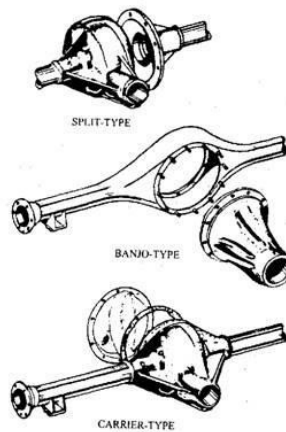


## Unit 5- Rear axle assembly

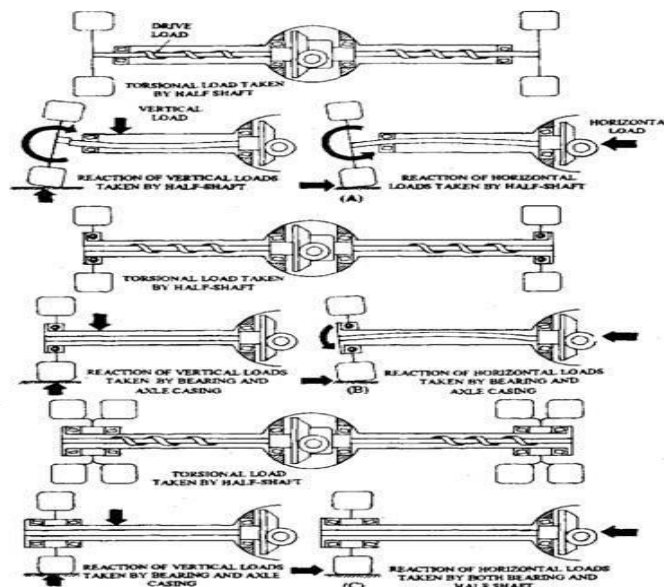
### Rear Axle

The vehicle with non-independent rear suspension uses either a dead axle or a live axle. The dead axle only supports the weight of the vehicle, but the live axle besides fulfilling this task, contains a gear and shaft mechanism to drive the road wheels. The arrangements for supporting the road-wheels on live axles and providing the driving traction use an axle-hub mounted on to the axle-casing and supported by ball or roller-bearing. The two main components installed inside the axle of a rear-wheel drive vehicle are the final drive and differential.



### Axle Casing

The casing used now days is either a banjo or carrier-type. In the past a split (trumpet) casing was occasionally used. These three types are shown in Fig. The type of axle casing used decides the method for the removal of the final drive



### **Axle Shafts and Hub Arrangements**

The axle shaft transmits the drive from the differential sun wheel to the rear hub. The various types of shafts may be compared based on the stresses they resist. A simple automobile shaft has to withstand

(i) torsional stress due to driving and braking torque, (ii) shear and bending stresses due to the weight of the vehicle, and (iii) tensile and compressive stresses due to cornering forces

### **FINAL DRIVE OR FINAL REDUCTION**

Final drive is the last stage of power transfer from propeller shaft to rear (or front if – automobile is front wheel driven) axles and then to wheels. It turns the propeller shaft motion at right angle to drive the rear axle.

The final drive is composed of a bevel gear (or pinion) and crown wheel. The level pinion is connected to propeller shaft. The pinion is in mesh with the crown wheel. Crown wheel is part of differential. Final drive provides fixed speed reduction. Because the crown wheel has more number of teeth and it is connected to rear axles and level pinion has less number of teeth.

For final reduction in speed two types of gears can be used. One of them may be use of level gears and another may be worm and worm wheel. Worm and worm wheel combination provides large reduction without employing larger gears. It is strong also.

### **Slip Joint**

The rear axle housing with wheel and differential is attached to the frame of automobile through springs. As the vehicle moves over uneven surface, this whole assembly moves up and down due to expansion and compression of springs. This changes the length of propeller shaft because it is connected to differential and gear box. Slip joint allows for the change in length of propeller shaft. When spring is compressed propeller shaft shortens and when spring is expanded, propeller shaft returns to original length.

### **DIFFERENTIAL**

When a four wheeler (car) takes a turn, the outer wheel turns faster than inner wheel. Thus, there is relative movement between inner and outer wheel. The function of the differential is to permit the relative movement between inner and outer wheels when vehicle negotiates (takes) a turn. The torque transmitted to each rear wheel is equal in this case, although their speed is different.

The differential is made up of a system of gears which connect the propeller shaft and rear axles. It is a part of inner axle housing assembly. The assembly consists of differential, rear axles, wheels and bearings.

### **Construction and Working**

It consists of sun gears, planet pinion, a cage, a crown wheel and a bevel pinion. A sun gear is attached to inner end of each rear axle (half shaft). A cage is attached on left axle. A crown gear is attached to the cage and the cage rotates with the crown gear. The crown gear is rotated by the bevel pinion. Crown gear and cage remain free on the left rear axle. Two planet pinions are on a shaft which is supported by the cage. The planet pinions mesh with the sun gears. The rear wheels are attached to outer ends of two rear axles. When the cage rotates, sun gears rotate. Thus, the wheels also rotate. In case one inner wheel runs slower than other when the vehicle takes a turn, the planet gears spin on their shaft, transmit more rotary motion to outer wheel. When vehicle runs in straight line, the crown gear, cage, planet pinions and sun gears turn together as a unit. Thus there is no relative motion.

### **TYPES OF DIFFERENTIAL**

There are three types of differential :

- (a) Conventional type,
- (b) Non-slip or self locking type, and
- (c) Double reduction type.

### **Conventional Type**

Final Drive Conventional type differential delivers same torque to each rear wheel. If any of the wheels slips due to any reason the wheel does not rotate and vehicle does not move.

### **Non-slip or Self Locking Type**

Non-slip or self locking type differential overcomes this drawback. Its construction is similar to that of conventional type differential. But, two sets of clutch plates are provided additionally. Also, the ends of planet shafts are left loose in notches provided on the differential cage.

### **Double Reduction Type**

Double reduction type differential provides further speed reduction by additional gear. This type of differential is used in heavy duty automobiles which require larger gear reduction between engine and wheels.

## **Unit– 6**

### **Front axle and steering mechanism**

#### **❖ Front Axle:- Functions**

- It supports the weight of front part of the vehicle.
- It facilitates steering knuckles and suspension springs.
- It transmits weight of vehicle through springs to the front wheels.
- It absorbs torque applied on it due to braking of vehicle.

#### **❖ FrontAxle**

- The front axle is designed to transmit the weight of the automobile from the springs to the front wheels, turning right or left as required.
- To prevent interference due to front engine location, and for providing greater stability and safety at high speeds by lowering the centre of gravity of the road vehicles, the entire centre portion of the axle is dropped.
- As shown in Fig. front axle includes the axle-beam, stub-axles, ack-rod and stub-axlearn.
- Front axles can be live axles and dead axles.
- A live front axle contains the differential mechanism through which the engine power flows towards the front wheels.
- For steering the front wheels, constant velocity joints are contained in the axle half shafts.

- Without affecting the power flow through the half shafts, these joints help in turning the stub axles around the king-pin.
- The front axles are generally dead axles, which does not transmit power.
- The front wheel hubs rotate on anti-friction bearings of tapered-roller type on the steering spindles, which are an integral part of steering knuckles.
- To permit the wheels to be turned by the steering gear, the steering spindle and steering knuckle assemblies are hinged on the end of axle.
- ❖ The pin that forms the pivot of this hinge is known as king pin or steeringknuckle pin.
- ❖ **Steering System:**
  - **Steering** is the term applied to the collection of components, linkages, etc. which will allow a vehicle to follow the desired course.
  - The front wheels are supported on front axle so that they can swing to left or right for steering. This movement is produced by gearing and linkage between the steering wheel in front of the driver and the steering knuckle or wheel.
  - The complete arrangement is called “Steering System”.
  - The function of steering system is to convert the rotary movement of the steering wheel into angular turn of the front wheels.
  - The steering system also absorb a large part of the road shocks, thus preventing them from being transmitted to the driver.
- ❖ **Requirements:**
  - It should multiply the turning effort applied on the steering wheel by the driver.
  - It should not transmit the shocks of the road surface encountered by wheels to the driver hands.

- The mechanism should have self-returning property so that when the driver releases the steering wheel after negotiating the turn, the wheel should try to achieve straight ahead position.

❖ **Functions:**

- It helps in swinging or turning the wheels to the left or right (at the will of driver).
- It converts the rotary movement of the steering wheel into an angular turn of the front wheels.
- It multiplies the effort of the driver by leverage in order to make it fairly easy to turn the wheels.
- It absorbs a major part of the road shocks thereby preventing them to get transmitted to the hands of the driver
- It provides directional stability.
- It helps in achieving the self-returning effect.

❖ **Front wheel steering Geometry:**

The term "*steering geometry*" (also known as "front-end geometry") refers to the angular Relationship between suspension and steering parts, front wheels, and the road surface. Because alignment deals with angles and affects steering, the method of describing alignment measurements is called steering geometry.

1. Castor
2. Camber
3. King Pin Inclination (Steering axis Inclination)
4. Scrub Radius
5. Toe-in or Toe- Out