

An Electromagnetic Mechanism Which Works Like an Engine

Shirsendu Das

Department of ME, TIT Agartala
Narsingarh, West Tripura, India

Abstract - Engine is the main power source of Automobiles, where combustion takes place & produces heat which converts into mechanical energy. We know IC-Engines are used in Automobiles, Aeroplane etc. But the incomplete combustion produces some harmful gasses, which is one main cause of air pollution. Modern Science & Technology has been taken many positive steps for emission control. Like, using CNGs & LPGs instead of petrol & diesel. Now technology brings Electrical bikes, scooters & cars. The battery of electrical vehicle can charge easily like mobile. They have less running cost & 100% emission free. But they have very less load carrying capacity & not suitable for long run. So basically we have to prefer Engines for more power & more running capacity. Here I have introduced a mechanism which has more load carrying & running capacity than electrical vehicles but makes zero emission or pollution.

Keywords – Application of Solenoid to reciprocate piston, Distributor Mechanism.

I. INTRODUCTION

Like conventional engines this system also has cylinder, piston (without piston rings), connecting rod, crank shaft. There is no inlet & exhaust valve or ports & no spark-plug also. In this system we will use 2 Solenoids at Top dead centre (TDC) & Bottom Dead centre (BDC). We know Solenoid behaves like a magnet when electricity is supplied to it. So we will induce these 2 solenoids for piston's reciprocation.

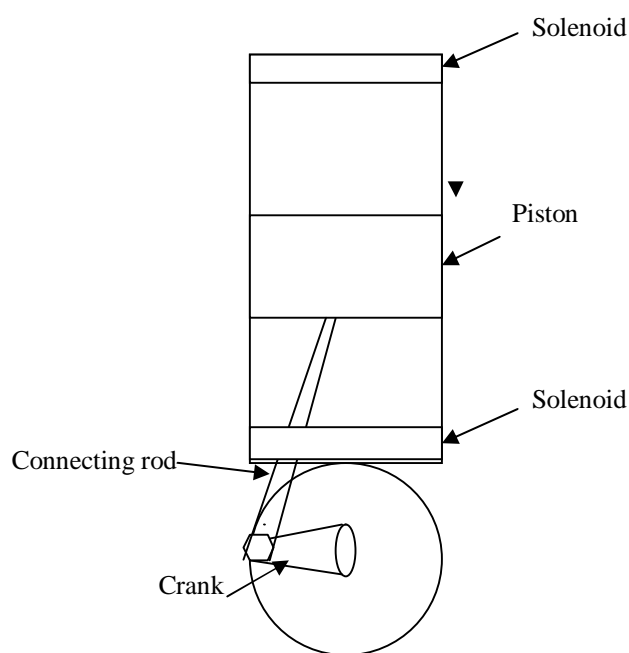


Figure -1

II. IMPORTANT ELECTRICAL PARTS & CIRCUIT

Battery induction system is used in this mechanism to induce solenoids. The different parts are-

1. Battery:-It is used for providing electricity in the induction system & it is the main power source.
2. Induction coil:-The induction coil consists of a soft iron core with both primary & secondary winding. The primary coil is connected with the battery while the secondary coil is connected to rest parts of the mechanism as shown in figure-2. The current flows through the primary coil, as a result of which a magnetic field is produced in the soft iron core. This magnetic field then raises the induced current in

the secondary coil. The turn ratio (ratio between primary & secondary winding) depends on required voltage.

3. Switch:-There is a switch between battery & primary coil for connecting or disconnecting the primary coil with battery.

4. Rheostat or Variable resistance:-It is placed between secondary coil & distributor. This variable resistance will perform the task of accelerator. When accelerator will press the resistance will become less & more amount of current will flow to distributor and vice versa.

4. Distributor:-The main skill of the mechanism is based on the distributor. Distributor also used in Automobile Ignition system for distributing the current in different spark plug as per firing order. But the function of distributor is totally different in this system. Distributor is connected to crank shaft with power drive & its arm rotates in same r.p.m of crank shaft. The distributor has 2 lobes which are connected with 2 solenoid respectively. The main function of distributor is to induce the solenoids as per requirement.

5. Capacitor:-A capacitor can use with secondary coil if required.

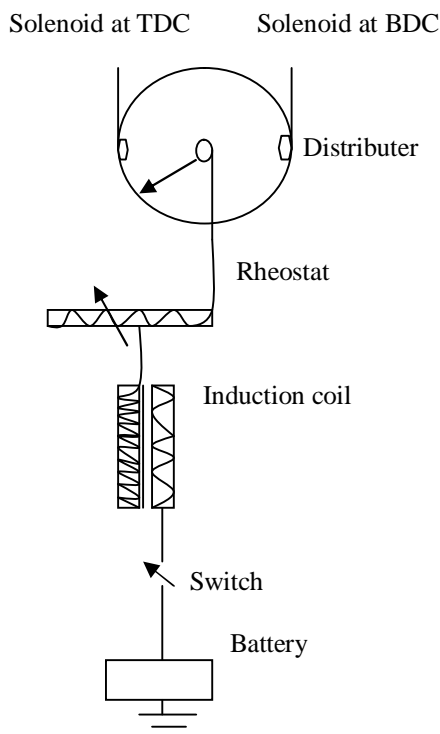


Figure -2

III. WORKING PRINCIPLE OF THE MECHANISM

Our main intension is to produce continuous revolution in crank shaft by reciprocating the piston inside the magnetic field. One important thing is that the piston should be made with magnetic materials like iron but rest parts of this system have to made with non-ferrous or alloy materials. First of all we will rotate the crank shaft by self-starting or by other means. When the crank shaft will rotate the piston will state to reciprocate. The distributor is connected with crank shaft by a drive for getting same r.p.m. When the piston is coming towards BDC & distributor arm rotates towards the lob-1(the lob of distributor which connects with solenoid at TDC).When the piston at BDC then the arm touches the lob-1.So the solenoid at TDC becomes a magnet & attracts the piston towards it. When piston is coming towards TDC, the distributor arm also rotates towards lob-2 with same speed of crank shaft. So when the piston at TDC, the distributor arm touches the lob-2 & the piston attracts by solenoid at BDC.Then the process will continue.

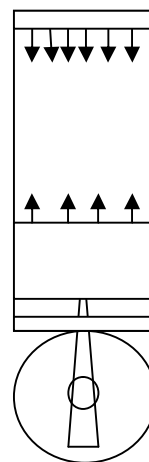


Figure- 3(a)

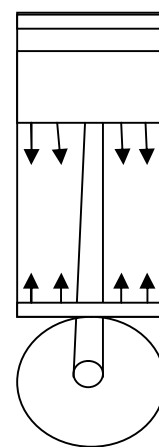


Figure- 3(b)

IV. CONDITION FOR DESIGNING

1. In time of designing the mechanism, set up of piston & distributor arm is very important. The set up has to make in this manure that initially when the piston is at BDC, the distributor arm has to touch that lob of distributor for which

solenoid of TDC can be induced or vice versa. Otherwise the mechanism will not start.

2. The distributor arm has to rotate in same r.p.m with crank shaft.
3. Except piston the other parts (cylinder, connecting rod, crank shaft etc) should be made by non-magnetic materials like aluminium alloys or forged steel.
4. There is no need of any air-tight arrangement & we can ignore piston rings (compression ring & oil ring) so that the piston can reciprocate freely.
5. Lubrication system inside the cylinder can destroy the solenoids. So dry lubricant like graphite, hexagonal boron nitrite, molybdenum disulfide etc can use in the inner wall of cylinder & piston's surrounding so that the problems regarding lubrication process can eliminate.

V. NUMERICAL CALCULATION

CALCULATION OF MAGNETIC FIELD:-

Magnetic field required to move the piston (B) = μIn

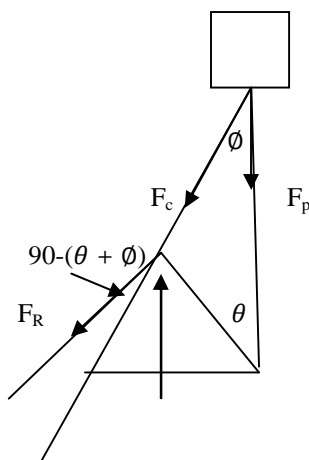
Where, μ = Permutivity of free space, I = Current, n = Number of turn.

Again we know, magnetic field (B) = $f \times A$,

$$\text{Magnetic flux density (f)} = \frac{B}{A}$$

Where, A = cross sectional area of piston

CALCULATION OF POWER:-



$$(\theta + \phi)$$

Magnetic force or force of solenoid on the piston

$$F_p = \frac{1}{8\pi} f^2 \times A^2 \times 10^{-7} \text{ N}$$

Where, f = Magnetic flux density. A = Area of the piston effected by solenoid (cross sectional area of piston).

$$\text{Force acting on connecting rod (F}_c) = \frac{1}{\cos \phi} \times F_p$$

$$\text{Crank efforts (F}_R) = F_c \cos[90 - (\theta + \phi)]$$

or, $F_R = F_c \sin(\theta + \phi)$

Torque (T) = $F_R \times r$. Where, r = crank radius.

$$\text{Power (P)} = \frac{2\pi NT}{60} W.$$

If we consider the weight of the piston (vertical alignment) calculation will slightly change. Because when piston will move downward weight will add with magnetic effort. So the force acting on the piston during downward movement $F = F_p + W$, where W = weight of piston = mg .

Similarly when the piston will move upward direction, weight will act just opposite direction. So the force acting on the piston during upward movement (F) = $F_p - W$.

So the solenoid at the TDC should provide more magnetic force than solenoid at BDC. The difference between the magnetic forces of solenoid is equal to the weight of the piston.

VI. BATTERY CHARGING SYSTEM

Battery can charge with a Dynamo/ Alternator like automobiles.

VII. SOME IMPORTANT POINTS

- a. In Automobile for more power multi-cylinder engine is used but here cylinder is not main factor. Main factor is increases magnetic field & magnetic property of solenoid.
- b. The amount of charge required for the mechanism is less. Current is just required for few fraction of seconds in every rotation of crank shaft. But as long the system runs battery will with recharging system (alternator).

VIII. POWER TRANSMISSION

The power which will produce by this mechanism can transmits like normal Automobiles (clutch, gear box etc).

IX. DISADVANTAGES

1. It cannot produces power like an Engine.
2. It can provide less uniform torque at crank-shaft than engine.
3. It is not applicable for multi-cylinder system.

X. ADVANTAGES

1. It has less running cost than an Engine.
2. It does not make pollution (basically air pollution) & can help to check Global warming.
3. It takes less amount of charge from battery in every revolution of crank shaft for few fractions of seconds.
4. It can produce much more power & running capacity than battery car & bikes.
5. This cannot produce much power like an IC-Engine but can be use as an equivalent system of an engine & it is acceptable for future energy insufficiencies.

XI. ACKNOWLEDGEMENT

The author would like to thank Mr. Alak Majumdar (BE, M.Tech in ETCE) (majumder.alsk@gmail.com) for his support in this work.

REFERENCES

- [1] Magnetic force calculation from Australian Magnetic Solutions (www.magneticsolution.com.au).
- [2] Basic concept of Engine from the book 'Automotive Engine' by Srinivasan.
- [3] Basic concept of electromagnet & electromagnetism from Text Book of Physics by C.R.Dasgupta.