = 4Ã—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)/2Âμ0 Where, B = Flux density (T)
A = Cross-sectional area of magnet (radius r = 0.0125 m)
Âμ 0 = Permeability of free space = 4Ã—10-7
Now flux density B = Br /2 Ã— [(D + z)/ (R2 + (D + z) 2) 0.5 z/ (R2 + z 2) 0.5]
Where, Br = Remanence field = 1.21
T z = distance from a pole face = 0.005 m
Thickness of magnet = 0.012 m
D = thickness of magnet = 0.012 m
R= semi-diameter of the magnet = 0.0125m
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,
Total force F = F 1 + F 2 F = 36.85 N Torque T = F Ã— r
r = crank radius = 0.01m Torque T = 0.3685 N-m
Mass of Fly wheel = (2N)/60, where N = speed = 200rpm
Therefore = 20.94 rad/s
Energy stored on flywheel E = T Ã—
Where T = torque = Angle of rotation = 180o = radians on substitution we get energy stored E = 1.157 J
Also, E = 0.5 Ã— I Ã— 2
Where, I = moment of inertia of flywheel = angular velocity
On substitution we get moment of inertia, I = 5.277 Ã— 10-7 Kg-m 2
Moment of inertia, I = 0.5 Ã— m Ã— r 2 Where, m = mass of fly wheel
r = radius of fly wheel = 0.07 m
On substitution, we get m = 2.154 Kg Output power
P = (2NT)/60
Where, N = speed = 200 rpm T = Torque = 0.3685 N-m
On substitution, we get Output Power P = 7.718 W
Efficiency = (Output/Input) Ã— 100 = (7.718/36) Ã— 100
Therefore, Efficiency = 21.44%

4. RESULTS

After fabrication of solenoid engine, we are checking the working conditions and based during the working we noted output values from the calculations we are getting output values as efficiency=21.44% and output power= 7.718watts.

5. CONCLUSION

Hence based on the design and fabrication of solenoid engine we concluded that it as has high efficiency as compared with internal combustion engines and we observed that due the voltage fluctuations occurred in solenoid engine its torque is lower as compared with other conventional engines and because of its lower torque it is not suitable for automobiles applications. And finally we can conclude that it is suitable for domestic applications.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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