

ASSIGNMENT

Submitted by
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1. Explain the journey of automotive with the help of flow chart from the beginning of 18th century to the 21st century & Give brief description on the following milestones in the automotive.

Ans.

1672 → Invention of the first steam powered vehicle.

↓

1768 → Nicholas Cugnot invented the very first steam engine
Speed 4km/hr, Payload 4 tonnes.

↓

1806 → Isaac de Ravez invented the first ICE vehicle
in 1806 (Fuel - H₂ gas)

↓

1826 - Samuel Brown tested the first industry applied ICE
Ayos Zedic got a patent for electric motor in 1826.

↓

1886 - Thomas Parker invented the first EV. EV vehicles
to undergoe production.

↓

1890 - William Morrison invented morrison carriage
Speed 20mph.

↓

1906 - Introduced the advanced EV which has the range of
100 miles on a single charge.

↓

1910 - Golden Era of EV. But EV started declining after
1910 ~~era~~ due to severe reasons.
world war, assembly line production.

↓
1912 - Petrol powered cars became easier to drive due to the invention of self start;

↓
1924 - EV was completely dominated by gasoline cars (1924-1960)

↓
1960 - Concept, prototype & serious design of EV

↓
1990 - 1st generation of EV

↓
1991 - Introduce the Low emission vehicle I (LEV I)

↓
2000 - Hybridised EV & increasing level of gas supply demand.

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2003 - CARB introduced LEV II, ULEV, PZEV

↓
2006 - Introduced Santa Auto Expo (Tesla Roadster)

↓
2010 - Nissan Leaf (The 1st affordable 5 door hatchback)

↓
2011-2020 - EV industry started growing gradually.

↓
2020 - The market started growing again due to ~~and~~ increased subsidy, Green Credit (Every time you recharge the vehicle will get 20% refund)

3. Explain the diagram, Construction & working of Brushless motor BLDC?

Ans:

A brushless DC motor (BLDC) is a permanent magnet synchronous electric motor which is driven by direct current (DC) electricity & it accomplishes electrically controlled commutation system (Commutation is the process of producing rotational torque in the motor changing phase current through it at appropriate times). BLDC motors are also referred as trapezoidal permanent magnet motors. ~~are also referred as~~ High speed of operation even in loaded and ~~and~~ unloaded conditions due to the absence of brushes that limits the speed. It has ~~etc~~ EMI is less.

BLDC motor can be constructed in different physical configurations depending on the stator winding. These can be configured as 4ϕ , 2ϕ , or 3ϕ motors. However 3ϕ BLDC motor with PM stator.

Stator

- stator is made up of silicon steel stampings with slots.
- The slots are accommodated armature winding
- This windings are wound with specified no. of poles.
- Speed of brushless DC motor can be controlled by ~~eee~~ controller. It's stator v/g which can be achieved by controlling the DC i/p v/g of the inverter.

Rotor

- BLDC motor incorporates a permanent magnet in the rotor
- The number of poles in the rotor can vary from 2 to 8 pole pair with alternative ~~set~~ south & north pole depending on the application requirement.
- In order to achieve the max torque in the motor the flux density of the material should be high.
- Brushless DC motor is also having rotor position sensor which produce electrical signals that indicates the current position of the rotor.

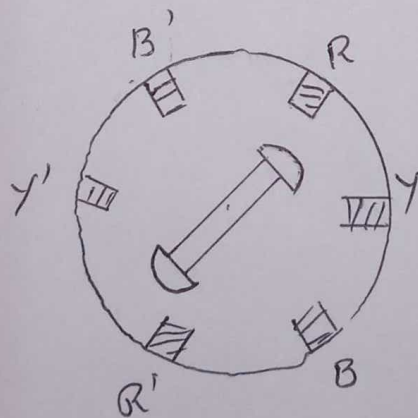
Hall Sensor

It provides the information to synchronise stator armature excitation with rotor position.

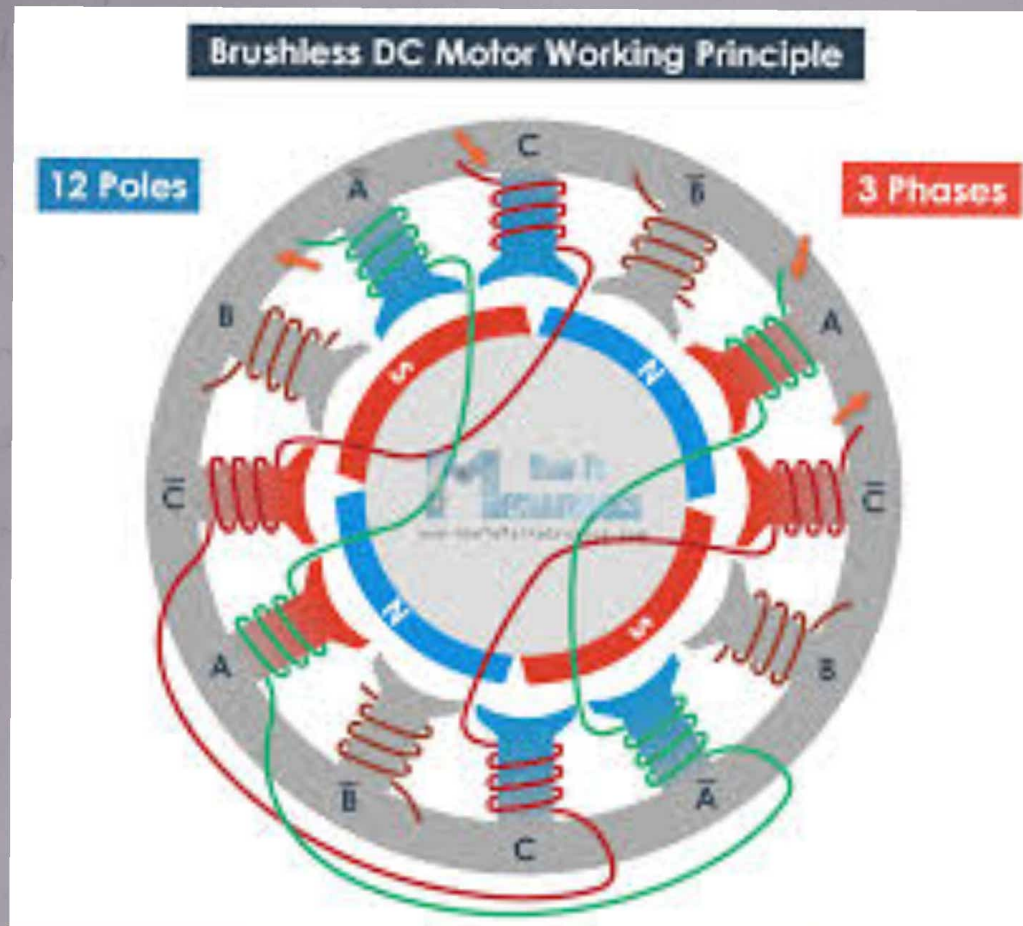
Working

It works similar to that of a conventional DC motor. The Lorentz force law which states that whenever a current carrying conductor placed in a magnetic field it experience a force. As a consequence of reaction force the magnet will experience an equal & opposite force. In case BLDC motor, the current carrying conductor is stationary while the PM moves.

When the stator coils are electrically switched by supply source it becomes electromagnet & start producing the uniform field in the air gap. Through the source of supply DC. Switching machine to generate an AC vly waveform with trapezoidal shape, due to the force of interaction b/w electromagnet stator & rotor continuous to rotate.

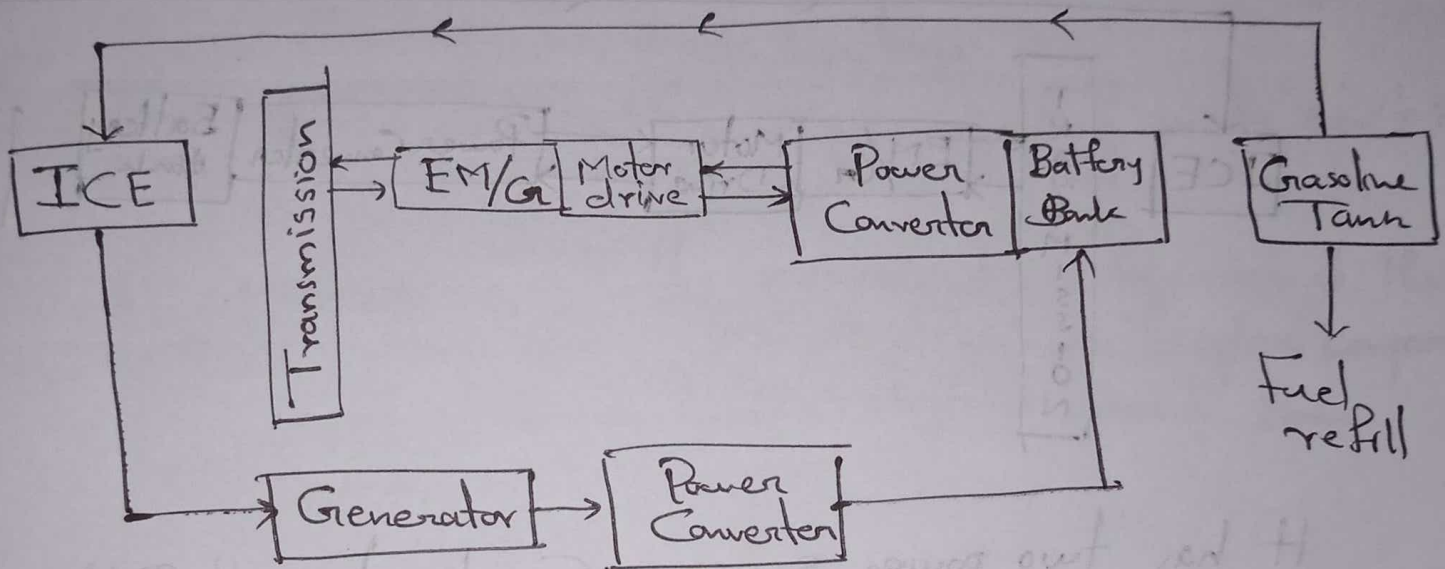


The figure shows, which stator is excited based on different switching states with the switching windings as high & low signals. corresponding windings - energized as north poles. The permanent magnet rotor with N & S poles align with stator poles causing motor to rotate.



Explain & draw the layout of following Hybrid EV with their two advantages, disadvantages & industrial application.

a) Series Hybrid EV.



It is called Series Combination. Motor is driving the vehicle. ICE is charging the battery pack. So primary source is motor, ICE secondary.

Motor power > Engine power.

Advantages

Motor is powerful.

EV is fitted with ICE to recharge the battery.

It saves fuel.

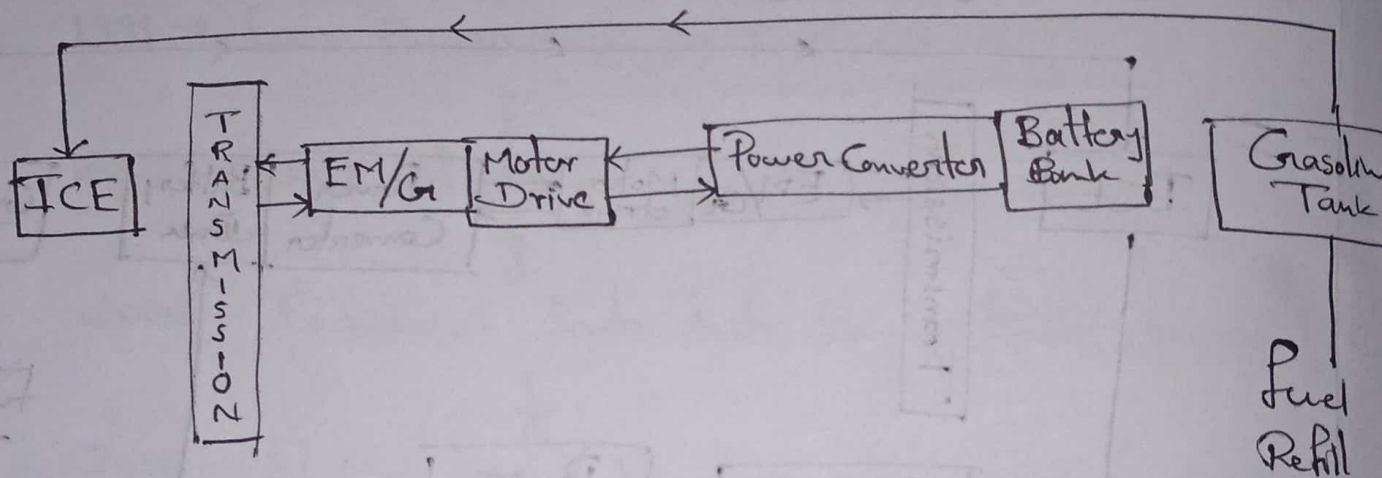
Disadvantages

Battery pack is larger in size.

Costly.

The overall efficiency decreases.

b) Parallel Hybrid EV



It has two power sources Gasoline tank & Battery

ICE is primary engine & Electric motor is secondary

Case 1

When ICE is in operation motor did not take place & in off state.

Case 2

ICE is off. Motor is running

Case 3

Motor & engine will running together.

Case 4

When battery is low ICE engine runs the vehicle & charges the battery.

Case 5 (Regenerative Braking)

In order to use the vehicles inertia so that motor act as generator to recharge the battery.

Advantage

- Multipurpose
- Energy loss is less
- Compactness due to smaller traction motor

Disadvantage

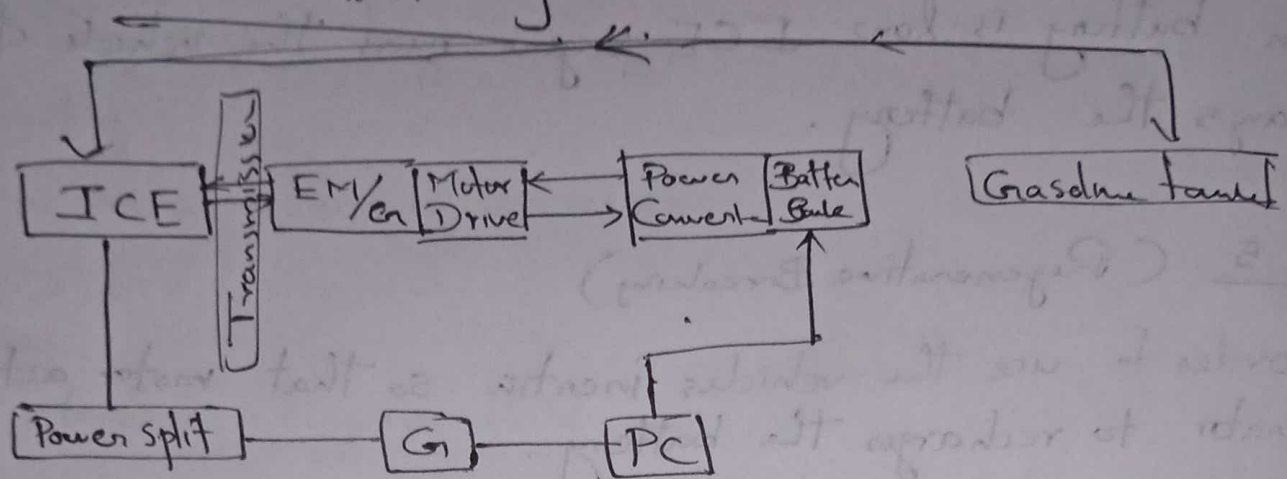
- The engine operating points can't be fixed.
- The mechanical configuration & the control, strategy are complex compared to series hybrid drive train

c) Plug-in Hybrid

It is almost similar to parallel hybrid. An extra plug is attached to the battery bank to charge the battery.
eg: BMW i8.

- When in hybrid mode motor will run the front wheel & engine will run the rear wheel.
- When in eDrive mode front wheel runs on motor only. Speed range will be less.
- Sport mode → Both will be working at max performance.
- I.C.E of moving car charges the battery.

d) Series-Parallel Hybrid.



Engine is connected to a device known as powersplit. It split the power b/w generator & transmission. If you don't want to charge the battery & use the engine to drive the vehicle you can shift to transmission & if you want both that is also possible.

Toyota price - 1996.

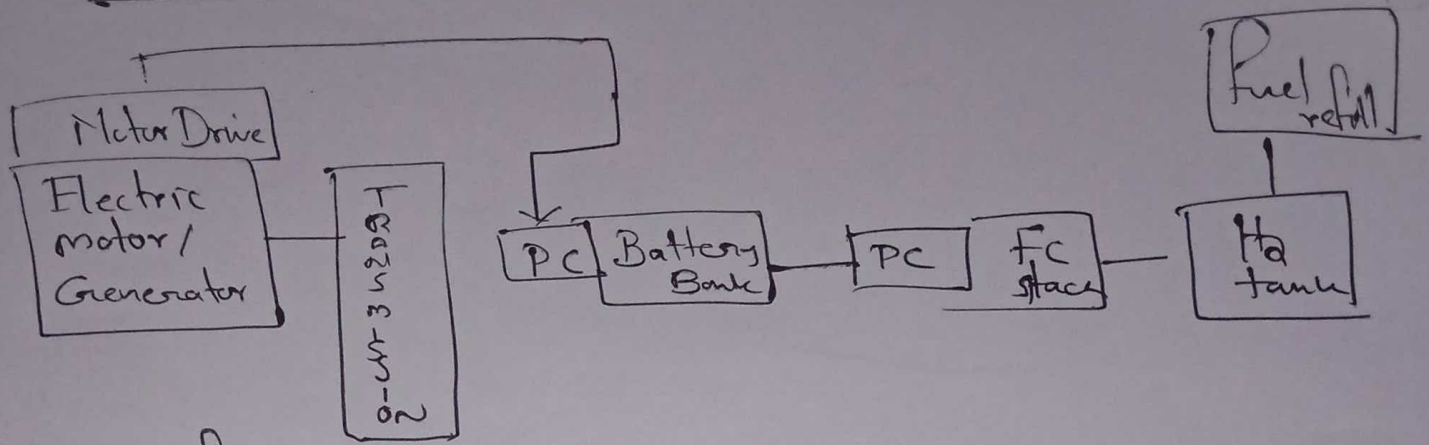
Advantage -

Disadvantage

Really bulky.
Costly.

High efficiency

e) Fuel Cell EV



Instead of engine using fuel cell.

Concept is same as series hybrid

Hydrogen will come to fuel cell & recharges the battery which run the vehicle.

eg: Hyundai Nexo.

Advantage

- High efficiency.
- No harmful emission
- Renewable energy.

Disadvantage

- High cost.
- Difficulty to handle fuel. (explosive)
- Less Space
- Storage & transportation of hydrogen