

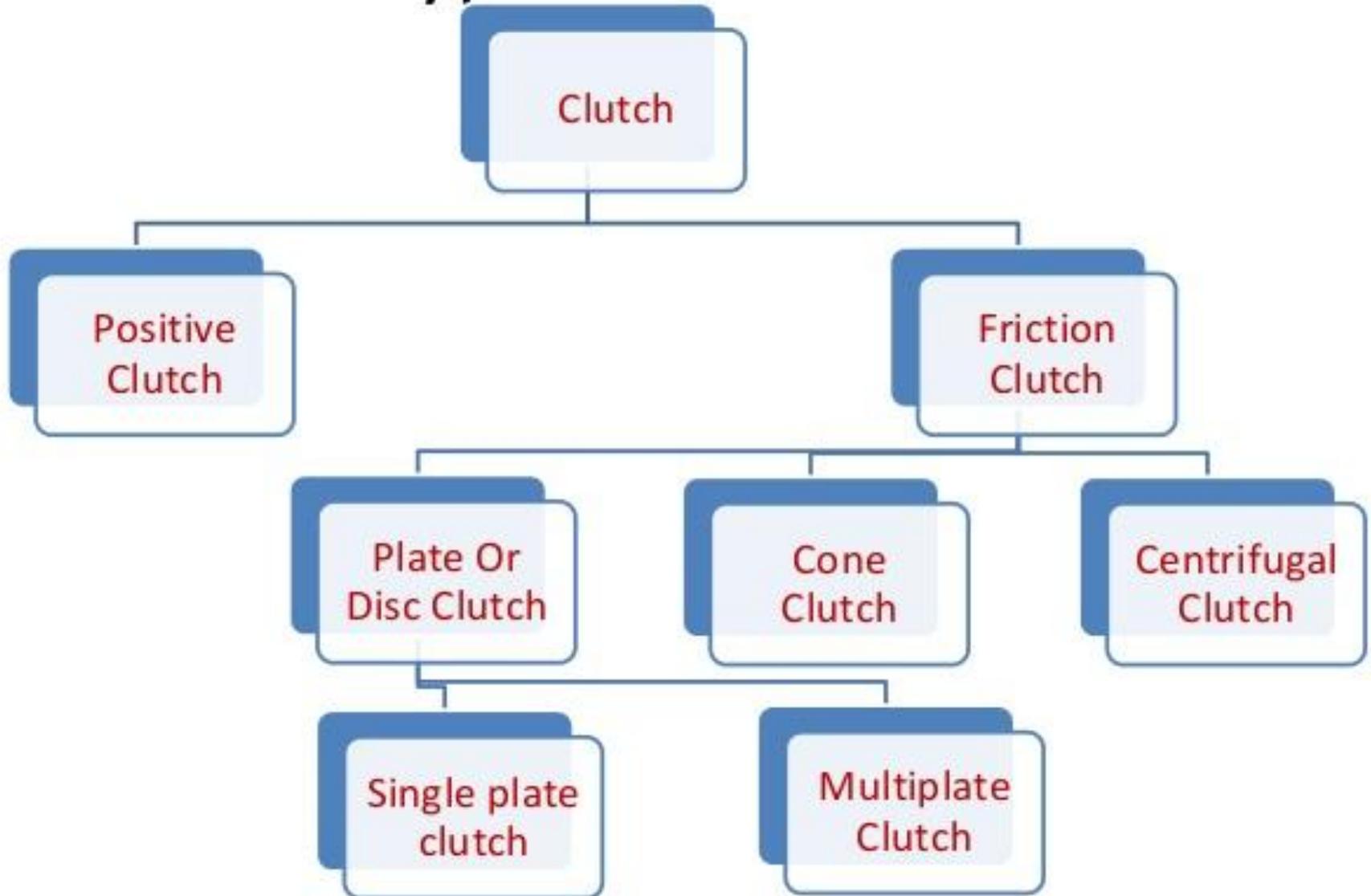
# What is Clutch?

- The Clutch is a mechanical device used to connect or disconnect the driven shaft from the driving shaft at the will of the operator while power is transmitted from driving to driven shaft.
- Clutch is mounted between driving and driven shaft and power is transmitted from one shaft to the another shaft which is required to be started and stopped frequently.

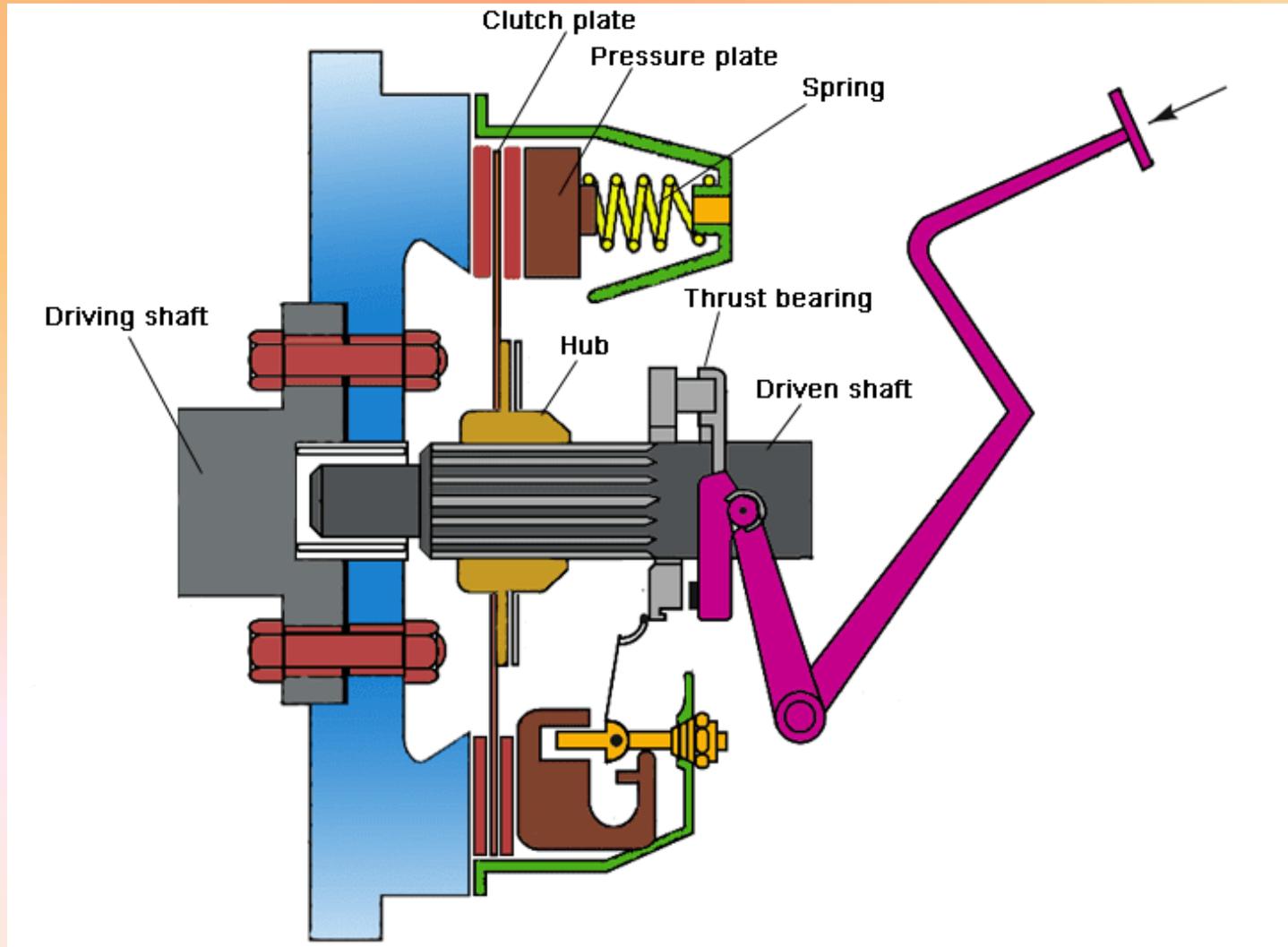
# Functions of the clutch

- To **connect** and **disconnect** the shafts
- To **start or stop a machine** (or a rotating element) without starting and stopping the prime mover.
- To maintain **constant speed, torque and power**.
- To **reduce shocks transmitted** between machine shafts.
- For **automatic disconnect, quick start and stop, gradual starts, and non-reversing and over running functions**.

# Types Of Clutch

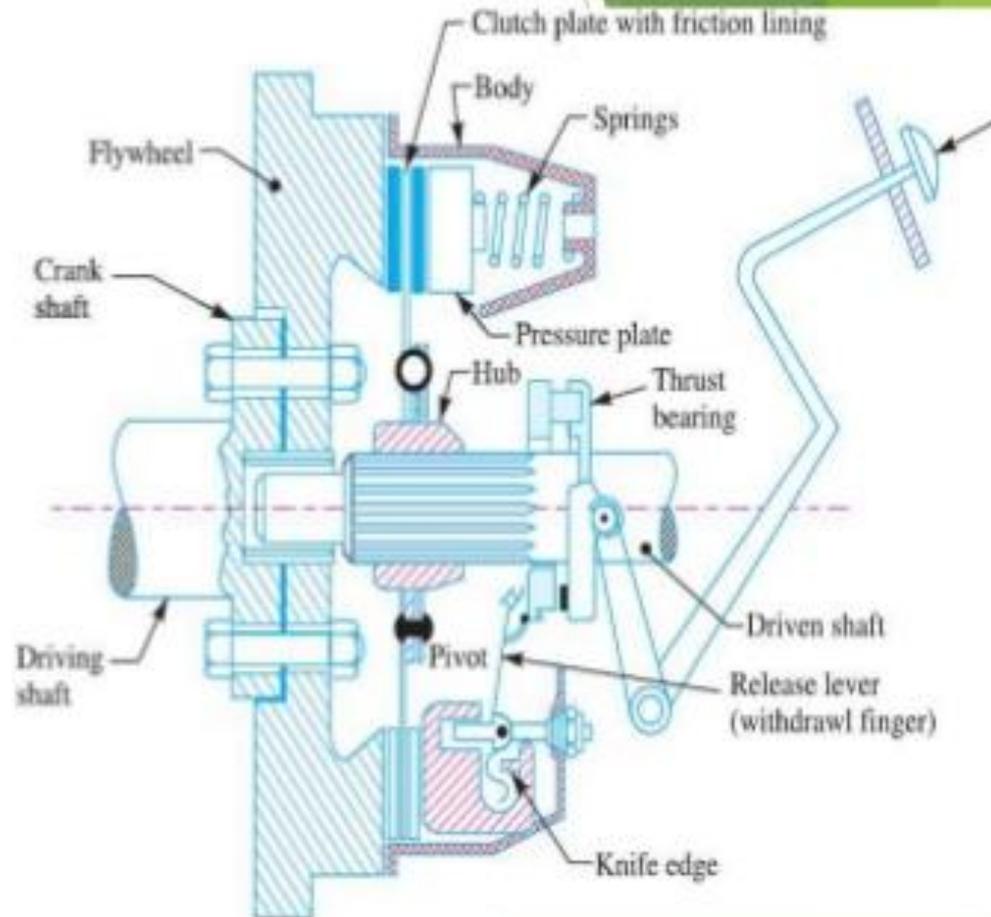


**Single plate friction clutch** is a type of friction clutch in which power is transmitted by means of friction between the contact surface usually called clutch plates. As name suggest a this clutch consists of only one clutch plate with both side friction lining (frictional surface)



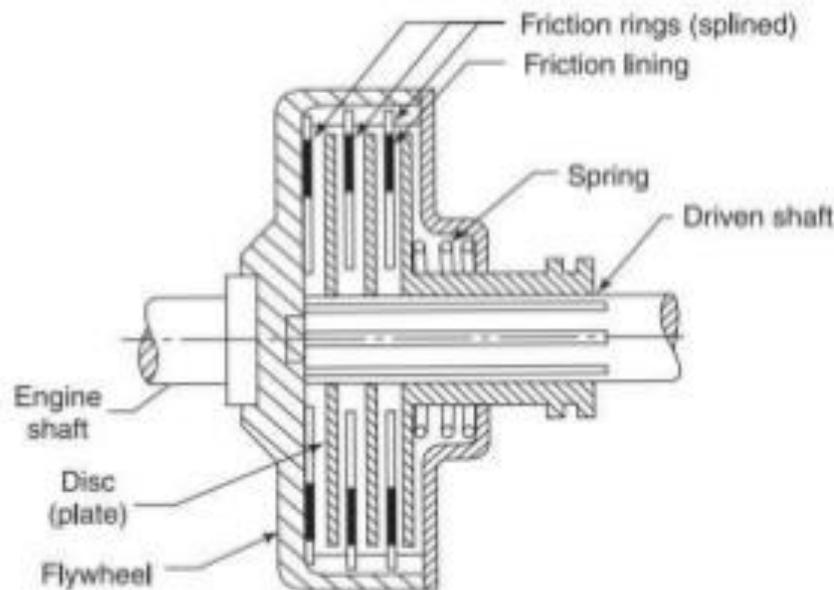
# Single Plate Clutch

- ▶ **Working-** The diagram shows the pressure plate pulled back by the release levers against the compression springs; so that the friction linings on the clutch plate are free of flywheel and pressure plate. The flywheel rotates without driving the clutch plate and hence the shaft.
- ▶ When the pressure of the thrust race is released the compression springs are free to move the pressure plate to the left bringing it in contact with the clutch plate.
- ▶ The pressure plate moves to the left, sliding the clutch plate on its splined hub, along the driven shaft until the friction lining touches the flywheel. The compression springs now cause the linings to be gripped between the pressure plate and the flywheel and the friction between the linings and flywheel and pressure plate causes the clutch plate to revolve, turning the driven shaft.



# C.) Multi-Plate Clutch

- Multi-plate clutch is same as the single plate clutch but there is two or more clutch plates are inserted between the flywheel and pressure plate. This clutch is compact then single plate clutch for same transmission of torque.



# Friction Clutch

- ▶ Friction Clutches work on the basis of the frictional forces developed between the two or more surfaces in contact.
- ▶ Friction clutches are usually over the jaw clutches due to their better performance.
- ▶ The major types of friction clutches are
  - ▶ Dry Clutch
  - ▶ Wet Clutch

# CENTRIFUGAL CLUTCH

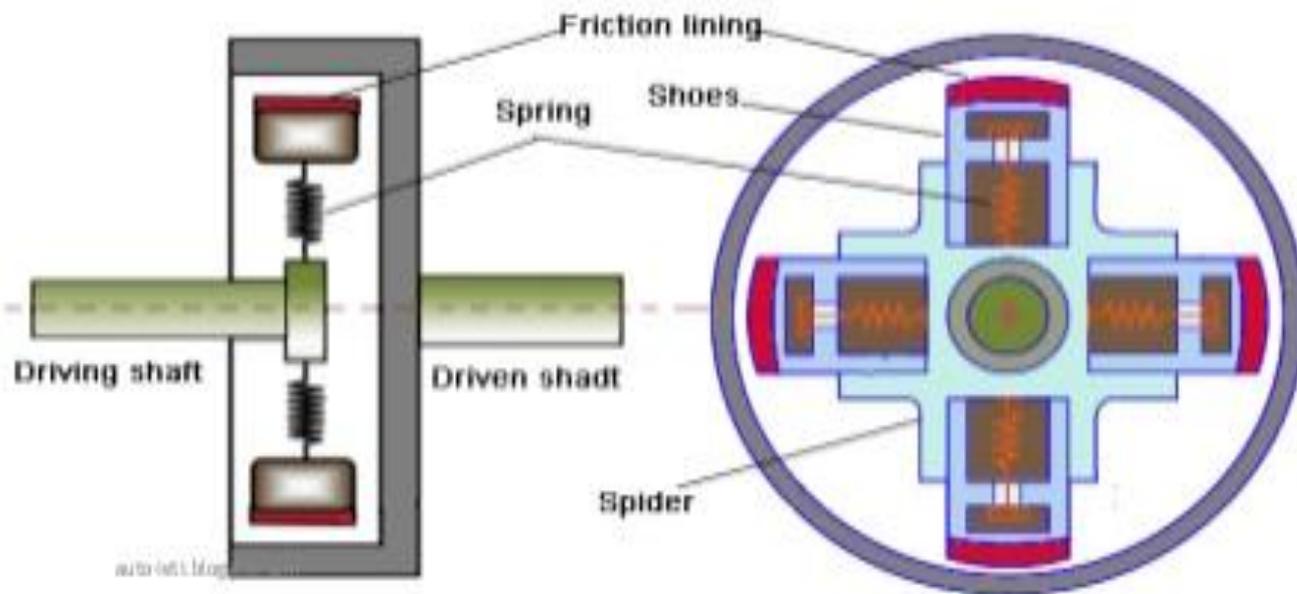
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- ✓ This clutch system employs centrifugal force to automatically engage the clutch when the engine rpm rises above a threshold and to automatically disengage the clutch when the engine rpm falls low enough.
- ✓ A centrifugal clutch is used in some vehicles (e.g., mopeds) and also in other applications where the speed of the engine defines the state of the clutch, for example, in a chainsaw.

# Centrifugal Clutch

- ▶ A centrifugal clutch is a clutch that uses centrifugal force to connect two concentric shafts, with the driving shaft nested inside the driven shaft.
- ▶ It consists of number of shoe on the inside of a rim of pulley. The outer surface of pulley is covered with friction material.
- ▶ These shoes are moves radially in guides.



Centrifugal Clutch

# Centrifugal Clutch

## Advantages

- ▶ This type of mechanical clutch is automatic, so no kind of control mechanism is necessary.
  - ▶ Centrifugal clutch is fairly cheap compare to normal type on clutch.
  - ▶ It prevents engine from stalling in other words minimizes engine braking force.
- It is very helpful in various speed ranges compare to direct drive system.

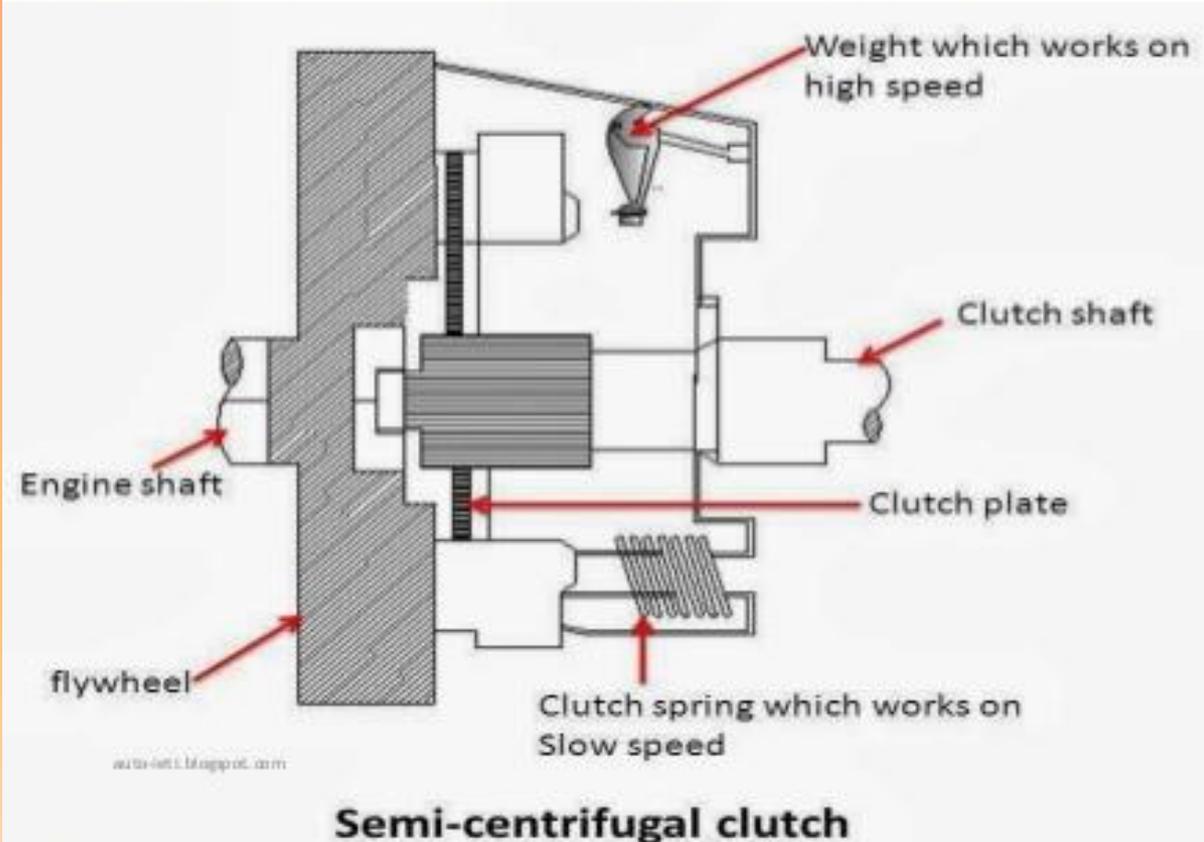
## Disadvantages

- ▶ This clutch is not appropriate for transferring significant torque or power because they can slip if loaded heavily.
- ▶ Sometimes the centrifugal clutch do not engage or disengage reliably and therefore can cause a safety hazard.
- ▶ Some loss in hose power to rear wheel due to friction pads or shoes movement.

# Semi Centrifugal Clutches

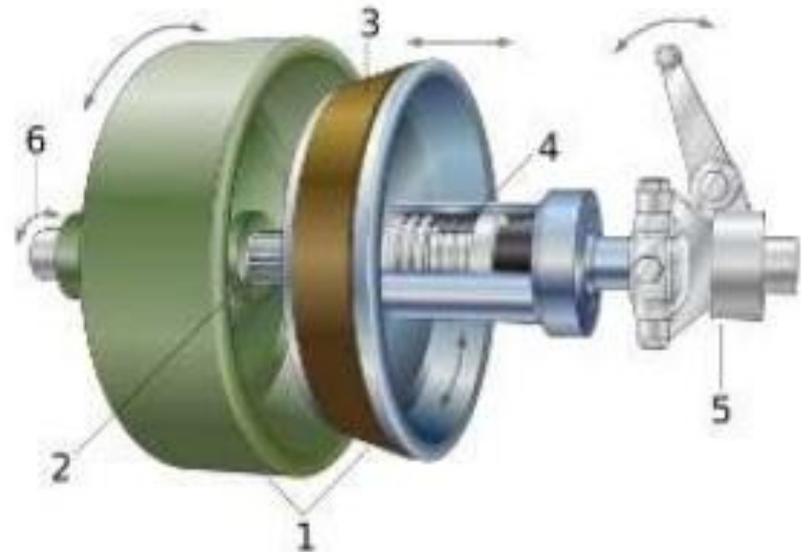
It is used in high powered engines and racing car engines where **Clutch** disengagements require appreciable and tiresome drivers effort. The power transmitted with partly by **clutch** springs and remaining by the **centrifugal** action of an extra weight provided in the system.

## Semi-Centrifugal Clutch



# CONE CLUTCH

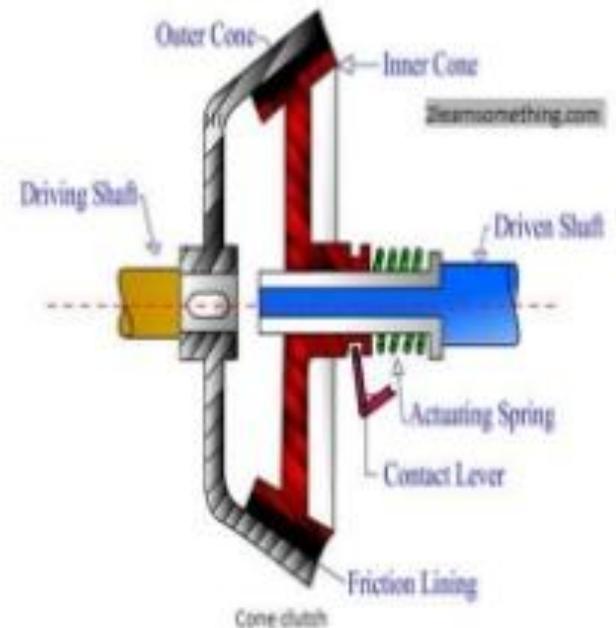
1. Cones: female cone (green), male cone (blue)
2. Shaft: male cone is sliding on splines
3. Friction material
4. Spring: brings the male cone back after using the clutch control
5. Clutch control: separating both cones by pressing
6. Rotating direction: both direction of the axis are possible



# Cone clutch

Cone clutch consists of friction surfaces in form of cone. The engine shaft consists of a female cone. The male cone is mounted on the splined clutch shaft. It has friction surfaces on the conical portion. The male cone can slide on the clutch shaft.

- ❖ When the clutch is engaged the friction surfaces of the male cone are in contact with that of the female cone due to the force of spring.
- ❖ When the clutch pedal is pressed, the male cone slides against the spring force and the clutch is disengaged.



# Hydraulic clutch

- The job of the hydraulic clutch is to engage or disengage the engine from the transmission as the driver changes gears;
- The hydraulic clutch does this by forcing pressurised hydraulic fluid into the clutch disengagement apparatus.

A **gear box** is a mechanical method of transferring energy or motion from one device to another and is used to increase torque while reducing speed.

## Function of a GearBox...

- ▶ In practice, the main use of a Gearbox is to act as a **reduction gear**. These can be variable or non-variable, depending on the application.
- ▶ This not only **decreases wear** on the motor, but also allows **greater acceleration** - in fact the larger the reduction ratio, the larger the acceleration.
- ▶ In other words, if when the motor is turning 2500 rpm the output shaft is turning 500, the gearbox is reducing the number of revolutions from input to output.
- ▶ Torque converters, hydraulics, electrical power and hybrid configurations may also be used for the same purpose.

# Function Of A Gear Box

- Torque ratio between the engine and wheels to be varied for rapid acceleration and for climbing gradients.
- It provides means of reversal of vehicle motion.
- Transmission can be disconnected from engine by neutral position of gear box

# Types of Gearboxes

## **Types of Gearboxes:**

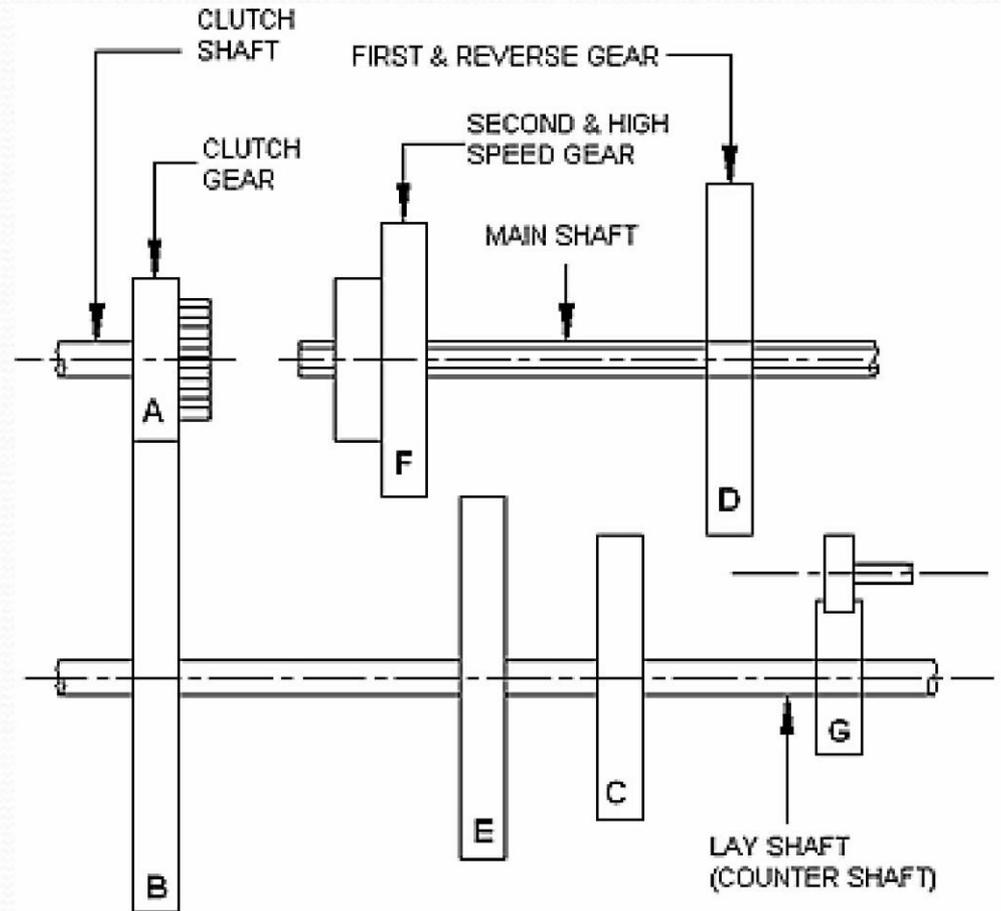
- ▶ Sliding Mesh Gear box
- ▶ Constant Mesh Gear Box
- ▶ Synchromesh Gear Box
- ▶ Epicyclic Gear Box

An engine may consist of one or more gearbox.

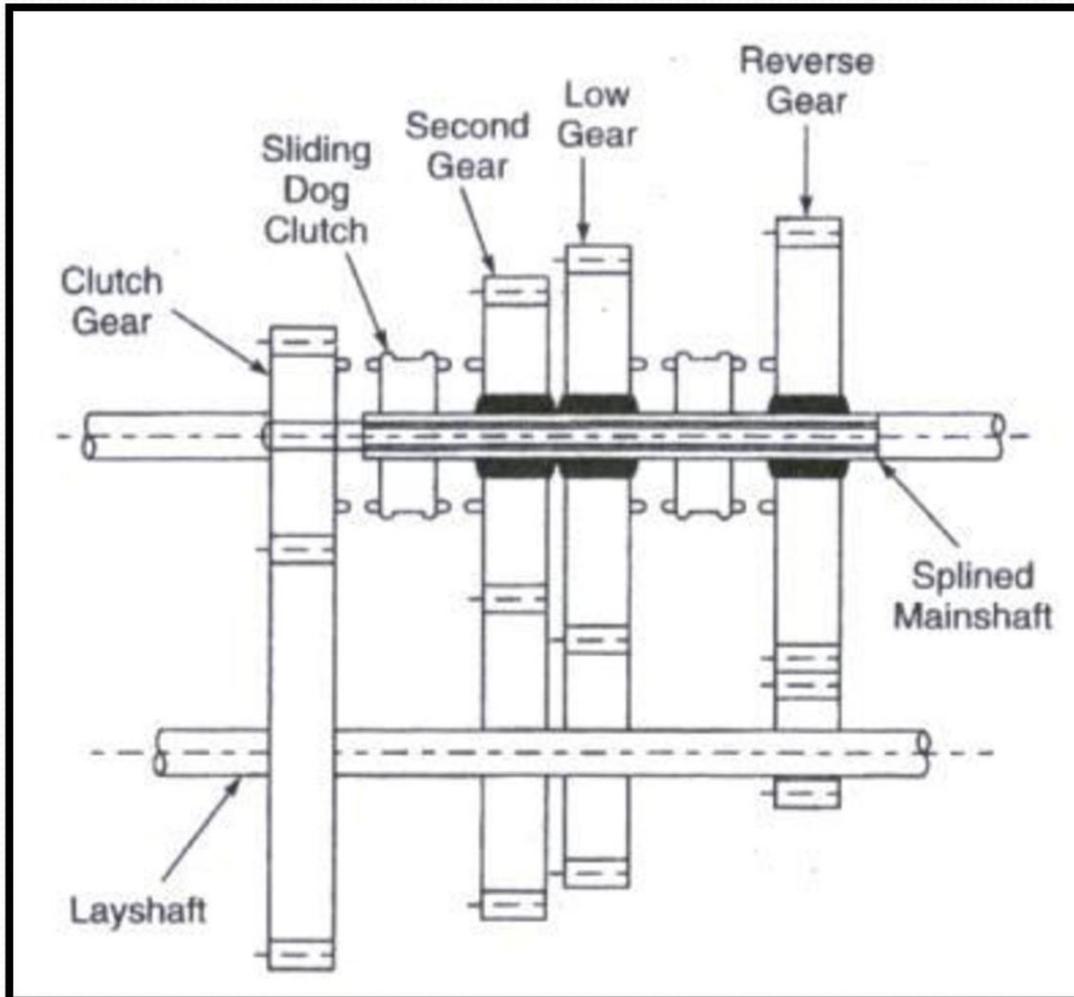
There may be gearboxes which are a mixture of these types.

# SLIDING MESH GEAR BOX

- In this type of gear box, gears are engaged and disengaged by sliding of the gear wheels.
- Gear wheels on the splined main shaft engage with gear wheels on the lay shaft or counter shaft by sliding themselves.



# CONSTANT MESH GEAR BOX



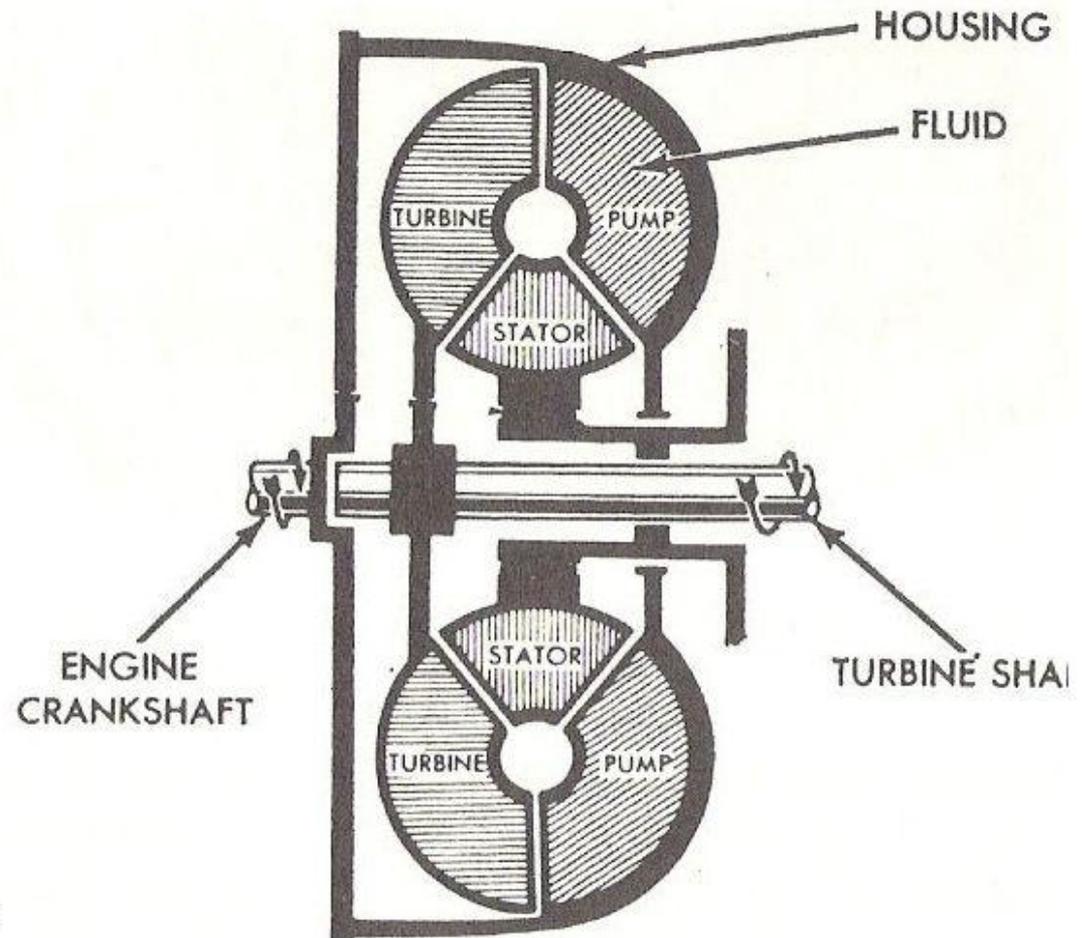
- In this case, Gear wheels on the main shaft and the lay shafts are constantly engaged and the rotary motion is transmitted to the main shaft by engaging dog clutches

# Synchromesh Gear Box

- Similar to constant mesh type, because all the gears on the main shaft are in constant mesh with corresponding gears on the layshaft.
- The gears on the main shaft are free to rotate on it and that on the layshaft are fixed to it.
- Avoids the necessity of double declutching.
- The parts which ultimately are to be engaged are first brought into frictional contact which equalizes their speed, after which these may be engaged smoothly.

## TORQUE CONVERTER

- TC has an engine driven impeller and a turbine connected to gearbox input shaft.
- It is also able to deliver a higher torque than that engine produces, because it is also able to deliver a higher torque and small vane wheel known as reactor(stator).
- A one way clutch (ORC) lock reactor to gear box casing at lower engine speed.
- In a fluid flywheel, oil returning from turbine tends to curb the speed of impeller.
- But in TC, the vanes of locked reactor direct oil along a torque favorable path back to the centre of impeller enabling it to give extra thrust to turbine blades.



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- ▶ **Overdrive** is a device interposed between the transmission (gear box) and propeller shaft to permit the propeller shaft to turn faster than or-over drive the transmission main shaft.
  - ▶ It is so called because it provides a speed ratio over that of the high speed ratio.
  - ▶ The overdrive permits the engine to operate only about 70 percent of the propeller shaft speed, when the vehicle is operating in the high speed ranges.
  - ▶ Overdrive is usually, employed supplementary to conventional transmission.
  - ▶ It is bolted to the rear of the transmission between the transmission and propeller shaft
  - ▶ A slightly higher rear-axle gear ratio is employed with an overdrive than without one.

# Working

- If the car is in overdrive (on a four-speed transmission), the transmission will automatically select the gear based on vehicle speed and throttle pedal position.
- When we accelerate gently, shifts will occur at lower speeds than if accelerate at full throttle.
- When we floor the pedal, the transmission will downshift to the next lower gear.
- When we move the shift selector to a lower gear, the transmission will downshift unless the car is going too fast for that gear. If the car is going too fast, it will wait until the car slows down and then downshift.
- When we put the transmission in second gear, it will never downshift or upshift out of second, even from a complete stop, unless we move the shift lever.

# Advantages

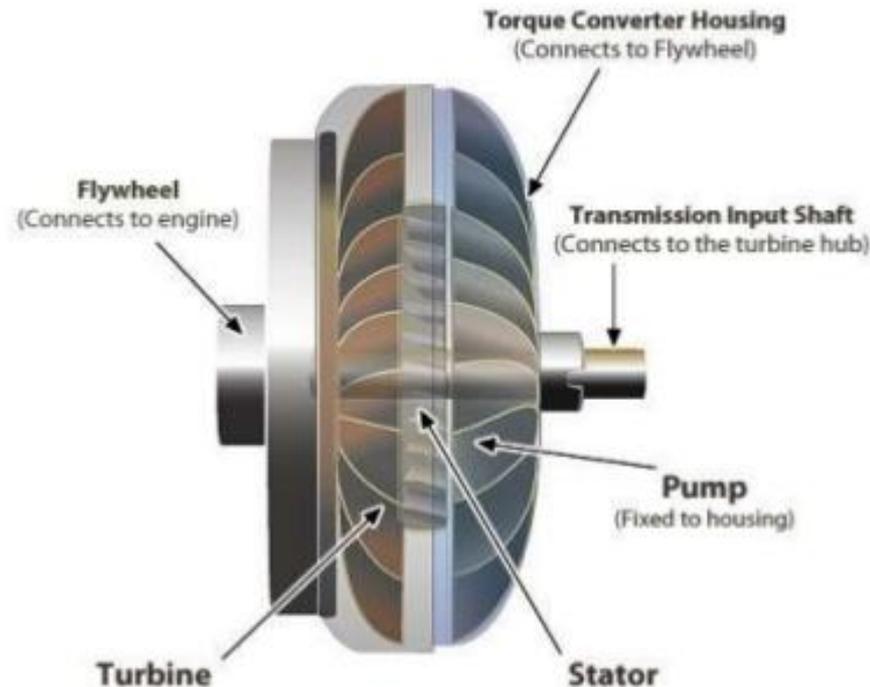
**H**ere are some of the features of an automatic transmission:

- ▶ If the car is in overdrive (on a four-speed transmission), the transmission will automatically select the gear based on vehicle speed and throttle pedal position.
- ▶ If you accelerate gently, shifts will occur at lower speeds than if you accelerate at full throttle.
- ▶ If you floor the gas pedal, the transmission will downshift to the next lower gear.
- ▶ If you move the shift selector to a lower gear, the transmission will downshift unless the car is going too fast for that gear. If the car is going too fast, it will wait until the car slows down and then downshift.
- ▶ If you put the transmission in second gear, it will never downshift or upshift out of second, even from a complete stop, unless you move the shift lever.

**Automated manual transmission (AMT)** is a specific type of semi-**automatic transmission**. It consists of a conventional **manual transmission** with an electronically-controlled hydraulic clutch and computerized gear **shift** control, and the driver can usually override the computer control with a clutch less "**manual**" mode.

## WORKING OF AUTOMATED TRANSMISSION

- Gear selection in automatic transmissions depends on many operational conditions, such as vehicle speed, engine speed, performance mode (where fitted) selected as well as driver assist systems such as traction control, stability control, automatic/autonomous braking and cruise control.



- An **automatic transmission**, also called auto, self-shifting transmission, n speed automatic (where n represents its number of forward gear ratios), or AT, is a type of motor vehicle transmission that automatically changes the gear ratio as the vehicle moves, meaning that the driver does not have to shift the gears ...
- A **continuously variable transmission (CVT)**, also known as a shiftless transmission, stepless transmission, pulley transmission, or, in case of motorcycles, a 'twist-and-go', is an automatic transmission that can change seamlessly through a continuous range of effective gear ratios.

## **Introduction of Propeller Shaft**

- Propeller shaft is connecting the drive from gear box to final drive. Hence it is also called Drive Shaft.

**OR**

- It is the group of parts connecting the transmission with the drive wheels. It consists of propeller shaft (also called Drive Shaft), Universal Joints/Constant Velocity Joints and Slip Joints.

## **Function of Propeller Shaft**

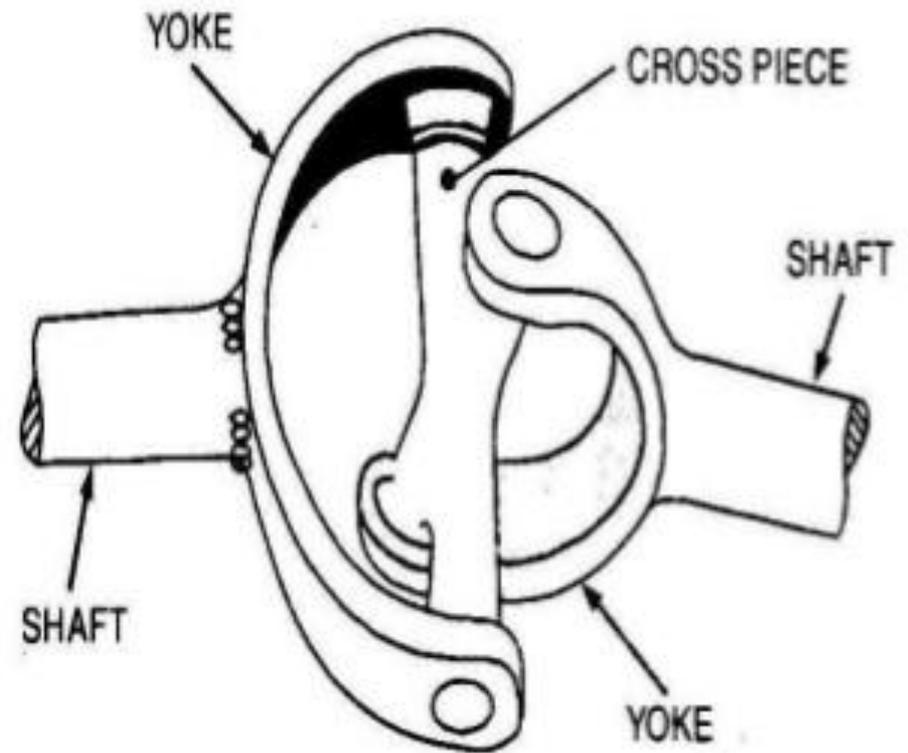
- Propeller shaft take power from the gear box output shaft without making any change in power, it transmits the same to the input pinion of the differential unit, from where power is transmitted to the drive wheels through rear axle.
- To accommodate the change in line and level between gear-box output shaft and differential input pinion shaft.

# PROPELLER SHAFT

- The propeller shaft is a shaft that transmits power from gear box to the differential.
- On one end, propeller shaft is connected to main transmission shaft by universal joint.
- On the other hand, it is connected to differential pinion shaft by another universal joint.
- Propeller shaft transmits the rotary motion of main transmission shaft (coming from gear box) to the differential so that rear wheels can be rotated.
- A sliding (slip) joint, is also fitted between universal joint and propeller shaft on transmission side which takes care of axial motion of propeller shaft.
- Propeller shaft is made of a steel tube which can withstand torsional stresses and vibrations at high speeds.

# Universal Joint

➤ A simple universal joint does not transmit the motion uniformly when the shafts are operating at an angle. Because of this, two universal joints are used in a vehicle, one between the gear box and the propeller shaft and other between the propeller shaft and the differential pinion shaft.





# What is a differential?

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**Differential** is a device capable of transmitting torque and rotation through three shafts, almost always used in one of two ways. In one of these, it receives one input and provides two outputs; this is found in most automobiles. In an automobile and other wheeled vehicles, the differential allows each of the driving wheels to rotate at different speeds, while supplying equal torque to each of them.

## REAR AXLE HOUSING

The rear axles are enclosed in a protective casing known as REAR AXLE HOUSING.

It prevents the axle as well as the differential from dirt, sand and injury.

It also work as a container for the lubricants.



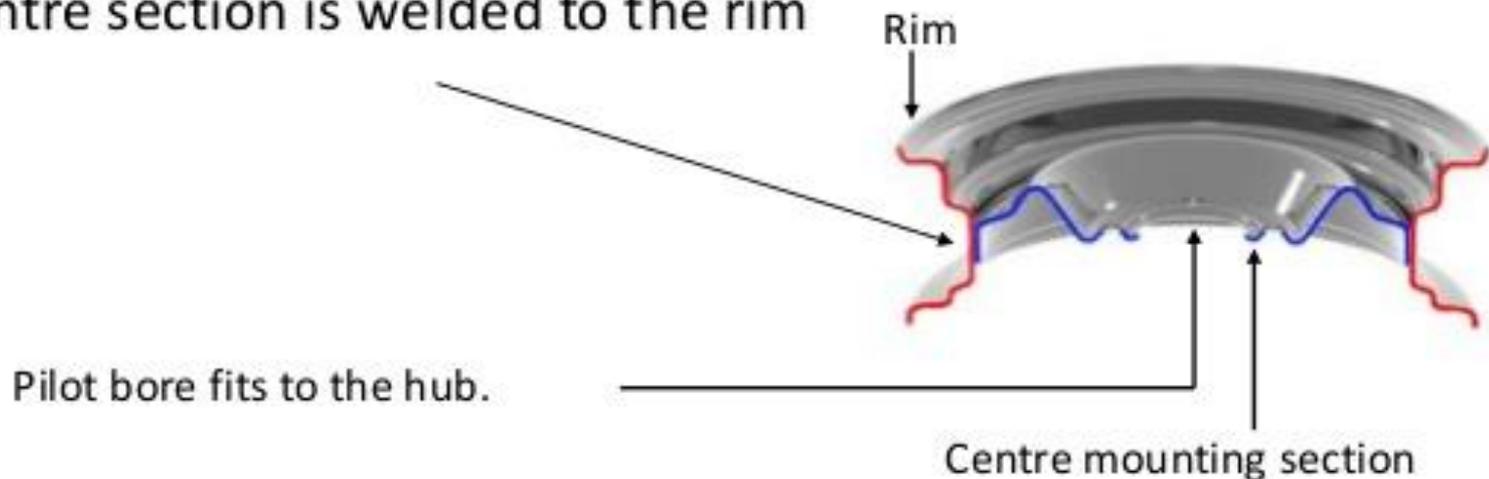
Fig: Mercedes Benz Rear Axle Housing (Banjo Type)

## TYPES OF WHEELS

1. **Steel Wheels (Disc wheel)** – A very popular design of wheel. Very strong and cheap to produce.
2. **Alloy Wheels** – Attractive and light weight, but can be difficult to clean.
3. **Spoke Wheels (Wire wheels)** – Used on older sports vehicles, but cannot be fitted with tubeless tyres.
4. **Divided rims** – the rims are made in two halves which are bolted together, the rims must never be separated while the tyre is inflated.
5. **Split rims** – the tyre is held in place by a large circlip, do not remove the tyre unless you have been properly trained.

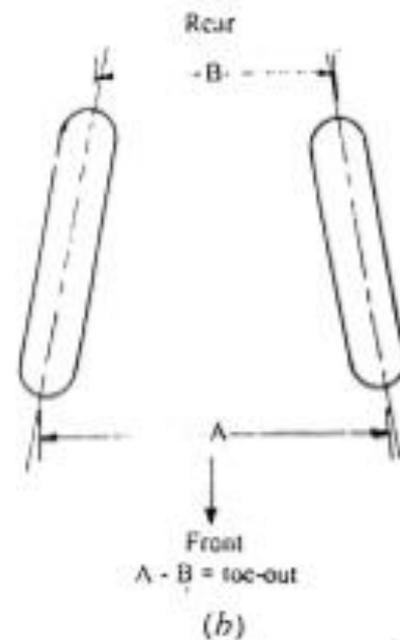
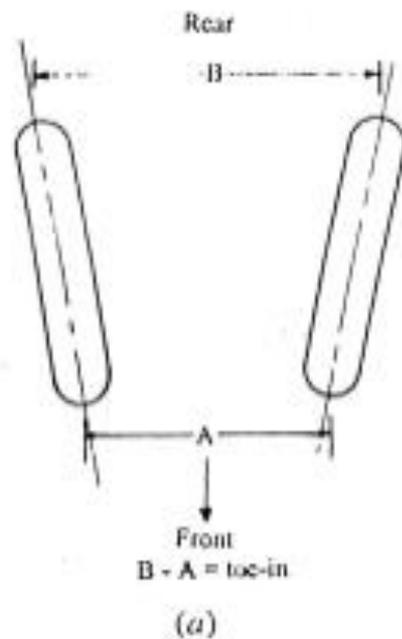
# Wheel - Basics

- Most standard wheels are made of steel.
- Some vehicles are fitted with alloy wheels that are made of magnesium or aluminum
- The rim holds the tyre.
- Well of the wheel allows the tyre to be removed and refitted
- Centre section is welded to the rim



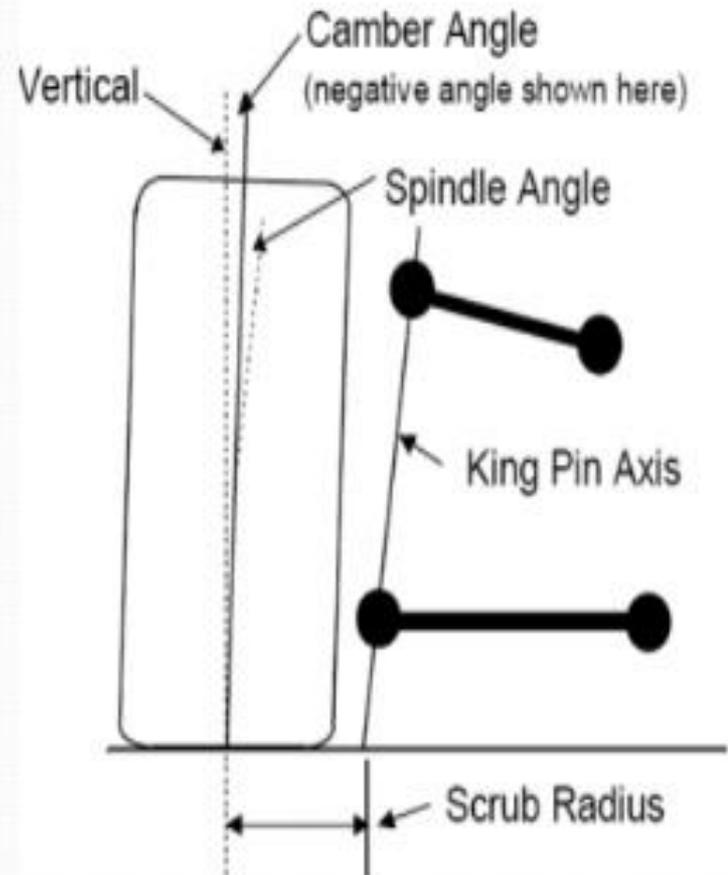
# Toe-in Toe-out

- It is the initial setting of front wheels carried out in a garage
- Here the front wheels are set closer at the front than at the rear – toe in
- If the front of front wheels are far off than rears – toe out



# Camber:-

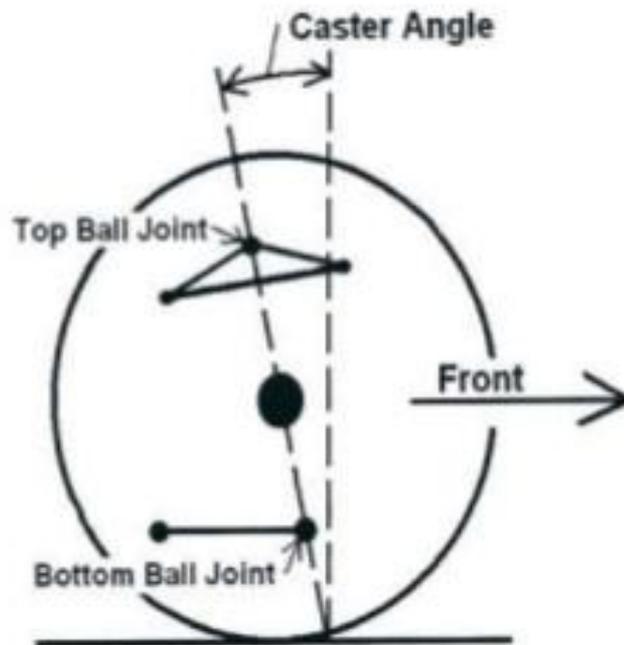
- ✓ Camber angle is the angle between the vertical line and centre line of the tyre when viewed from the front of the vehicle.
- ✓ Camber angle is positive when this is outward. This happens when wheels are further apart at top than at bottom. On the contrary, camber angle is negative when angle is inward. This happens when wheels are further apart at bottom than at top.
- ✓ The camber, should not be more than 2 degree, because this causes uneven or more tyre wear on one side than on other side.



## Caster:-

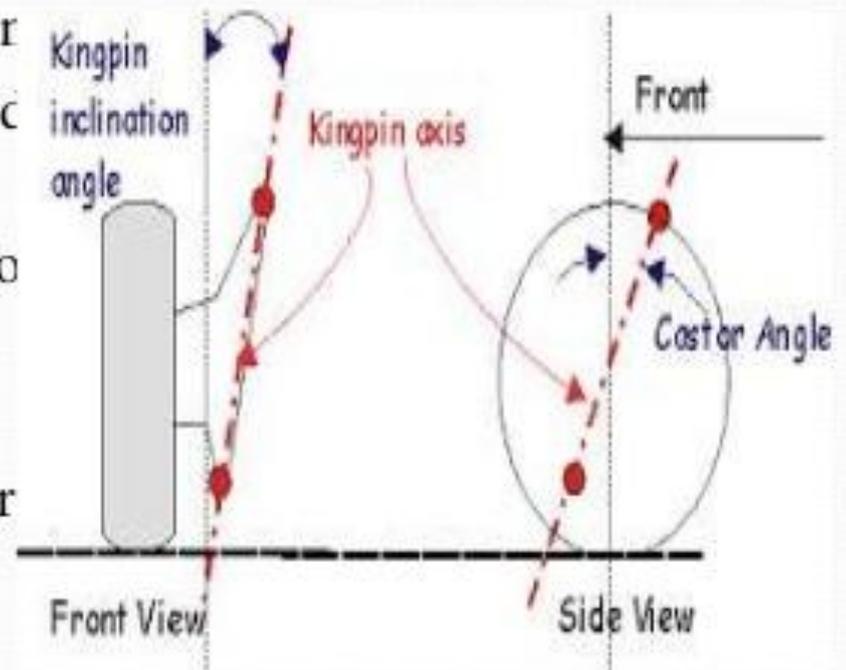
✓ Caster angle is the tilt of king pin centre line towards front of back from the vertical line.

✓ It is the angle between the vertical line and king pin centre line in the wheel plane when looked from side.

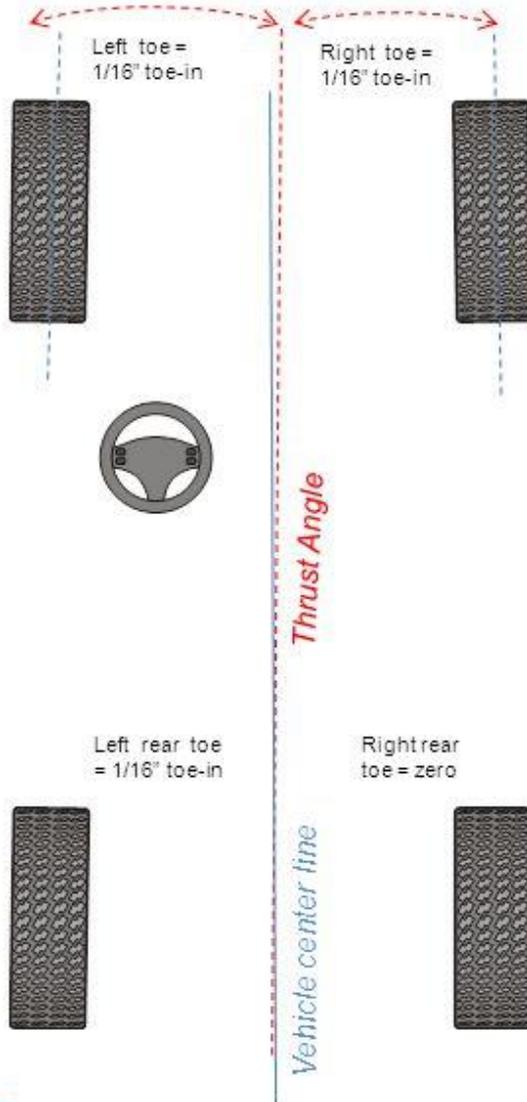


# King pin inclination

- ✓ It is the angle between king pin centre line and vertical line when seen from the front of the vehicle.
- ✓ It is also called steering axle inclination
- ✓ King pin inclination and caster are used to improve directional stability in cars.
- ✓ This is also used to reduce steering effort when steering a stationary
- ✓ it reduces tyre wear.
- ✓ This inclination varies from 4 to 8 degrees in modern cars.



# Four wheel alignment



- If there is rear toe angles exceed the alignment specifications and are adjustable the best procedure is to adjust the rear wheel toe and then adjust the front toe to the new thrust angle.

# Specification of tyres used in Indian vehicles



- A** **Width** of tyre in millimetres
- B** **Profile** height of a tyre sidewall as a percentage of the width
- C** The diameter of the wheels inner **rim** in inches
- D** **Load Index** indicates the maximum load the tyre can carry
- E** Indicates the **maximum speed** for the tyre
- F** The **model name** of the tyre. Unique to each manufacturer
- G** **Maximum load** that the tyre is designed to carry (in both kg and lbs)
- H** **Maximum pressure** that the tyre is designed to be inflated to (in both bar and psi)
- I** **Brand name** of the manufacturer

# Factors affecting tyre life

- Inflation
- Vehicle maintenance
- Manner of driving
- Miscellaneous factors