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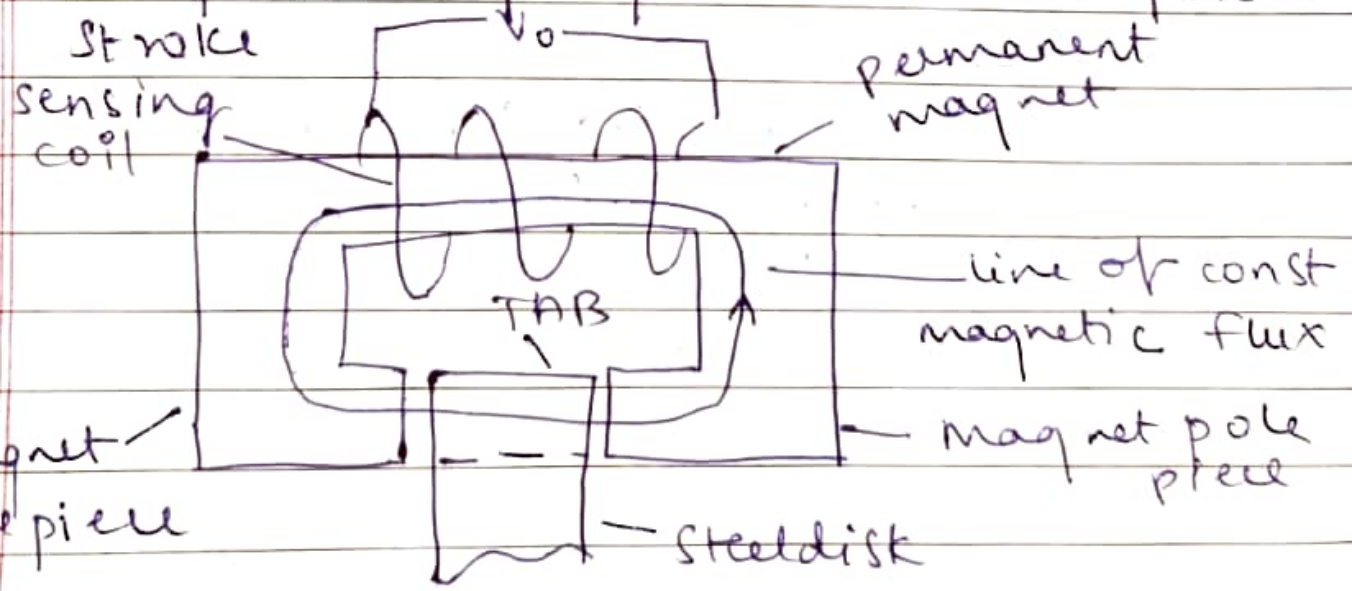
Chapter - 2

Magnetic Reluctance position sensor: is used to measure engine speed. The reluctance sensor is used in this case as an example this sensor consists of a permanent magnet with a coil of wire wound around it.

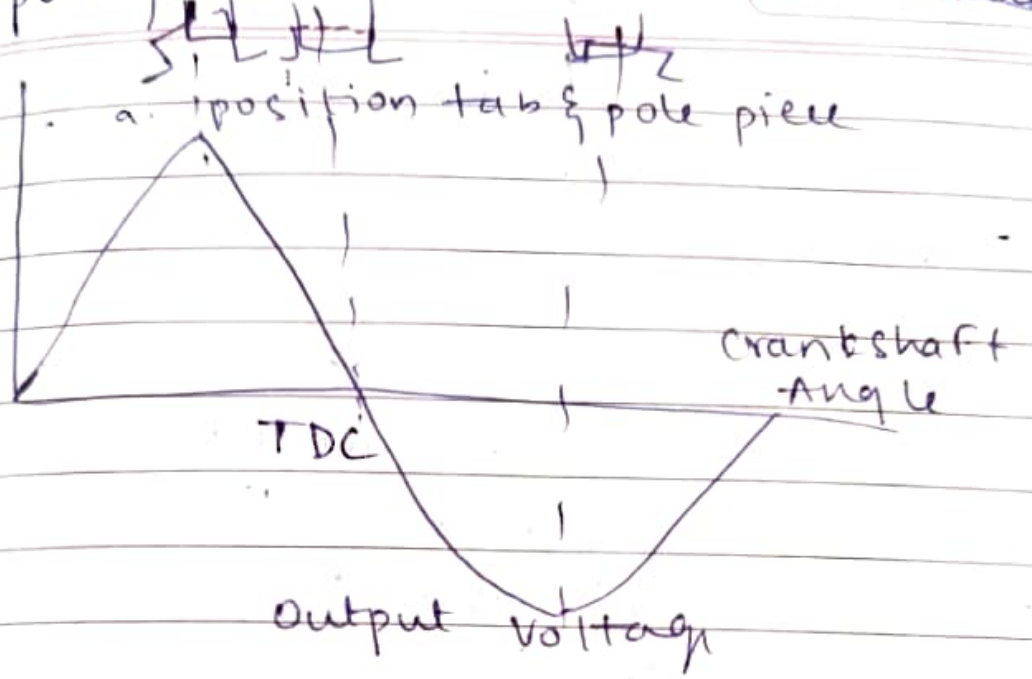
A steel disk dat is mounted on the crankshaft has tabs that pass b/w the pole pieces of this magnet.

The steel disk has 4 protruding tabs, which is appropriate for an 8-cylinder engine the passage of each tab correspond to the TDC position of cylinders on its power



the change in magnetic flux induces a voltage Vo, in sensing coil dat is proportional to the rate of change of magnetic flux

→ ~~the magnitude of a magnetic flux~~
→ Vo, begins to increase from 0 as a tab begins to pass b/w pole pieces reach a max, then, falls to zero



Drawbacks

→ Non linearity, sensitive to temp, limited resolution

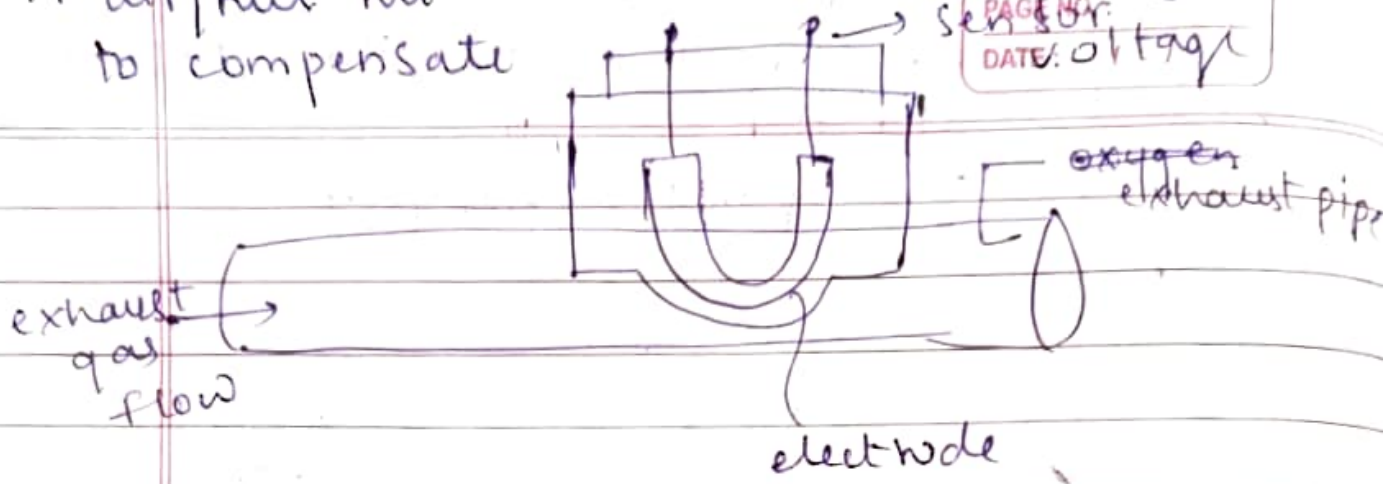
To Overcome

→ linearization techniques
→ temp compensation
→ selecting right sensor

2)

→ the sensor used to maintain the desired air-fuel ratio is oxygen sensor also known as exhaust gas oxygen (EGO) sensor
→ here s/m keeps the air/fuel mixture close to ideal by constantly switching back

→ management uses oxygen sensors to determine if air/fuel mix is rich or lean & adjusting to compensate



→ exhaust sensors is located in exhaust manifold, it directly measures the amount of oxygen remaining in exhaust gas.

→ ECO sensor operation is based on the distribution of oxygen ions.

→ Oxygen sensor generate a voltage signal based on oxygen content.

↓

if high voltage → lean burn
low " → rich burn

→ The Engine control unit (ECU) receives the oxygen from oxygen sensor

→ based on signal ECU adjusts fuel injection amount to achieve desire stochiometric air-fuel ratio.

→ this create a closed loop s/m where the oxygen sensor continuously provides a feedback to ECU for fuel mix control

→ this sensor is often called a lambda(λ) sensor

$$\lambda = \frac{(air/fuel)}{(air/fuel\ at\ stoichiometry)}$$

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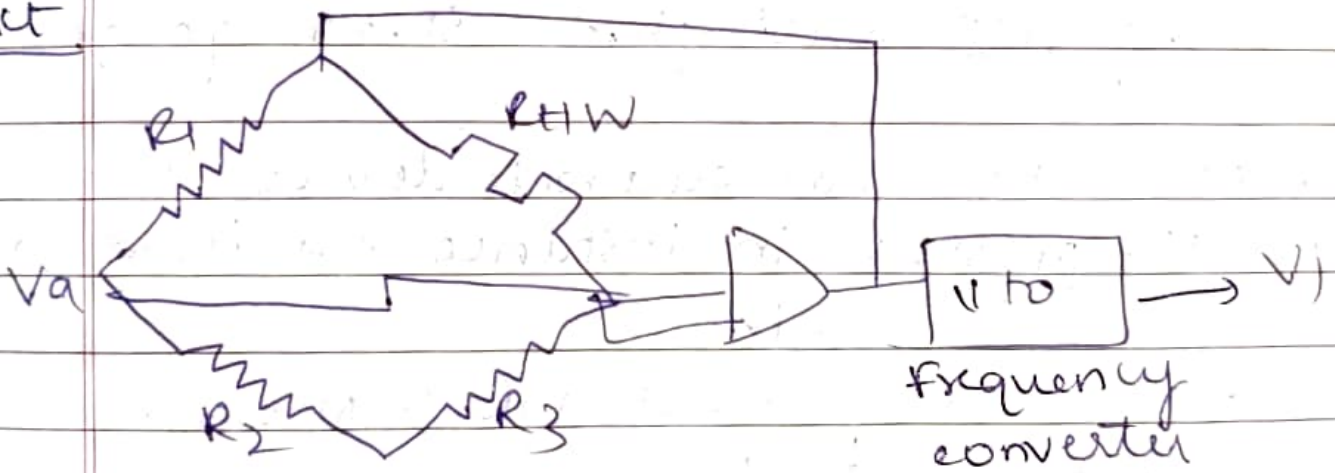
3) Mass air flow sensor using wheat stone bridge.

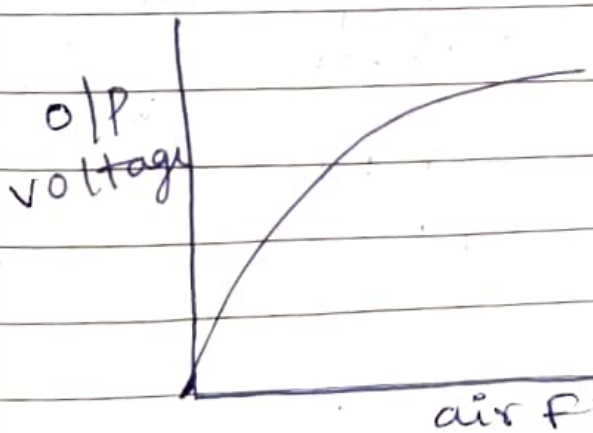
→ MAF sensor is computer controlled sensor that calculates the volume & density of air taken by engine.

→ it uses wheatstone bridge ckt to measure the amount of air entering the engine, which is crucial to maintain air fuel ratio.

→ MAF is variation of classical air-flow sensor it is also known as hot-wire anemometer ckt.



Waveform



working:

→ MAF sensor contains a thin platinum wire element in air intake path.

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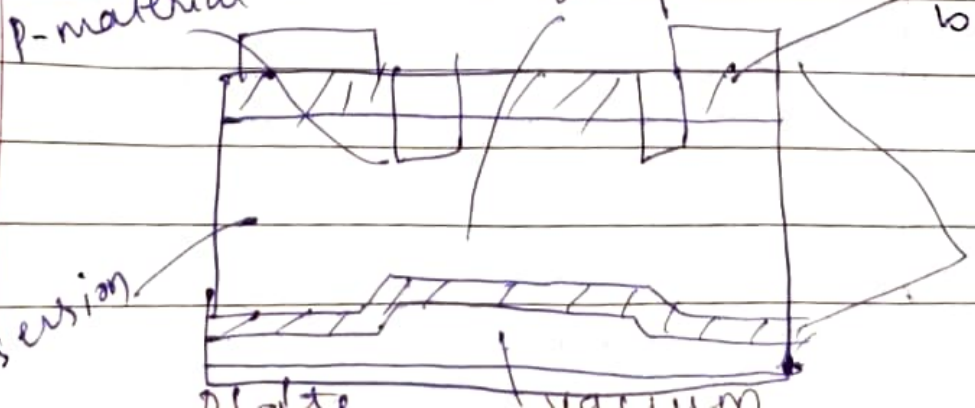
→ it acts as a one-leg of wheatstone bridge
→ platinum wire is continously being heated by passing current through it
→ this establishes temp diff b/w air & wire
→ as airflow cools the wire, resistance decreases
→ voltage across two resistors in WB is zero
→ so basically it aims to maintain a const temp diff b/w wire & incoming air.

4) Map sensor

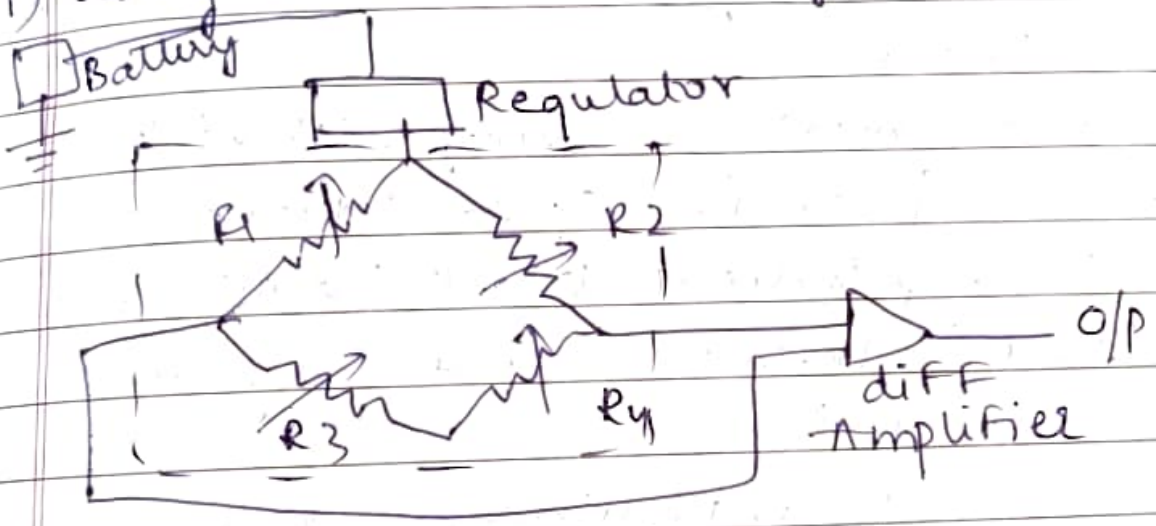
→ i) using silicon diaphram strain gauge.

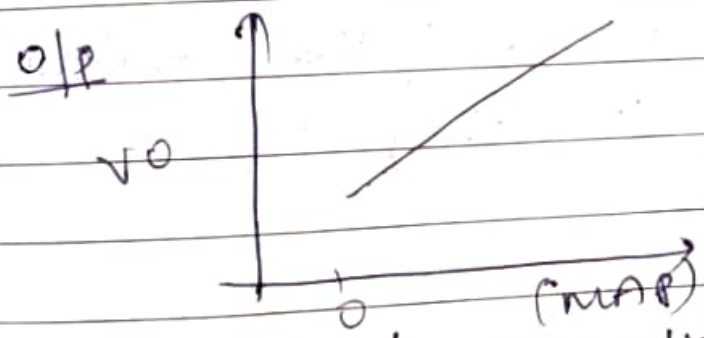
→ MAP sensor is an electronic device dat measures the pressure in instance manifold of an IC engine
→ MAP sensor provides inform to engine control module about engine load
→ Map sensor works by measuring diff b/w atmospheric pressure & pressure inside intake manifold



→ sensor consists of diaphragm & strain gauge that detects the deflection of diaphragm
→ the change in resistance of strain gauges due to pressure, becomes the o/p signal of map sensor.
→ map translates the resistance change into an absolute pressure value in intake manifold.

ii) using wheatstone bridge





→ it is similar to non-bridge design
→ components: silicon diaphragm
strain gauge

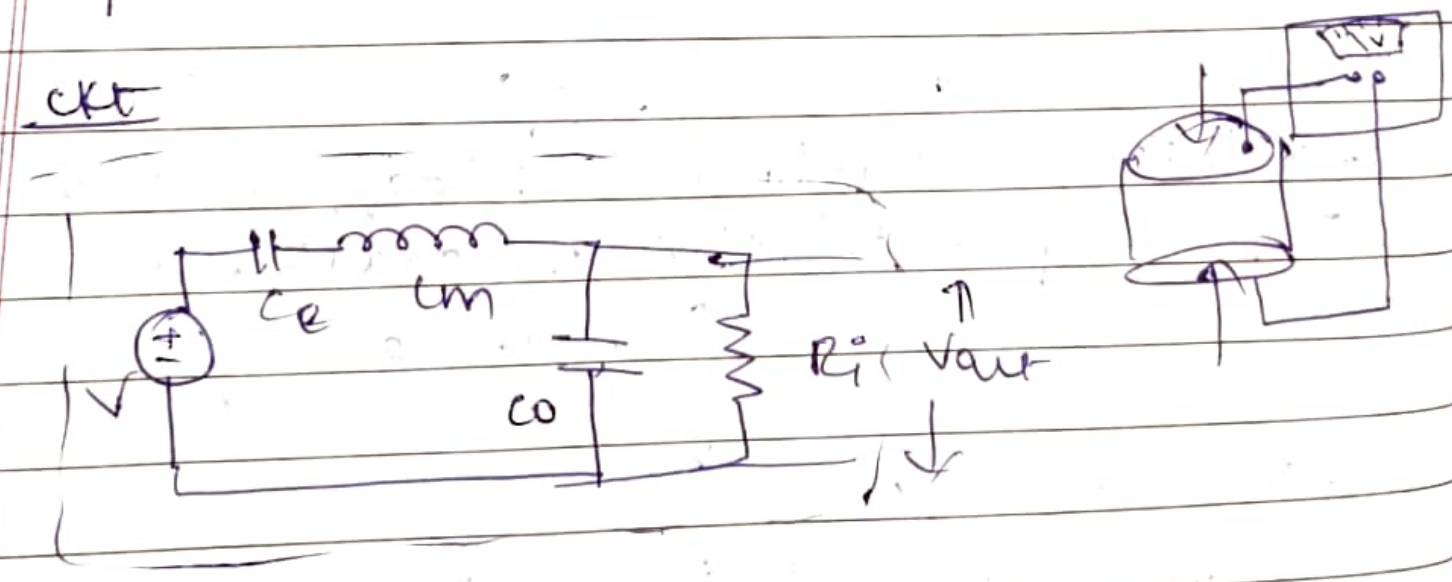
→ working
→ when pressure in manifold increases it pushes the diaphragm

→ lower the pressure ⇒ the deflection
→ then strain gauge experiences stress
→ then there will be bridge imbalance
→ then o/p voltage becomes non-zero

5) Knock sensors

→ this sensor is employed in closed loop ignition timing to prevent undesirable knock
→ it occurs most commonly with high manifold pressure & excessive spark advance.
→ it is imp to detect knock & avoid excessive knock; otherwise, there may be damage to the engine.
→ one way of controlling knocking is to sense when knocking begins & then retard the ignition until knocking stops.

ckt



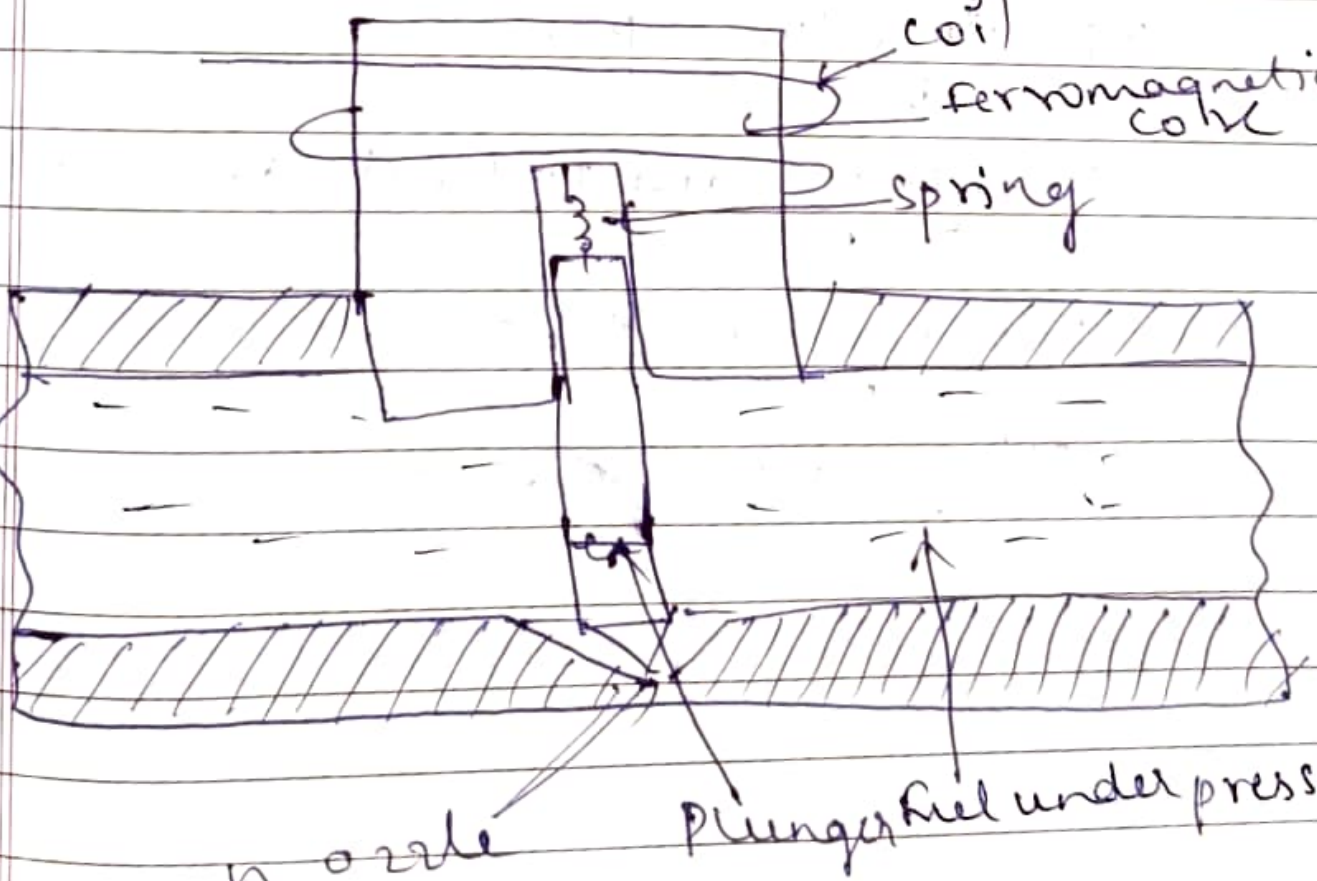
→ Knock sensors generate a voltage when vibration is applied to them utilizing the piezoelectric effect.

→ due to the vibration a pressure creates an electric charge in piezo-element which o/p of sensor.

→ Once signs of knocking are detected, the knock sensor sends a voltage signal to the engine management computer, which retards the spark timing slightly to avoid detonation

6)

→ In fuel injector with solenoid separated valve, there are 2 main components working together to deliver fuel at high pressure



1) Solenoid valve: it acts as electrically controlled switch

→ it consists of coil that generates a magnetic field an electric current flows through it.

2) Separated valve: this controlls the actual flow fuel.

→ it has small opening that allows high pressure fuel to pass through

Working:

→ ECU determines appropriate timing & amount of fuel injection for optimal engine operation

↓

Solenoid activation

↓

→ application of magnetic force

↓

Separate valve opens

↓

Fuel is injected due to high pressure

↓

Solenoid deactivation

↓

Spring closes the valve