



A review of solenoid engine types, working principle and its applications

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Abstract

Solenoids are coils of wire that, when electric current is connected, make a magnetic field that applies a force over a metallic element. Solenoids help convert energy to activity in a flash and function admirably for applications that require quick activity. They are basic, economical and pack a lot of intensity into a little structure factor. Since their power is corresponding to the situation of their moving components, they work best for short distances, making them perfect for valves, interlocks, electromechanical transfers, and so on. In this paper we have studied about different perspective of solenoid engine.

Keywords: solenoid engine, coil, electric current

1. Introduction

In contrast to motors, solenoids specifically give linear (and not rotational) development. Solenoids are found in numerous gadgets, for example, door locks and valves. On the off chance that it have a vehicle or have a clothes washer, they are utilizing solenoids. Note the spring on the sliding barrel shaped bar or armature in the picture above. The spring holds the bar out to one side, however when the coil is invigorated the magnetic power pulls it to one side. At whatever point the coil is turned off, the spring hauls the bar out to one side once more. André-Marie Ampere invented the solenoid in the late 1820s [2].

This venture is going to electricity worked engine development. It additionally alludes to any gadget that changes over electrical energy to mechanical energy utilizing a solenoid. The gadget makes an attractive field from electric current and uses the magnetic field to make linear motion. In this engine there is no fuel like petroleum and diesel. So this motor is worked on unadulterated electricity originating from a battery source [2].

2. Literature survey

The American researcher Joseph Henry (1797-1878) developed a little electromagnetic motor, with a reciprocating beam. He called it as a "philosophical toy", and there was unquestionably no expectation of receiving helpful work in return. It was first portrayed in American Journal of Science, 1831, Vol 20 p342. In a British diary Philosophical Magazine in 1838, F Watkins inspected Henry's innovation in detail and depicted it as the first cyclic electric motor, i.e. one that kept working without manual switching or resetting [3].

Additionally the paper distributed in Power and Energy Conference, 2008. PECon 2008. IEEE second International expresses that, Designing an electric vehicle (EV) utilizing electric motor as its prime mover is extremely normal. In any case, fusing the electric engine to the general EV configuration is moderately intricate. The most recent format plan of an EV requires a mind boggling controller to oversee the entire framework particularly the electric engines. Because of this multifaceted nature, the creators have built up an option electromagnetic prime mover for EV to supplant

the current electric engine. This new prime mover is planned dependent on the solenoid idea and the internal combustion engine (ICE) working systems. In this paper, the creators are presenting another electromagnetic prime mover known as solenoid powered engine (SPE) [3].

3. Components of solenoid engine

Components of solenoid engines are as follows

- Electromagnetic solenoid
- Connecting rod
- Proximity sensor
- Relay
- Crank
- Fly Wheel

i) Electromagnetic Solenoid

A cylindrical coil of wire whose diameter across is little contrast with its length is known as a solenoid. It tends to be utilized to produce a basically uniform magnetic field like that of a bar magnet, Figure 1, when a current is going through it. The magnetic field is coordinated along the axis of the solenoid.

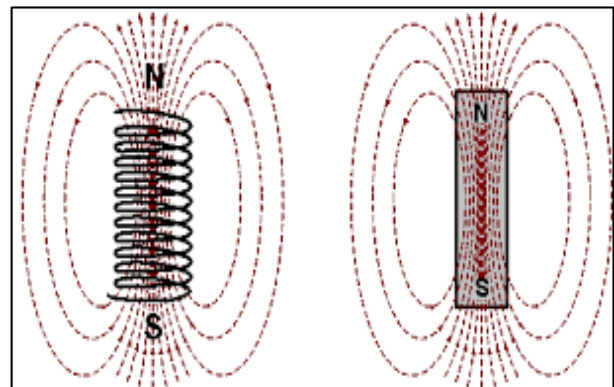


Fig 1: The Magnetic Field is similar for both the solenoid and the bar Magnet

By wrapping the Current carrying Coil a center of iron, the Magnetic Field can additionally be fortified and an Electromagnet is shaped, Figure 2.

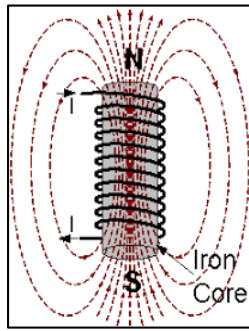


Fig 2: Solenoid wrapped around a core of iron

Electromagnet changes over electric energy into mechanical energy. It is utilized in numerous electromechanical devices, for example, circuit breakers, engines, relay and so forth [4].

ii) Connecting Rod

An connecting rod is a pole which interfaces a piston to a crank or crankshaft in a responding motor. Together with the crank, it frames a straightforward instrument that changes over responding movement into rotating motion.

iii) Proximity Sensor

A proximity sensor is a sensor ready to distinguish the pressure of adjacent articles with no physical contact. A proximity sensor frequently transmits an electromagnetic field or a beam of emission radiation (infrared, for example), and searches for changes in the field or return signal.

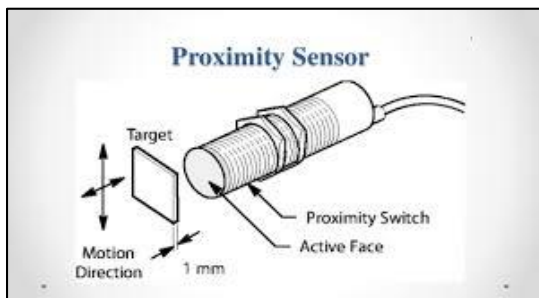


Fig 4: Proximity Sensor

iv) Relay

A relay is an electrically worked or electromechanical switch made out of an electromagnet, an armature, a spring and a lot of electric constants. The electromagnet switch is worked by a little electric flow that turns a bigger flow on or off by either discharging or withdrawing the armature contact, consequently cutting or finishing the circuit.

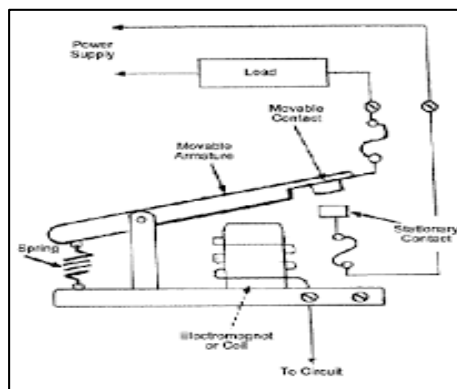


Fig 5: Relay

v) Crankshaft

The crankshaft is a engine part that changes over the linear (responding) movement of the piston into rotational movement. The crankshaft is the principle pivoting part of a motor and is usually made of ductile iron..

A crankshaft-related with crank is a mechanical part ready to play out a transformation between reciprocating motion and rotational motion. In a reciprocating engine, it deciphers responding movement of the piston into rotational motion; though in a responding compressor, it changes over the rotational motion into reciprocating motion

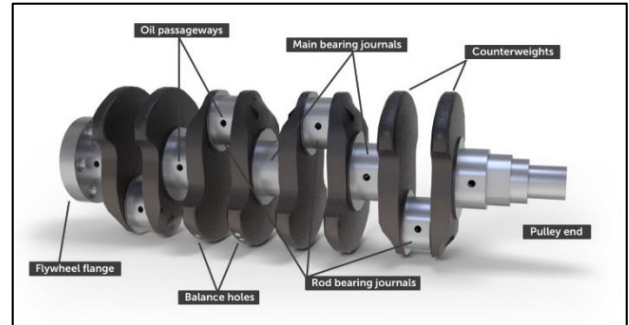


Fig 6: Crankshaft

4. Types of solenoids

There are different Types of Solenoids are accessible in the market. They contrast regarding their material, plan and capacity. Be that as it may, a wide range of solenoids rely upon the equivalent electrical standards.

1. AC Laminated Solenoid
2. DC C-Frame Solenoid
3. DC D-Frame Solenoid
4. Linear Solenoid
5. Rotary Solenoid

i) AC Laminated Solenoid

An AC laminated solenoid is well known for the measure of power that can be performed in their first stroke. They can likewise utilize a more extended stroke than a DC solenoid. They are reachable in a few distinct arrangements and extents. These sorts of solenoids will deliver a perfect buzz when they are being utilized.



Fig 7: AC Laminated Solenoid

ii) C-Frame Solenoid

A DC C-Frame solenoid utilizes just a casing, shaped like the letter C, which is covered around the coil. This sort of solenoid has a broad scope of various applications. Despite the fact that they are acclaimed in a DC configuration, they can likewise be intended to be utilized with AC control.

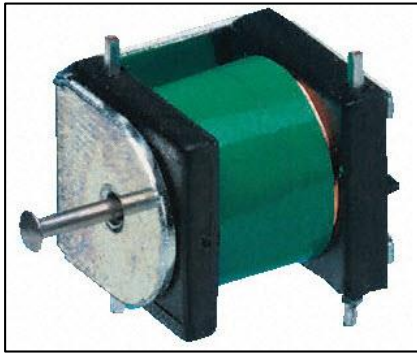


Fig 8: DC C-Frame Solenoid



Fig 10: Rotary Solenoid

iii) DC D-Frame Solenoid

A DC D-Frame solenoid gears have a two-piece outline that is secured around the coils. These are utilized in a few unique applications like mechanical applications. Like the C-Frame, these solenoids can likewise be structured in AC choices, for applications when the properties of an AC solenoid are more appealing than a DC solenoid.

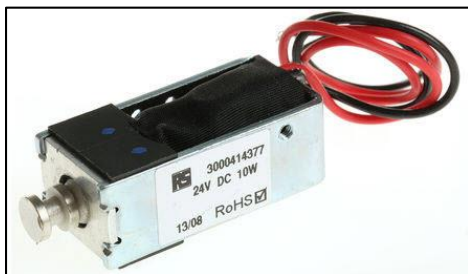


Fig 9: DC D-Frame Solenoid

iv) Linear Solenoid

This sort of solenoids is increasingly acquainted with the vast majority. These are equipped for utilizing a pulling or pushing power on a mechanical gadget and can be used for an assortment of metering undertakings. These solenoids are utilized in an alternate applications. For example, a solenoid on the starter gadget of a vehicle which incorporates an engine. At whatever point electrical flow moves through the solenoid, at that point it will move in a straight style to get two contacts together.



Fig 9: Linear Solenoid

v) Rotary Solenoid

Rotatory solenoid is a genuine case of mechanical force which can be utilized in various strategies to make simple of a programmed control process and very simple to make life less demanding. In this solenoid, there is the comparative coil and center plan, however it is fairly changed. In a rotational solenoid, a circle is utilized rather than the solenoid being a straightforward gadget with a center and coil. The body of the solenoid is agreed with the grooves and ball bearings are utilized to make simpler movement.

5. Working of solenoid engine

A solenoid is a coil of wire in a corkscrew shape folded over a piston, regularly made of iron. As in all electromagnets, an magnetic field is made when an electric flow goes through the wire. Electromagnets have favorable position over changeless magnets in that they can be turned on and off by the application or evacuation of the electric flow, which is the thing that makes them valuable as switches and valves and enables them to be altogether automated.

Like all magnets, the magnetic field of an actuated solenoid has positive and negative poles that will pull in or repel material delicate to magnets. In a solenoid, the electromagnetic field makes the piston either go in reverse or forward, which is the means by which movement is made by a solenoid coil [5].

6. Applications

Solenoids are around wherever in our home and vehicle. Vehicles utilize them in starters, fuel injectors, some electric door locks, and changing gears in programmed transmissions. Most more seasoned electric doorbells utilize a solenoid to strike the metal ring. In the home, solenoid controlled water valves can be found in clothes washers, dishwashers, icemakers, focal humidifiers, and programmed sprinkler frameworks for yards. Pinball machines use solenoids for flippers and bumpers.

7. Conclusion

A solenoid is a straightforward segment that incorporates a coil of wire that is secured around a center made out of a metal. At the point when a current is connected to the solenoid, it has the impact of amassing a steady attractive field. Power changes to attraction then it changes to power and, in this manner, these two powers are joined into one.

An appealing thing about the uniform field in a solenoid is that, if the solenoid has a tremendous length, the magnetic field would be the comparable wherever along the component. In a solenoid, in some cases this means exceptionally little electrical parts having the capacity to complete a grand measure of work. For example, an incredible solenoid can just slam shut a valve that would interest for even the burliest plumber to near to hand [6].

8. References

1. <https://www.fictiv.com/blog/posts/an-introduction-to-solenoids>.
2. https://os.mbed.com/users/4180_1/notebook/an-introduction-to-solenoids/.
3. Vijay Kumar, Anurag, Abhishek Rocky, Ashutosh Kumar, Ankit Kusum, Aditya Nath Yadav, "SOLENOID

Engine", Indian Journal of research, volume-6 | ISSUE-7 | JULY-2017 | ISSN - 2250-1991 | IF: 5.761 | IC Value: 79.96..

4. Sreenivas K, Suresh T, Sai Srinivasulu P. Solenoid Engine", International Journal of Engineering Trends and Applications (IJETA) – Volume 5 Issue 2, Mar-Apr 2018.
5. <https://sciencing.com/a-solenoid-work-4567178.html>.
6. <https://www.elprocus.com/different-types-of-solenoid-working-applications/>.