



A Review on Solenoid Drive in Automobile

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Abstract –

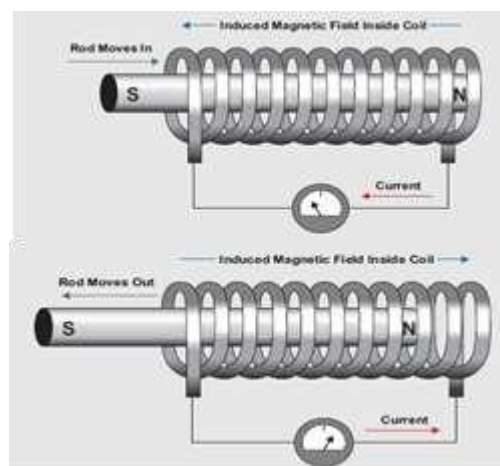
The purpose of this paper is to present an experimental study of simple geometries representing the electrical contact in automotive connectors when current passes through them. The starting system is designed to provide the vehicle operator with a convenient, efficient, and reliable means of cranking and starting the internal combustion engine used to power the vehicles and all its accessory systems from within the safe and secure confines of the passenger compartment.

Keywords – Ignition, armature, starter, motor, engine, automotive.

Introduction –

The internal combustion engines in today's cars are started by means of traditional starter motors. Newer start-stop (Smart Idle Stop System, i-stop) and mild hybrid-system cars make wide use of the same type of starter motor. It consists of two main parts: a pinion-engaging mechanism (PEM) and a DC motor. The PEM is the system of components (solenoid switch, pinion-engaging lever, and overrunning clutch with drive pinion) that engages the drive pinion with the ring

In a nutshell, a solenoid is one of the few components responsible for starting your car. It's generally positioned between your vehicle's ignition module and the engine. Solenoids (also typically called starter solenoids or starter relays) operate by receiving both large electrical currents from your vehicle's battery and smaller electrical currents from the ignition system when the car key is turned.



Overview of a Solenoid –

Solenoid is electromagnetic device in which a coil is wound around the steel rod and the current passes through the coil because of magnetic field induce in the steel rod and it moves in and out. The current running through the coil generates magnetic potential difference across air gap. This magnetic potential difference produces an attractive force between the opposing core and plunger, which moves the plunger to cause tripping mechanism in switch gear product. As the key is turned, the starter solenoid then closes two contacts or metal points together. In doing so, the solenoid relays electrical currents from the ignition to the starter motor. That begins a chain electrical reaction to start the combustion engine overall. Think of the solenoid as the initial spark that starts your car's engine and leads to all of its complex mechanical parts turning in unison.

Location in the car –

The location of a solenoid can vary depending on your vehicle's make and model. Most cars have their solenoids mounted right on the starter motors, connected to other "starter" components like the starter gear and starter control terminal.

So what exactly is a starter motor, you ask? It's essentially a magnetic and electric motor connected to your car's battery, designed to receive low current power and begin turning the aptly-named starter gear, again turning to start a larger electrical reaction and (eventually) your entire engine.

However, a few cars have their solenoids mounted elsewhere in the engine compartment. Regardless, the solenoid is always located between the ignition and the engine, so check your owner's manual to learn more about your solenoid's exact location with your make and model.

Importance

Solenoids are critical car components since they allow your ignition system to reach the starter motor and, in turn, cause your car to turn on in the first place.

Without a solenoid, turning your key wouldn't start your car at all. However, you could still start your vehicle by directly interacting with the battery and starter motor. But starting your car this way would require you to pop the hood of your vehicle before each drive. That procedure might even be impossible, depending on the complexities of your car's engine bay.

Therefore, it's essential to make sure that your solenoid is working correctly at all times. It's a vital component if you want to enjoy the convenience of key-turning engine ignition.

Solenoid Working

Let's break down the solenoid engine starting process in a bit more detail:

When you insert your key into the ignition and turn it, the action sparks a small electrical current that is sent from the ignition switch to the starter solenoid. When the solenoid receives this current, it closes a pair of heavy metallic contacts. The contacts relay a proportionately larger electrical current through themselves and to the starter motor. The starter motor receives the current and begins to set the engine in motion.

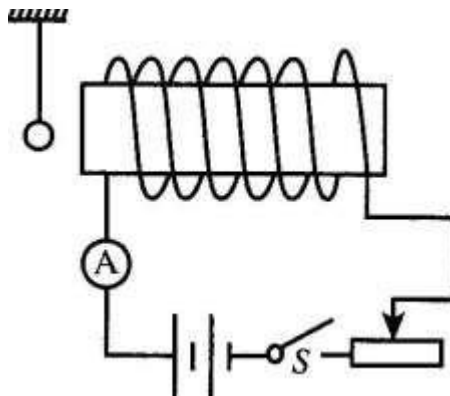
What happens next? The engaged solenoid operates a lever called a plunger, which forces a component called a pinion into a meshed position with another part called a ring gear, locking them together. The ring gear is crucial since it clutches the engine and prevents the starter motor from spinning up to dangerous speeds.

It all sounds very technical, but this is the bottom line - your key turns in the ignition and sends electricity through the starter solenoid, which sends the electricity to the starter motor, which starts the rest of your engine and allows it to run smoothly.

Working Principle

Wire wound magnetic coils, with an open heart, are solenoid switches to receive a cylindrical sliding plunger. A magnetic field can occur inside the hollow opening once the coil is triggered, which drags the cylindrical plunger into it depending on the direction of the switch as well as the poles of the plunger. Here, the plunger link can be made mechanically to conduct the high-power switching to a series of switch contacts.

There are four connector terminals on a solenoid switch, where the coil uses two and can most often be separated from all the remaining terminals. That keeps the coil fully autonomous. Generally, relative to the terminals of the coil, the terminals of the switched current are considerably heavier.

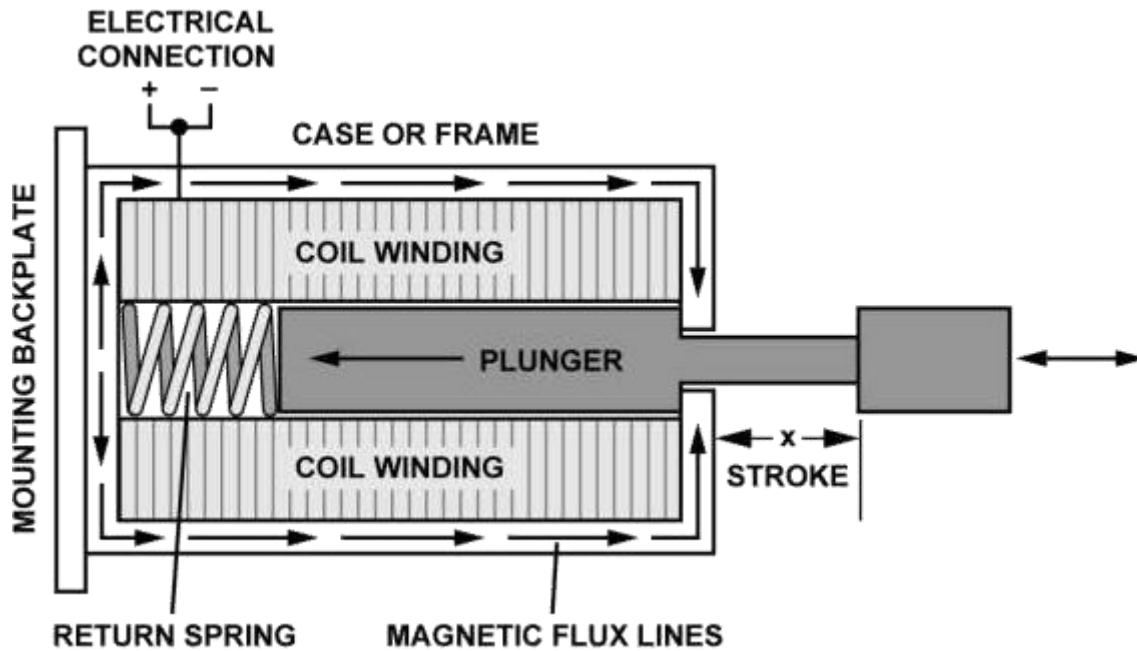


Solenoid Structure –

The solenoid consists of coil, movable plunger, spring, fixed support and U frame casing as shown in the figure. The electromagnetically inductive coil is wound around the plunger. We use mild steel as a plunger. When current flows inside the wound coils an electromagnetic force induced by the magnetic field inside the solenoid. Because of this electromagnetic force plunger moves in linear motion in solenoid.

Working and theoretical Calculation - As we know the current passes through the coil and an electromagnetic force induced inside the solenoid but at normal current the magnetic field produce is much lesser force as compared to the force exerted by opposing force by spring.

$F_s > F_e + m \cdot g$. Whereas F_s is spring force, F_e is electromagnetic force, M is mass of plunger and g is acceleration due to gravity. But as current increases at a certain limit the magnetic field increases. This magnetic field induce EMF on plunger. And hence the force of plunger increases because of which it moves in linear motion on downward side.



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How Solenoids Can Fail

Solenoids are extremely critical parts for proper automotive function, and while they are modestly durable, solenoids can still fail under certain circumstances. A malfunctioning solenoid will prevent your engine from starting when you turn the key in the ignition.

It's important to know how solenoids can fail so you can identify potential malfunctions and repair your vehicle or bring it to a mechanic as soon as possible. In most cases, solenoids stop working when they don't receive enough power from the battery.

In this case, the solenoid won't provide the necessary electrical current to the starter motor. A low power malfunction is characterized by a rapid clicking sound when you turn your ignition key. This loss of power can be caused by things like:

- Low battery power overall.
- Corroded or weak connections in the battery cable.
- Damaged red cables connected to the battery housing.

Summary

Your car's solenoid is a small but vital component. It's somewhat difficult to understate how helpful this little piece is, but without it, we simply wouldn't be able to hop in our cars, turn a key, and hit the road with the same ease that we do today.

Therefore, be sure to monitor your solenoid and pay attention to the potential symptoms of failure outlined above. These details should help you get your solenoid or battery repaired, recharged, or replaced if your car ever fails to start.

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