

# Unit : 04

## 1) Explain in detail sliding mesh gear box

A sliding mesh gearbox is a type of manual transmission used in automobiles and other vehicles. In this type of gearbox, the gears are mounted on separate shafts and the driver selects the desired gear by sliding them into mesh with the corresponding gear on the output shaft. Here are the construction, working, advantages, and disadvantages of a sliding mesh gearbox in detail:

### **Construction :**

A sliding mesh gearbox consists of a set of gears, shafts, and bearings that are mounted inside a housing. The gears are arranged in pairs, with each pair being mounted on a separate shaft. The shafts are supported by bearings and are arranged in parallel or at an angle to each other. The gearshift lever operates a set of selector forks that slide the gears along the shafts to engage them with the corresponding gear on the output shaft.

### **Working :**

In a sliding mesh gearbox, the gears are not always in mesh with each other. The driver selects the desired gear by moving the gearshift lever, which moves the selector forks to engage the corresponding gear pair. When the gears are engaged, the input shaft and the output shaft rotate at different speeds depending on the gear ratio, and the clutch is used to disengage the gears when changing gears or coming to a stop.

### **Advantages :**

**Wide range of gear ratios:** Sliding mesh gearboxes offer a wider range of gear ratios compared to constant mesh gearboxes, providing better performance and fuel efficiency.

**Smoother gear changes:** They provide smoother gear changes since the gears are not always in mesh, allowing for a more comfortable driving experience.

**Cost:** They are less expensive to manufacture than constant mesh gearboxes since they have fewer gears and a simpler design.

**Easy to shift:** Sliding mesh gearboxes are easier to shift compared to constant mesh gearboxes since the gears are not always in mesh.

**Durability:** They are durable and can handle high torque loads, making them suitable for heavy-duty applications.

### **Disadvantages :**

**Noise:** They produce more noise than other types of gearboxes since the gears must be brought into mesh when shifting gears.

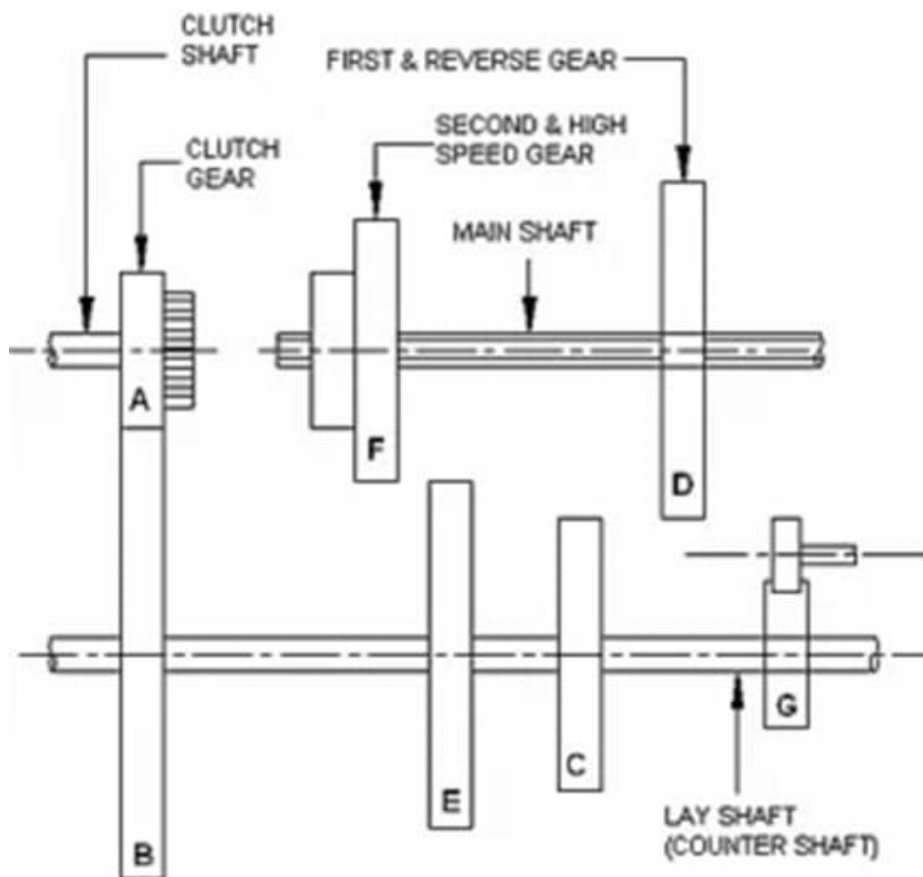
**Complexity:** They are more complex than constant mesh gearboxes, requiring more gears and a more sophisticated selector mechanism.

**Maintenance:** They require more maintenance since the gears are subject to wear and must be replaced periodically.

**Gear clash:** If the gears are not engaged correctly, it can cause a loud "clash" sound and damage the gearbox.

**Difficult to repair:** They are more difficult to repair than constant mesh gearboxes due to their more complex design and the need for precision in their construction.

Overall, sliding mesh gearboxes offer a wider range of gear ratios and smoother gear changes compared to constant mesh gearboxes. However, they have some disadvantages, such as increased noise and complexity, which must be considered when selecting a gearbox for a vehicle.



## 2) Describe constant mesh gearbox in detail.

A constant mesh gearbox is a type of manual transmission used in automobiles and other vehicles. In this type of gearbox, the gears are always in mesh with each other, and the driver selects the desired gear by sliding a selector collar along the gear shaft to engage the appropriate gear pair. Here are the construction, working, advantages, and disadvantages of constant mesh gearbox in detail:

**Construction :**

A constant mesh gearbox consists of a set of gears, shafts, and bearings that are mounted inside a housing. The gears are arranged in pairs, with each pair being mounted on a common shaft. The shafts are supported by bearings and are arranged in parallel or at an angle to each other. The selector mechanism is attached to the gearshift lever and operates the selector collar, which slides along the gear shaft to engage the appropriate gear pair.

### **Working :**

In a constant mesh gearbox, the gears are always in mesh with each other, but only one pair of gears is engaged at any given time. The driver selects the desired gear by moving the gearshift lever, which moves the selector collar along the gear shaft. The selector collar has dog teeth on its outer surface, which engage with corresponding slots on the gear pair to lock them together. The gears on the input shaft and the output shaft rotate at different speeds depending on the gear ratio, and the clutch is used to disengage the gears when changing gears or coming to a stop.

### **Advantages :**

**Durability:** Constant mesh gearboxes are very durable due to their simple design, with fewer moving parts compared to other types of gearboxes.

**Smooth operation:** Constant mesh gearboxes provide smooth gear changes, allowing for a more comfortable driving experience.

**Efficiency:** They are efficient and provide better fuel economy since there is less power loss due to friction and slippage.

**High torque capacity:** Constant mesh gearboxes have a high torque capacity, making them suitable for high-performance vehicles.

**Easy to repair:** They are easy to repair and maintain since their design is simple, and the parts are readily available.

### **Disadvantages :**

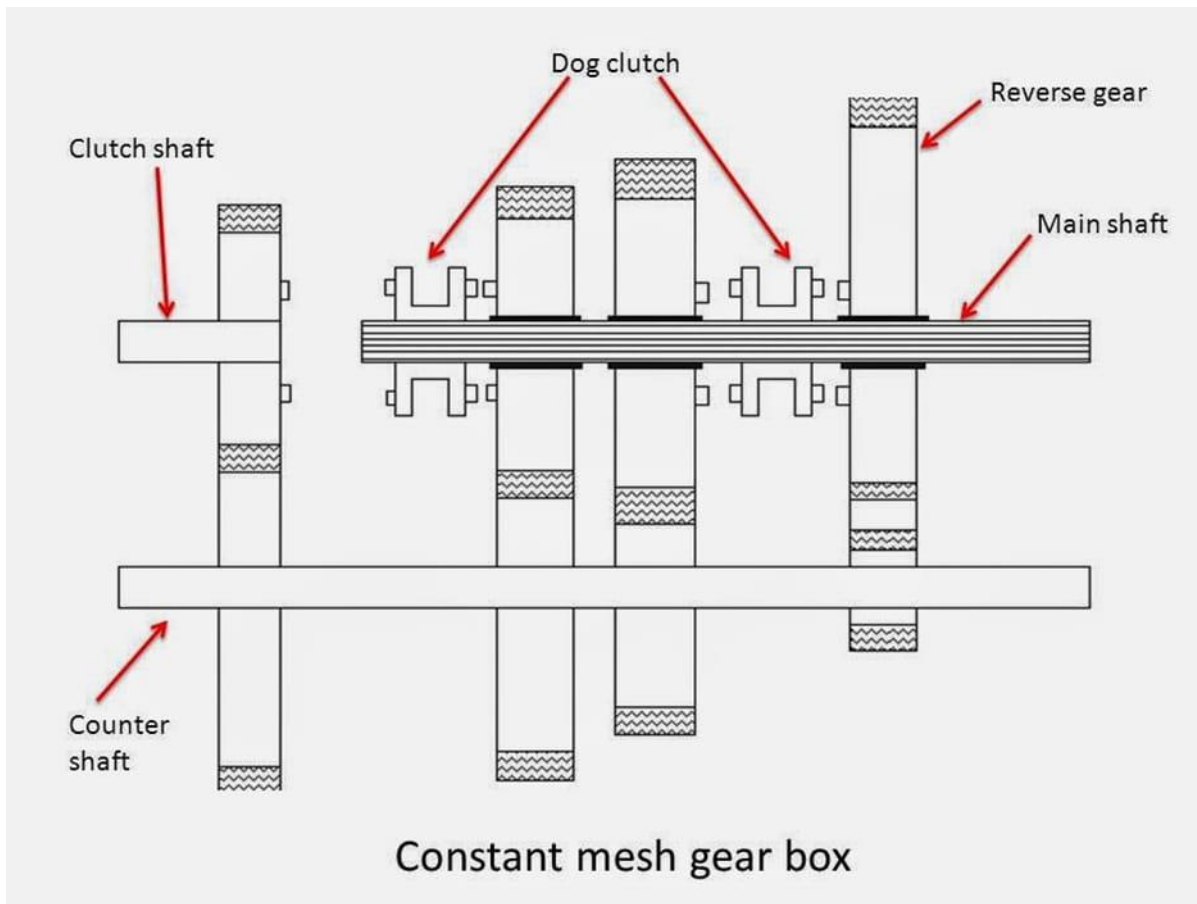
**Noise:** Due to the constant mesh of gears, constant mesh gearboxes produce a lot of noise when in operation.

**Cost:** The manufacturing and maintenance of constant mesh gearboxes can be expensive due to the precision required in their construction.

**Limited gear ratios:** Constant mesh gearboxes have limited gear ratios compared to other types of gearboxes, which can limit the performance and fuel efficiency of the vehicle.

**Shifting difficulty:** Constant mesh gearboxes require more skill and effort to shift, especially when compared to automatic transmissions.

**Gear clash:** If the gears are not engaged correctly, it can cause a loud "clash" sound and damage the gearbox.



### 3) Write a note on synchromesh gearbox

A synchromesh gearbox is a type of manual transmission used in automobiles and other vehicles. In this type of gearbox, the gears are mounted on separate shafts and are brought into mesh with each other using a synchromesh mechanism. Here are the construction, working, advantages, and disadvantages of a synchromesh gearbox in detail:

#### **Construction :**

A synchromesh gearbox consists of a set of gears, shafts, and bearings that are mounted inside a housing. The gears are arranged in pairs, with each pair being mounted on a separate shaft. The shafts are supported by bearings and are arranged in parallel or at an angle to each other. The gearshift lever operates a set of selector forks that move the gears along the shafts to engage them with the corresponding gear on the output shaft. The synchromesh mechanism consists of a cone-shaped friction surface, which is mounted on the input shaft, and a similar friction surface mounted on the output shaft.

#### **Working :**

In a synchromesh gearbox, the gears are brought into mesh using the synchromesh mechanism. When the driver selects a gear, the synchromesh mechanism slows down the input shaft until it matches the speed of the output shaft. Once the speeds are matched, the driver can engage the gear without the gears clashing or grinding. The synchromesh mechanism also helps to reduce the wear on the gears and allows for smoother gear changes.

## Advantages :

Smooth gear changes: Synchromesh gearboxes provide smooth gear changes since the synchromesh mechanism allows the gears to mesh smoothly without grinding or clashing.

Durability: They are durable and can handle high torque loads, making them suitable for heavy-duty applications.

Efficiency: Synchromesh gearboxes provide better fuel efficiency compared to sliding mesh gearboxes due to the reduced friction in the synchromesh mechanism.

Easy to use: They are easy to use and require less effort to shift gears compared to sliding mesh gearboxes.

Maintenance: They require less maintenance compared to sliding mesh gearboxes since the synchromesh mechanism reduces wear and tear on the gears.

## Disadvantages :

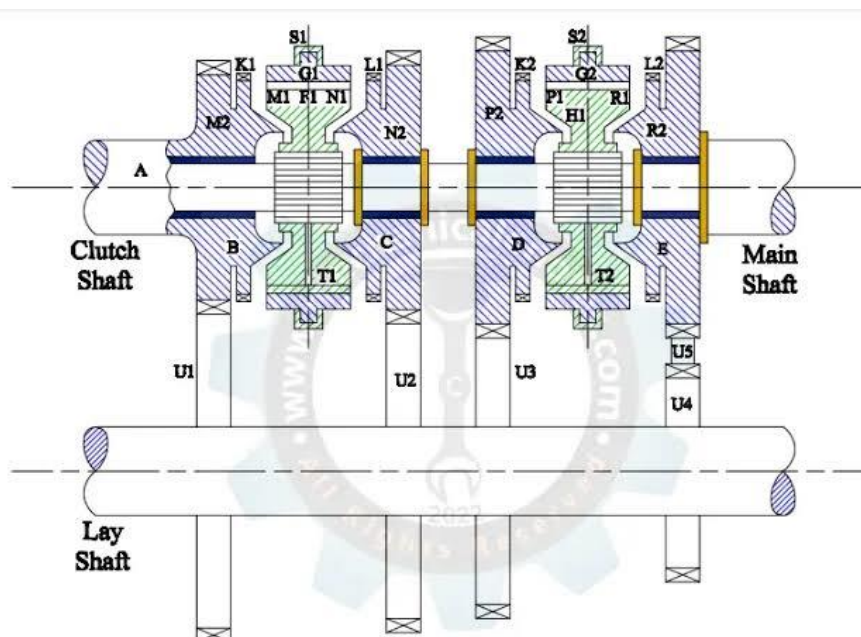
Cost: Synchromesh gearboxes are more expensive to manufacture compared to sliding mesh gearboxes due to the complex synchromesh mechanism.

Complexity: They are more complex than sliding mesh gearboxes due to the synchromesh mechanism, which requires more gears and a more sophisticated selector mechanism.

Noise: They can produce some noise when the synchromesh mechanism is engaged, although it is generally less than sliding mesh gearboxes.

Not suitable for heavy loads: They are not suitable for heavy loads since the synchromesh mechanism is not as strong as the gears themselves.

Difficulty in repairing: They can be more difficult to repair compared to sliding mesh gearboxes due to the complexity of the synchromesh mechanism.



## **4) What are the various functions of transmission.**

The transmission is an essential component of a vehicle's drive train, responsible for transmitting power from the engine to the wheels. Here are the various functions of a transmission:

1. Providing torque multiplication: The transmission allows the engine to operate within its optimum power range by providing torque multiplication through the use of gears. This helps the vehicle to accelerate and climb hills more efficiently.
2. Selecting gears: The transmission allows the driver to select the appropriate gear ratio for the driving conditions. Different gear ratios provide different levels of torque multiplication and speed, allowing the vehicle to operate more efficiently.
3. Modifying torque: The transmission can modify torque output to match the driving conditions. For example, the transmission can downshift to provide more torque for climbing a hill or upshift to reduce engine speed and increase fuel efficiency on a highway.
4. Enabling reverse gear: The transmission allows the vehicle to move in reverse by engaging a reverse gear.
5. Providing a neutral position: The transmission provides a neutral position that disengages the engine from the drivetrain, allowing the vehicle to coast without power from the engine.
6. Enabling the use of overdrive: Many transmissions feature an overdrive gear that allows the engine to operate at a lower RPM at highway speeds, reducing fuel consumption and engine wear.
7. Smooth power transfer: The transmission helps to provide smooth power transfer from the engine to the wheels, reducing vibration and noise.

## **5) List down the requirement of transmission.**

The transmission is an essential component of a vehicle's drivetrain, responsible for transmitting power from the engine to the wheels. Here are the basic requirements of a transmission:

1. Torque capacity: The transmission must be able to handle the maximum amount of torque generated by the engine without slipping or overheating.
2. Gear ratio range: The transmission must provide a range of gear ratios that allow the vehicle to operate efficiently at different speeds and under different driving conditions.
3. Smooth shifting: The transmission should provide smooth and precise shifting, with minimal noise, vibration, and harshness.

4. Durability: The transmission should be durable and able to withstand the stresses and strains of regular use, with minimal maintenance and repairs.
5. Efficiency: The transmission should be efficient, providing good fuel economy, low emissions, and reduced wear on the engine and drivetrain.
6. Compactness: The transmission should be compact and lightweight, to minimize the space required and reduce overall vehicle weight.
7. Reliability: The transmission should be reliable, with minimal risk of breakdown or failure, to ensure the safe and efficient operation of the vehicle.

## 6) what are the type of transmission.

There are several types of transmission used in automobiles. Some of the common types are:

**Manual Transmission:** Also known as a standard or stick-shift transmission, it requires the driver to manually shift the gears using a clutch pedal and gear stick. Manual transmissions are simple, efficient, and offer greater control over the vehicle's power output.

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1. **Automatic Transmission:** An automatic transmission shifts gears automatically without requiring the driver to manually engage a clutch or shift gears. The transmission uses a torque converter to transfer power from the engine to the transmission, and then to the wheels.
  2. **Continuously Variable Transmission (CVT):** A CVT uses a belt or chain to transfer power from the engine to the wheels. Unlike traditional transmissions, a CVT offers an infinite number of gear ratios, making it more efficient and smoother to operate.
  3. **Dual-Clutch Transmission (DCT):** A DCT uses two separate clutches, one for even-numbered gears and another for odd-numbered gears. This allows for smoother, quicker shifts and greater fuel efficiency.
  4. **Automated Manual Transmission (AMT):** An AMT is similar to a manual transmission but uses an automated clutch and gear-shifting mechanism. The driver can select the gear using paddle shifters or a gear lever, but the transmission engages and disengages the clutch automatically.
  5. **Semi-Automatic Transmission:** A semi-automatic transmission is a combination of a manual and automatic transmission. The driver can manually shift gears using a gear lever or paddle shifters, but the clutch is operated automatically.
  6. **Electric Vehicle Transmission:** Electric vehicles use a single-speed transmission that doesn't require shifting. The motor's power output is controlled by an inverter, which converts the battery's DC power to AC power to drive the motor.
  7. Each type of transmission has its advantages and disadvantages, depending on the vehicle's application, driving style, and efficiency requirements.
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## 7) What are the various function of differential.

Differential plays an essential role in the functioning of automobiles, especially in their drive train. Some of the functions of differential in automobiles are :

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1. Providing torque to wheels: The differential transfers torque from the engine to the wheels. It allows the wheels to rotate at different speeds, which is necessary when turning corners.
  2. Reducing tire wear: The differential allows the outer wheels to rotate faster than the inner wheels when turning corners. This reduces tire wear and tear, making the tires last longer.
  3. Enhancing traction and stability: The differential transfers power to the wheels that have better traction. It ensures that the wheels rotate at different speeds, preventing them from slipping or skidding.
  4. Regulating vehicle speed: The differential allows the wheels to rotate at different speeds, depending on the terrain and driving conditions. This ensures that the vehicle maintains a steady speed and does not lose control.
  5. Improving fuel efficiency: The differential ensures that the engine's power is used efficiently by transferring torque to the wheels with better traction. This reduces the energy wasted on spinning wheels, improving fuel efficiency.
  6. Reducing stress on the drive train: The differential reduces stress on the drive train by allowing the wheels to rotate at different speeds. This prevents unnecessary wear and tear on the drive train components.
  7. Overall, differential is a crucial component in the drive train of automobiles, which allows for smooth and efficient operation, better traction, and stability.
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## 8) List down various requirements differential.

The differential is a crucial component in the drive train of automobiles, and it has several requirements to ensure smooth and efficient operation. Some of the requirements of differential in automobiles are:

**Torque transfer:** The differential should be able to transfer torque from the engine to the wheels efficiently, regardless of the driving conditions.

**Speed variation:** The differential should allow the wheels to rotate at different speeds when turning corners, ensuring that the vehicle maintains stability and control.

**Traction control:** The differential should be able to transfer power to the wheels with better traction, preventing wheel slip and skid and ensuring that the vehicle maintains traction on the road.

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**Durability:** The differential should be designed to withstand the stresses and strains of regular use, including high-speed driving, towing, and off-road use.

**Smooth operation:** The differential should operate smoothly and quietly, without excessive vibration, noise, or harshness.

**Maintenance:** The differential should be easy to maintain and service, with readily available replacement parts.

**Fuel efficiency:** The differential should be designed to maximize fuel efficiency by reducing energy wasted on spinning wheels or unnecessary friction.

Overall, the differential plays a critical role in the drivetrain of automobiles, and it should be designed to meet these requirements to ensure smooth and efficient operation of the vehicle.

## **9) Write in detail about the working mechanism of differential.**

The differential is a mechanism that allows the wheels of an automobile to rotate at different speeds while transferring power from the engine to the wheels. It is located between the drive wheels, and it is essential to the proper functioning of the vehicle's drivetrain.

The differential consists of several parts, including the ring gear, pinion gear, spider gears, side gears, and bearings. The ring gear is attached to the drive shaft and rotates with the engine, while the pinion gear is attached to the differential housing and meshes with the ring gear.

When the engine is running, the ring gear rotates the pinion gear, which transfers power to the differential housing. The differential housing contains the spider gears, which are located on a cross shaft and mesh with the side gears attached to the axle shafts.

When the vehicle is moving straight ahead, the spider gears rotate at the same speed, and the differential transfers power equally to both wheels. However, when the vehicle turns, the inside wheel rotates at a slower speed than the outside wheel, and the differential compensates for this by allowing the wheels to rotate at different speeds.

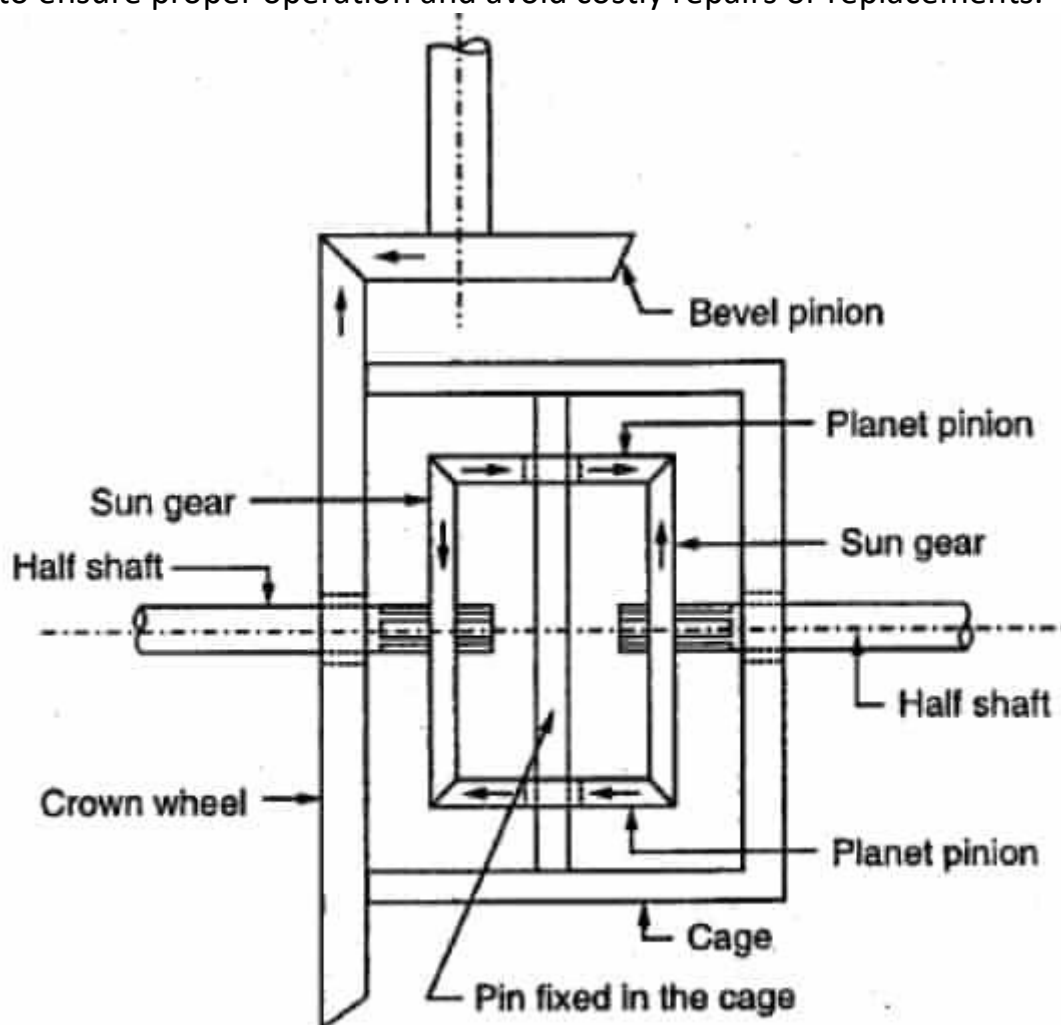
When the vehicle turns, the spider gears rotate around the cross shaft, allowing the wheels to rotate at different speeds. The outside wheel rotates faster than the inside wheel, and the differential compensates for this by transferring more torque to the outside wheel.

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The differential also includes a mechanism to prevent wheel spin, called a limited-slip differential. The limited-slip differential uses clutch plates or viscous fluid to transfer power from the slipping wheel to the wheel with better traction, ensuring that the vehicle maintains stability and control.

In summary, the differential in automobiles works by splitting the torque from the engine into two output shafts, which rotate at different speeds. It allows the wheels to rotate at different speeds when turning, compensating for the differences in distance travelled by the inside and outside wheels. The differential also prevents wheel slip and skid, ensuring that the vehicle maintains traction on the road.

The differential is a complex component that requires precise engineering and manufacturing to operate correctly. It is critical to the performance and safety of the vehicle, and any issues with the differential can cause problems with handling, traction, and overall vehicle operation. Regular maintenance and inspection of the differential are necessary to ensure proper operation and avoid costly repairs or replacements.



**Figure: Working of differential**

**10)What are the various function, type &requirements of rear axle.**

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The rear axle is an essential component of an automobile's drive train system. It transmits power from the differential to the drive wheels and supports the weight of the vehicle. The rear axle performs several functions, comes in different types, and has various requirements.

### **Functions:**

1. **Power transfer:** The rear axle transfers power from the differential to the drive wheels, enabling them to rotate and propel the vehicle forward.
2. **Wheel support:** The rear axle supports the weight of the vehicle and distributes it evenly across the drive wheels.
3. **Stability:** The rear axle provides stability to the vehicle by maintaining a consistent track width and wheelbase.
4. **Braking:** The rear axle also assists in braking by applying stopping force to the drive wheels.

### **Types:**

1. **Live axle:** A live axle is a solid axle that rotates with the wheels and transmits power directly to them.
2. **Dead axle:** A dead axle does not rotate with the wheels and does not transmit power to them.
3. **Independent rear suspension (IRS):** An IRS system allows the wheels to move independently of each other, resulting in better handling and ride comfort.

### **Requirements:**

1. **Strength:** The rear axle must be strong enough to support the weight of the vehicle and transmit power to the drive wheels without breaking or bending.
  2. **Durability:** The rear axle must be able to withstand the stresses of regular use and exposure to harsh road conditions.
  3. **Maintenance:** Regular maintenance of the rear axle, including fluid changes and inspections, is essential to ensure proper functioning and prevent damage or wear.
  4. **Compatibility:** The rear axle must be compatible with the other components of the drive train, such as the differential and drive shaft.
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In summary, the rear axle performs several critical functions in the drivetrain of an automobile, including power transfer, wheel support, stability, and braking. It comes in different types, such as live axle, dead axle, and IRS, and has various requirements, such as strength, durability, maintenance, and compatibility. Proper care and maintenance of the rear axle are crucial to ensure the safe and efficient operation of the vehicle.

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