

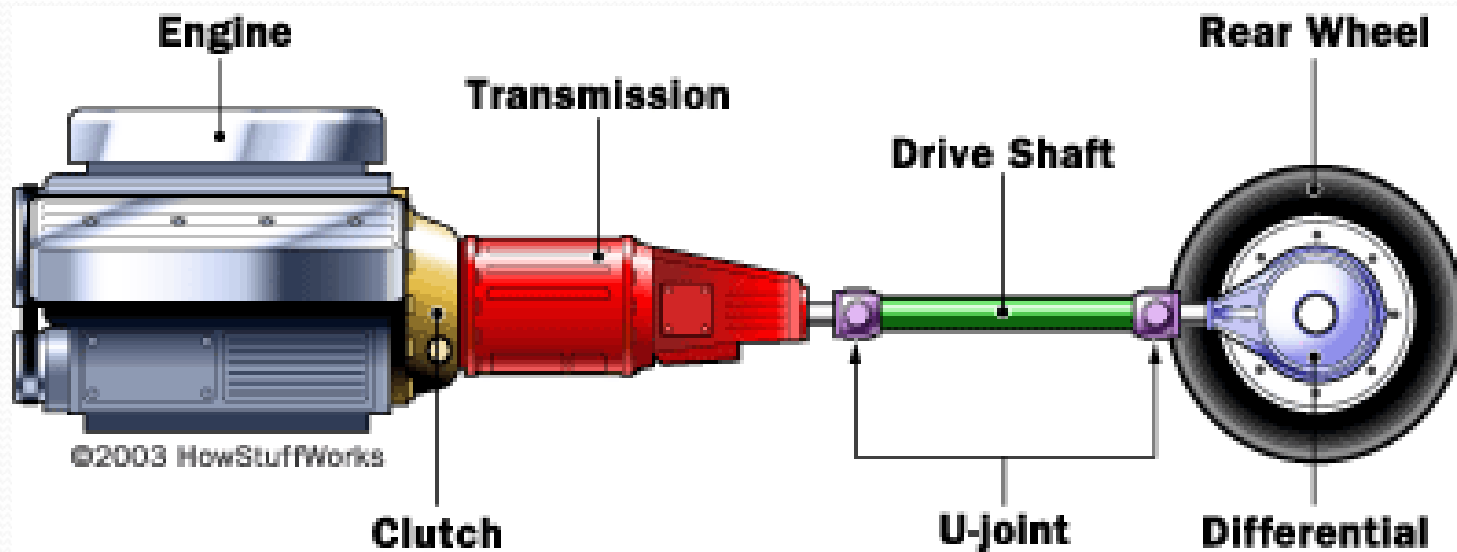
# UNIT - III



# TRANSMISSION

- Transmission means whole mechanism that transmits the power from engine crankshaft to the wheels
- A mechanism which provides us with suitable variation of the engine torque at the road wheels, whenever required.
- This may be a gearbox(manual transmission) or an automatic transmission.







# Functions of Transmission

- Main purpose of transmission is to provide a means to vary torque ratio between the engine and the road wheels as required.
- Transmission also provides a neutral position so that the engine and the road wheels are disconnected even with clutch in engaged position.
- A means to back the car by reversing the direction of rotation of the drive is also provided by transmission.





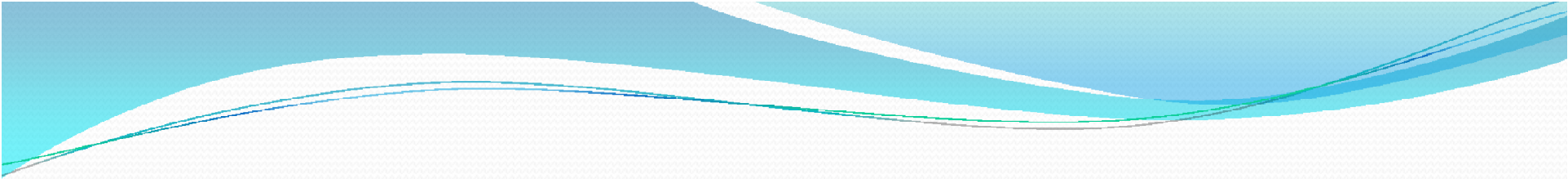
# Necessity of Transmission

- 1. Variation of tractive effort of the vehicle available at various speeds.**
  - (Tractive effort or tractive force is the pulling force exerted by a vehicle, or machine or body.)
- 2. Variation of resistance to the vehicle motion at various speeds**
  - (Resistance may be due to wind , weight of the vehicle, type of road , tyre friction)

## ● **PURPOSE OF GEAR BOX:**

- When a vehicle is starting from rest, accelerating and meeting other resistance, a high tractive effort is required at the driving wheels.
- The tractive effort at the wheels is depended upon the torque developed by the engine which increases, with in limits as the engine speed increases, reading a maximum at some predetermined number of revolution.
- If the engine was coupled directly to driven axle, the engine speed would necessarily below when high driving torque is required. To deal with the problem the engine revolutions are maintained by reduction gears. The reduction gears are enclosed in a metal box called a gearbox



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- The road wheel rotate at lower speed to suit the following operating conditions of the vehicle:
    - 1) Thus by maintaining. the optimum engine speed the gear box can multiply the engine torque to meet the torque requirement at the road wheels.
    - 2) In order to reverse the vehicle the gear box changes the direction of drive from engine to road wheels.
    - 3) The gear box also provides a neutral position so that the clutch may be left in engagement while the engine running.



# TYPES OF TRANSMISSION

- 1) MANUAL TRANSMISSION( Gear boxes)
- 2) AUTOMATIC TRANSMISSION





# MANUAL TRANSMISSION

- Conventionally called gear boxes.
- MECHANICAL Efficiency in direct drive is 98% whereas in reduction gear is slightly greater than 90%.



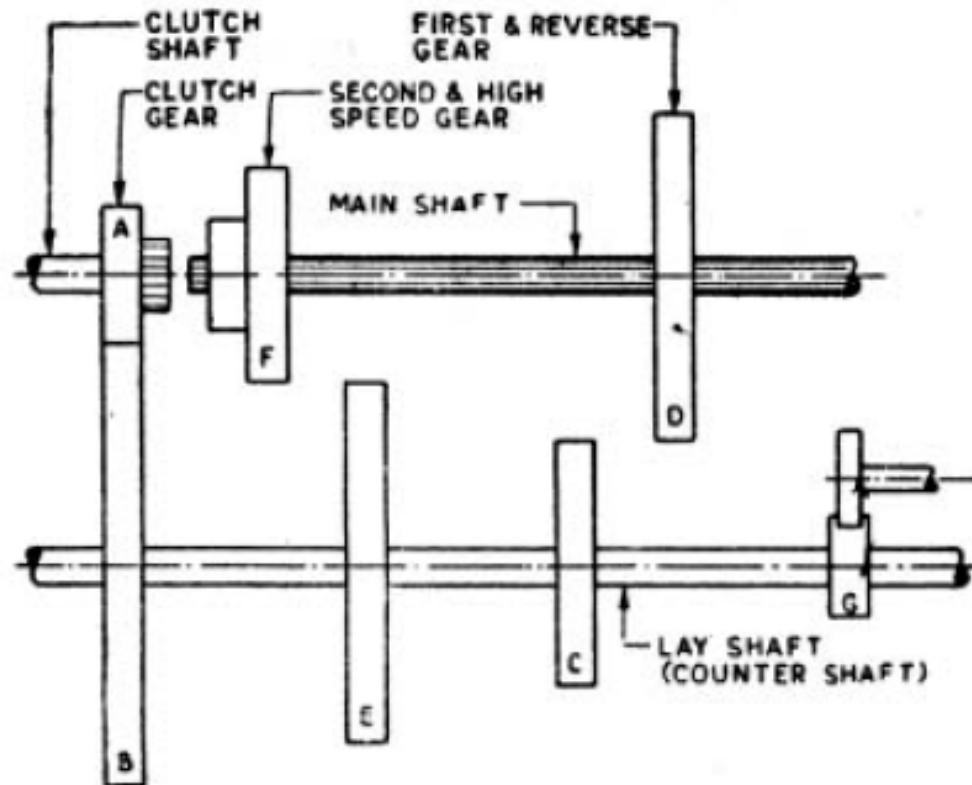
# TYPES OF GEAR BOX

- The gear boxes are classified according to the method of engaging the gears on the main shaft to the gear on the counter shaft:
  1. Sliding mesh type
  2. Constant mesh type
  3. Synchromesh type
  4. Epicyclic gear type



# SLIDING MESH GEAR BOX

- It is the oldest and simplest form of a gear box.

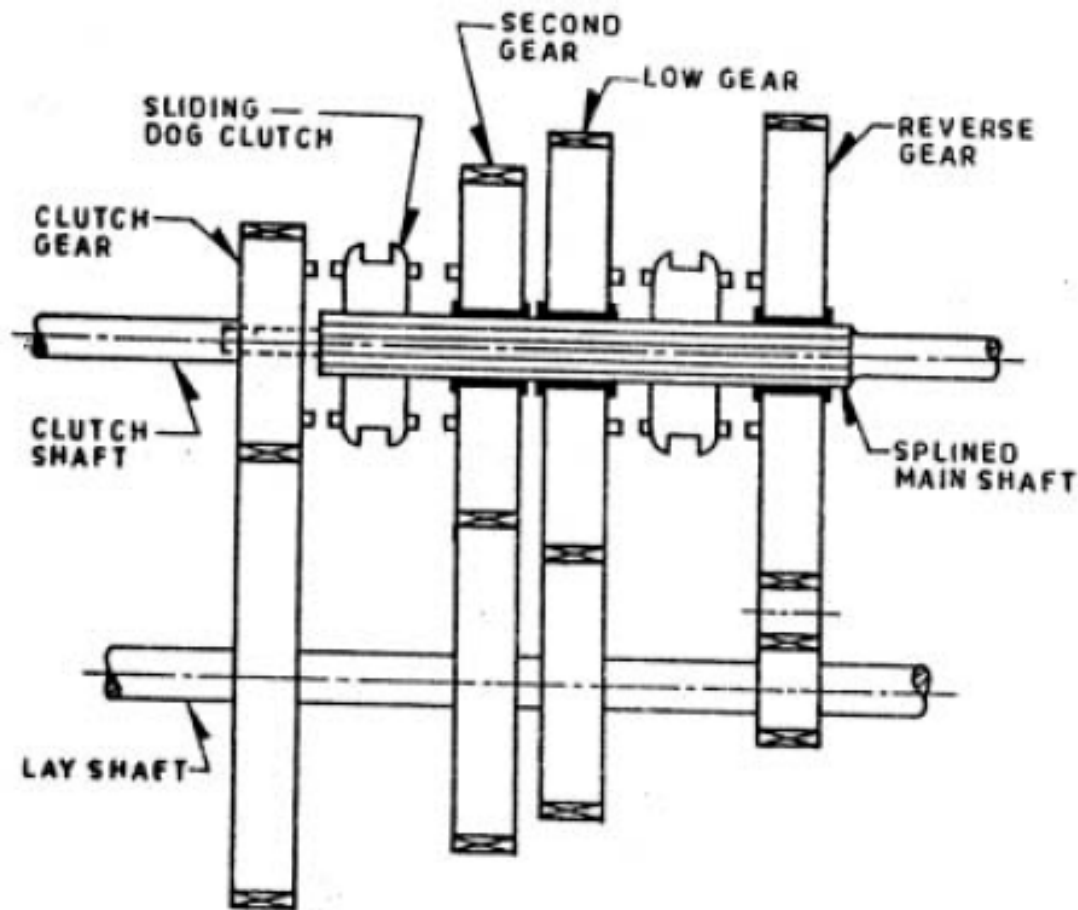


# Sliding Mesh Gear Box

- Simplest type of Gear Box
- Power comes from the engine to the clutch shaft and hence to clutch gear which is always in mesh with a gear on the layshaft.
- All the gears on the layshaft are fixed to it and as such they are all the time rotating when the engine is running and the clutch is engaged
- Three direct and one reverse speed are attained on suitably moving the gear on the main shaft by means of selector mechanism.



# Constant Mesh Gear Box



# Constant Mesh Gear Box

- All the gears are in constant mesh with the corresponding gears on the layshaft.
- The gears on the main shaft are free.
- The dog clutches are provided which are free to slide on the main shaft.
- The gears on the layshaft are fixed.
- When the left dog clutch is slid to left by means of selector mechanism , its teeth are engaged with those on clutch gear and we get the direct gear.
- Same dog clutch when slid to right makes contact with the second gear and second gear is obtained.
- Similarly , the movement of right dog clutch to the left results in low gear and towards right in reverse gear.

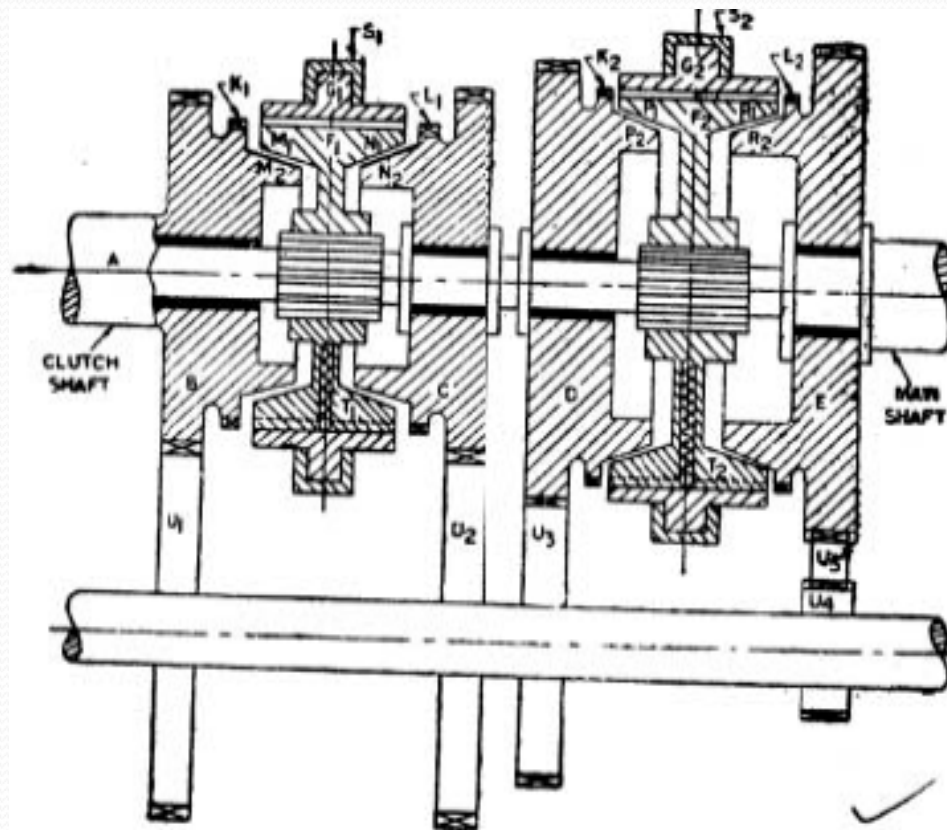




## Advantages ( compared to sliding mesh)

- As the gears have to remain always in mesh, it is no longer necessary to use straight spur gears. Instead **helical gears** are used which are quieter running
- Wear of dog teeth on account of engaging and disengaging is released because here all the teeth of dog clutches are involved compared to only two or three teeth in case of sliding gears

# Synchromesh gear box







# Synchromesh gear box

- The modern cars use helical gears and synchromesh devices in the gear boxes, that synchronize the rotation of gears that are about to be meshed .
- This eliminates clashing of the gears and make gear shifting easier.
- The synchromesh gear box is similar to the constant mesh gear but the synchromesh gear box is provided with a **synchromesh device** by which the two gears to be engaged are first brought into frictional contact which equalizes their speed after which they are engaged smoothly

## *Epicyclic Gear train*

Epicyclic means one gear revolving upon and around another. The design involves planet and sun gears as one orbits the other like a planet around the sun. Here is a picture of a typical gear box.

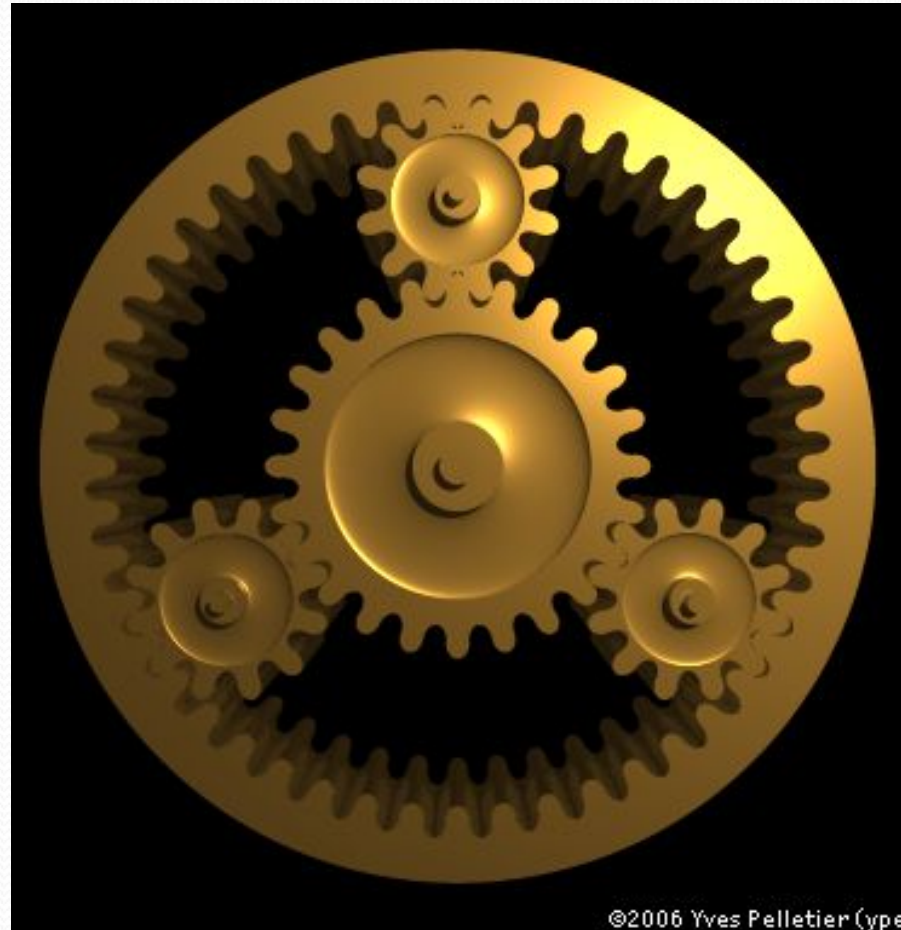


This design can produce large gear ratios in a small space and are used on a wide range of applications from marine gearboxes to electric screw drivers.



## *Epicyclic Gear train*

A small gear at the center called the sun, several medium sized gears called the planets and a large external gear called the ring gear.



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## *Epicyclic Gear train*

Planetary gear trains have several advantages. They have higher gear ratios. They are popular for automatic transmissions in automobiles. They are also used in bicycles for controlling power of pedaling automatically or manually. They are also used for power train between internal combustion engine and an electric motor.



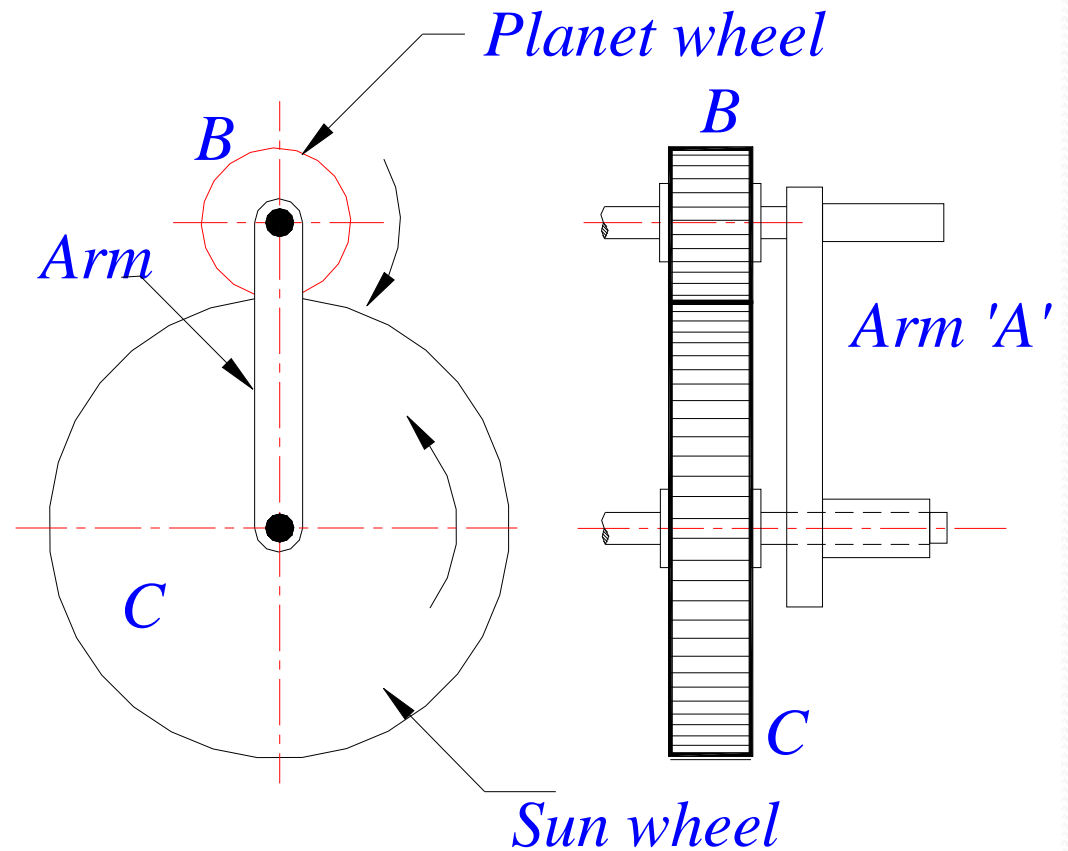
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# Epicyclic Gear train

## Basic Theory

The diagram shows a gear B on the end of an arm. Gear B meshes with gear C and revolves around it when the arm is rotated. B is called the planet gear and C the sun.







# Epicyclic gear box

- Epicyclic gearing, which is also known as planetary gearing, works like a miniature solar system of metal gears revolving around a central gear.
- These planetary gears often are placed inside the circumference of a much larger gear. The larger surrounding gear is stationary, which by design holds together all the inner gears and keeps them in balance.
- The epicyclic gearbox is used in a number of applications, including wheelchairs, cars and golf carts

# EPICYCLIC GEAR BOX

- Consist of two , three or even four epicyclic or planetary gear sets.
- A simple gear set has a sun gear, about which planets turn around.
- These planet gears are carried by a carrier and a shaft and are also in mesh internally with a ring gear, which is also called annulus or internal gear.
- Different torque ratios i.e. speed ratios are obtained by making any one of the parts viz. the sun gear , the planets and annulus stationary.





## Controls in epicyclic gear box

- There are two controls i.e. brake and the clutch
- The brake is in the form of a band that surrounds a drum attached to the gear. The clutch used is of multiplate type.
- Both the brake and the clutch are applied by fluid pressure.
- These are selected by hydraulic shift valves which are usually located in the bottom of the gear box



# Advantage of epicyclic gear box

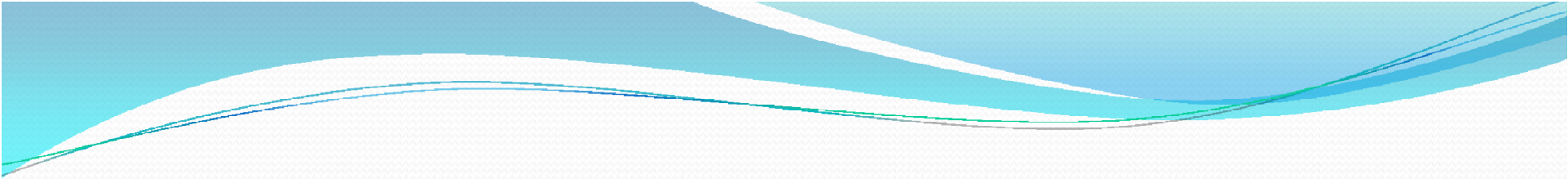
- All the gears are in constant mesh and to engage any desired gear one simply has to apply the particular brake or clutch.
- The drive from the engine need not to be disconnected as in case of ordinary crash type gear box.
- The gear changing operation thus becomes very easy with an epicyclic gear box, which makes it suitable for use in automatic transmission.





# Automatic Transmissions

- There is no clutch pedal in an automatic transmission car.
- There is no gear shift in an automatic transmission car. Once you put the transmission into drive, everything else is automatic.
- Both the automatic transmission (plus its torque converter) and a manual transmission (with- its clutch) accomplish exactly the same thing, but they do it in totally different ways

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- In manual transmissions, you know that an engine is connected to a transmission by way of a clutch. Without this connection, a car would not be able to come to a complete stop without killing the engine.
  - But cars with an **automatic transmission** have no clutch that disconnects the transmission from the engine. Instead, they use an amazing device called a **torque converter**





# Purpose of an Automatic Transmission

- Just like that of a manual transmission, the automatic transmission's primary job is to allow the engine to operate in its narrow range of speeds while providing a wide range of output speeds.
- The key difference between a manual and an automatic transmission is that the manual transmission locks and unlocks different sets of gears to the output shaft to achieve the various gear ratios, while in an automatic transmission, the same set of gears produces all of the different gear ratios. The planetary gearset is the device that makes this possible in an automatic transmission.



# Overdrives

- Overdrive is a device to **step up the gear ratio** in the car, it is fitted in between transmission and propeller shaft.
- It enables a high cruising speed to be obtained with comparatively low engine speed on long journeys. ( up to about 20-25%less)
- This results in less wear of the engine parts and decrease vibration and noise.
- As the friction losses at low speeds are less , there is saving of fuel also with the use of overdrive
- Overdrives are generally fitted on top gear only but in some sports cars , over drives are also fitted on gears other than the top gear which increases the torque ratios available



# Working of overdrive

- It consists of an epicyclic gear train in which sun gear is free to rotate on input shaft while the carrier can move on splines on input shaft.
- A freewheel clutch is also fitted on the input shaft splines. The output shaft is connected to the ring
- When the sun gear is locked with the casing i.e. it becomes stationary, the speed of Outputshaft is increased and **overdrive is engaged**.
- When sun gear is locked to the carrier or to the ring , **Normal direct drive** is obtained



# Control of the overdrive

- Engaging the overdrive or coming out of it is done by the movement of pedal operated by means of solenoid energized and controlled with a centrifugal governor.

1) Engaging the overdrive

2) Coming out of the overdrive



## Engaging the overdrive

- Overdrive can be engaged only above a certain minimum speed, called the cut-in speed, which is usually in the range of 30-50km/hr.
- The driver has to raise his foot off the accelerator pedal momentarily (with the overdrive in 'ON' position) as a result of which engine speed decreases.
- The centrifugal governor, above the cut-in speed closes an electrical circuit which energizes the solenoid.
- As a result the sun gear and sun gear control plate slows down and ultimately reverses the direction, at this moment the baffle ring also reverses through a certain angle and thus no longer blocks the pawl, which now engages the sun gear control plate and prevents its rotation, thereby locking the sun gear. The car is thus put into the overdrive.



# Advantages of overdrive

- Quieter driving will be possible
- Fuel consumption will be less
- Engine life will be prolonged





# Torque convertor

- A torque converter is a device which performs a function similar to that of a gear box i.e. to increase the torque while reducing speed.
- Whereas gearbox provides only a small number of ratio , the torque convertor provides a continuous variation of ratio from the lowest to highest.
- A torque convertor is designed to obtain a mechanical advantage or gear ratio by hydraulic means in the same manner as gears do by mechanical means.



# Construction

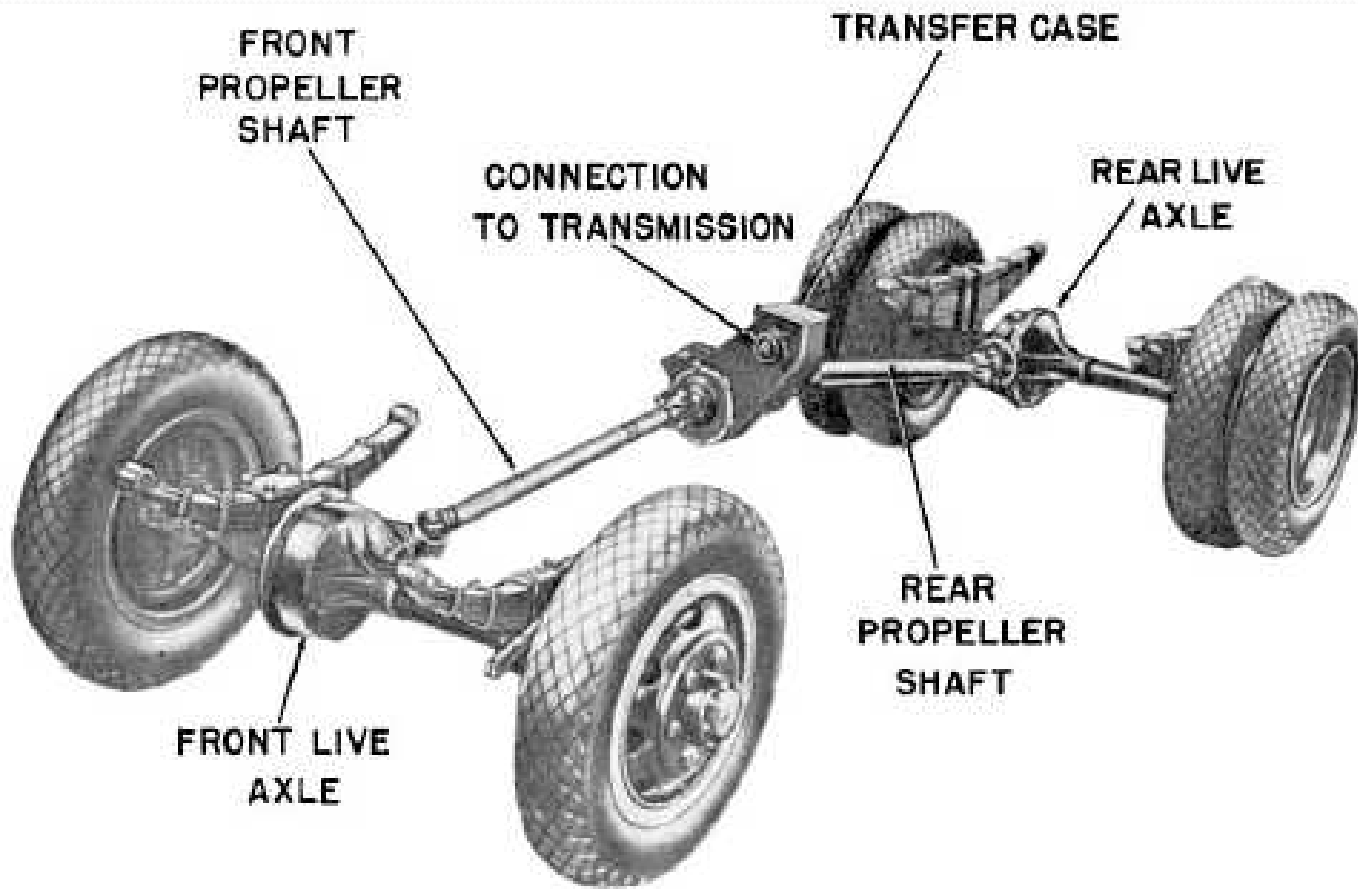
- The construction of torque converter is similar to that of fluid flywheel. The only difference is it has an additional stationary member called stator or the reaction member. It consists of three principal members.
  - 1) Driving member or impeller or pump, which is connected to the engine.
  - 2) Driven member or rotor or turbine which is connected to the propeller shaft.
  - 3) Stationary members or reaction member or stator which is fixed to the frame. It is the member which makes it possible to obtain a change of torque between input and output shafts. The stator is mounted on a free-wheeling one-way clutch so that it can turn in only one direction. A stationary shaft called the reaction shaft extends from the geared transmission in back of the converter through the pump to support the stator.





# TRANSFER CASE

- A **transfer case** is a part of a four wheel drive system found in four wheel drive and all wheel drive vehicles. The transfer case is connected to the transmission and also to the front and rear axles by means of drive shafts. It is also referred to as a "transfer case", "transfer gearbox" and "transfer box"
- The transfer box enables the driver to:
  - I. Drive in two wheel drive on highways or shift to four wheel drive for cross country operation.
  - II. To drive in high gear or low gear as required.



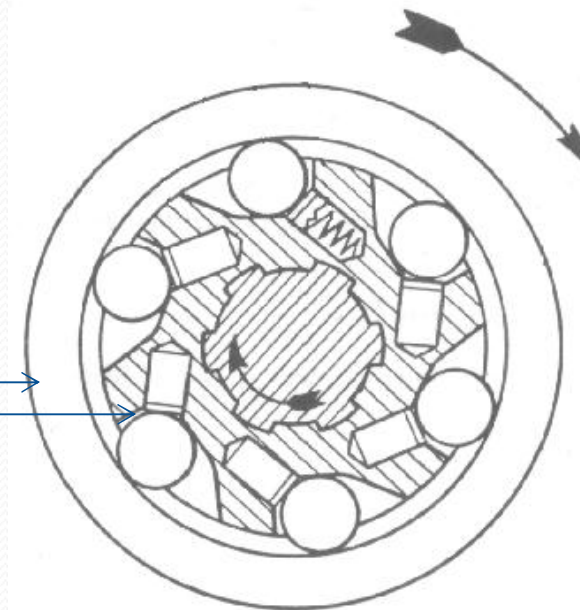


# Freewheel Unit

- Also called freewheel clutch, is provided just after the gear box.
- **Freewheel** or **overrunning clutch** is a device in a transmission that disengages the driveshaft from the driven shaft when the driven shaft rotates faster than the driveshaft.

Driven member

Driving Member





- **CONSTRUCTION :**

- The inner driving member is connected to the gear box shaft and the outer one to the propeller shaft.
- When the driving member is rotating , the driven member will also be rotating in same direction.
- But when the driven member becomes the driving member e.g. when the car is going downhill with the engine stopped or clutch disengaged, the inner member will not rotate along with the outer one.
- This results in fuel economy
- In some instances , the freewheel has to be locked ,
- Ex in reverse drive. In such cases the provision of locking the free wheel drive is there.
- There is a dog clutch provided whose teeth can engage with the teeth on inside of the outer free-wheel member. The dog clutch is automatically engaged by a connection from the reverse gear selector.





- **Advantages:**

- The engine can idle simply by closing the throttle without bringing the gears in neutral. Thus gear changing at low speeds is much simplified as the clutch need not to be disengaged for this purpose.
- Less wear on transmission whenever the car free wheels, the engine and the gear box are disconnected from the propeller shaft
- On long downward slopes appreciable amount of fuel is saved.( saving may be up to 20%)



# Disadvantage

- As there is no resistance due to engine and gear box friction while freewheeling , the brakes must be used more effectively to stop the vehicle on a downward slope.