- (i) Rzeppa :
- It consists of spherical inner and outer ball races having grooves cut parallel to shafts. Steel balls are placed in grooves on the spherical recess shown in Figure 3.47. The torque transmission is done from one race to another ball. The circular pattern of balls cause. shafts to turn at the same velocity.

  (ii) Bendix Weiss:
- The principle of driving through balls held in a circle around a sphere is used in this type of joint. Four numbers of driving balls are held into machined races in close fitting yokes. A fifth or centre ball is placed between two yokes as an inner race. The driving balls are arranged themselves in a circle in the same manner to Rzeppa joint. The aligning action of the balls gives a constant velocity joint.

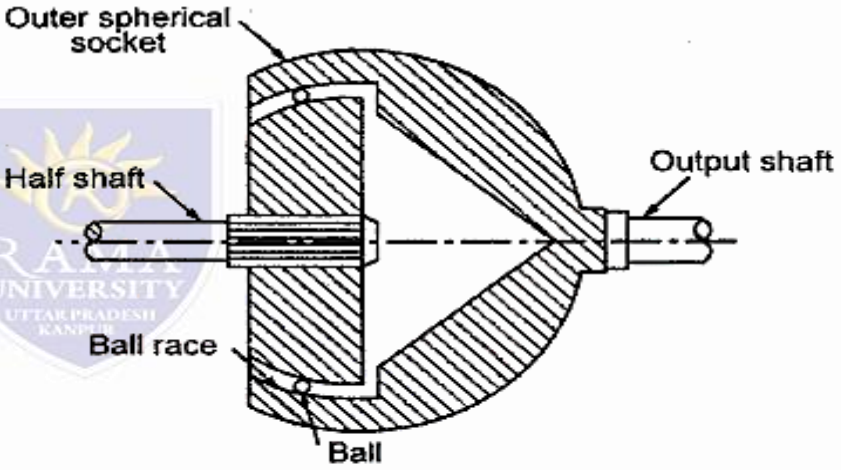
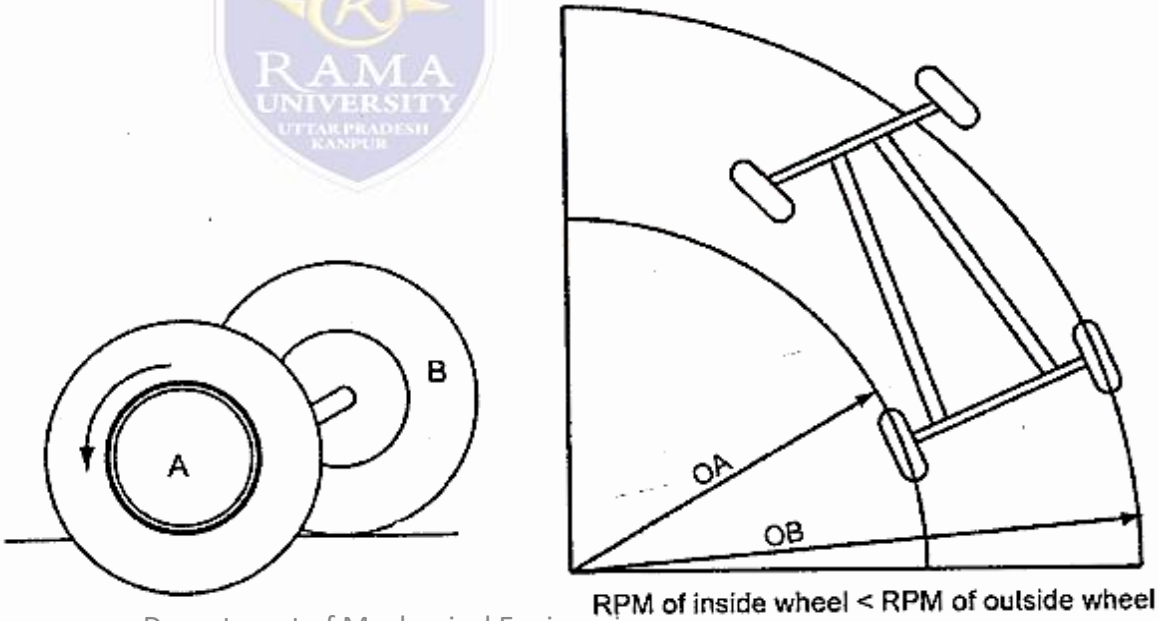


Figure 3.47 Constant velocity joint

- iii) Tracta:
- This joint differs from the above two joints. Four yokes are used in this joint in which two yokes are fastened to shafts and the other two are floating at the centre of the joint. The mating parts of the yokes are made into segments of a circle. Both circular segments and loating action of the two yokes provide a constant velocity joint.

- DIFFERENTIAL
- Need for the Differential Gear Unit
- Both right and left wheels are always rotated at the same speed when the vehicle is running on flat roads. But when the vehicle travels on curved road during turning the inner wheels need to run slower than the outer wheel as it is required to travel less distance. So, the wheels are designed in such a way that they rotate at different speeds. The path of the inside wheel (A) and the path of the outside wheel (B) of a vehicle when it turns along ~ curve are shown in Figure 3.48 for comparison. The outside wheel (B) draws an arc with the radius of distance OB and the inside wheel (A) draws an arc with radius of distance ~A. Therefore, the distance travelled by the outside wheel is more than the inside wheel. The outside wheel is forced to move faster and rotates more than the inside wheel. The wheel (A) on the rough surface naturally must run at higher rpm than other wheel (B) on the flat surface. Both wheels run at an identical rpm on ordinary roads due to contact between road surface and two wheels. The difference in rpm between right and left wheels occurs due to the difference in amount of tire inflation and wear. Mostly, both wheels are forced to run at the same rpm even anyone of them slips.
- So, tyres will wear faster. Therefore, the driving performance of vehicles will be slightly affected.
- Thus, a differential device is incorporated to allow the differences in rpm when it is transmitting equal torque.



RPM of inside wheel < RPM of outside wheel

Major Components of Differential

- The following main components are used in the differential assembly.
- l. Drive pinion or Bevel pinion
- 2. Ring gear or Crown wheel
- 3. Differential case
- 4. Differential side gear or Sun gears
- 5. Differential pinions (or) Planet gears
- 6. Axle shafts or Half shafts
- 7. Pinion shaft or Cross pin (or) spider.

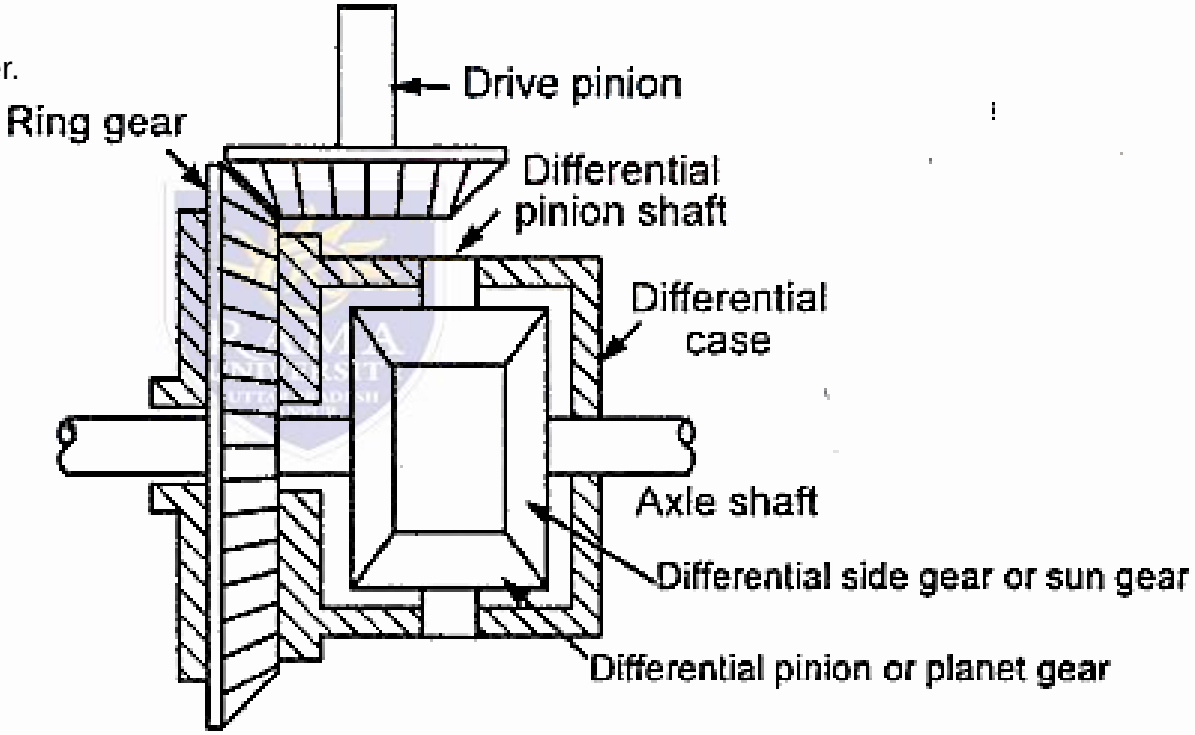


Figure 3.49 Rear wheel drive differential

- ## Construction

- Figure 3.49 shows the basic parts of the type of differential used in rear-wheel-drive cars. On the inner ends of each axle a smaller bevel gear called differential side gear is mounted. Two bevel gears are put together to mesh both driving and driven shafts at an angle of 90°. The differential case is mounted with two wheel axles and differential side gears. The differential case has bearings which rotate two axle shafts. Then, the two pinion gears and their supporting shaft, called pinion shafts, are fitted into the differential case. Then, the pinion shaft is meshed with the two differential side gears connected to inner ends of the axle shafts.

- The ring gear is bolted to a flange on the differential case. The' ring gear rotates the differential case. Finally, the drive pinion is mounted. The drive pinion is assembled with the differential housing called differential case or carrier. The driver shaft is connected with the drive pinion by a universal joint and it is meshed with the ring gear. So, the drive pinion is rotated when the driver shaft turns. Thus, the ring gear is rotated.

- ## Basic Principle of Operation

- Input torque is applied to the ring gear through drive pinion, which turns the entire differential ca~e. The differential case is connected to both the differential side gears only through the differential pinions. Torque is transmitted to the differential side gears through the differential pinions. The differential pinions revolve around the axis of the differential case, driving the differential side gears. While the car is running on a-straight road, the resistance at both wheels is equal and the ring gear, differential case, differential pinion gears and two differential side gears will turn as a unit. Itresults the side gears rotating at the same speed as the ring gear makes both drive wheels to rotate at the same speed. The differential pinions revolve without spinning about its own axis, and both wheels turn at the same rate.
- If the left differential side gear encounters resistance (when the vehicle runs on curved path), the differential pinions spin as well as revolve which allows the left differential side gear to slow down, with an equal speeding up of the right differential side gear. It causes the outer wheel to turn faster than the inner wheel. Thus, for example, if the vehicle is making a turn to the right, the main ring gear may make 10 full rotations. During that time, the left wheel will make more rotations because it has further to travel, and the right wheel will make fewer rotations as it has less distance to travel. The differential side gears will rotate in opposite directions relative to the ring gear by, say, 2 full turns each, resulting in the left wheel making 12 rotations, and the right wheel making 8 rotations. The rotation of the ring gear is always the average of the rotations of the differential side gears.

- Typesof Differential
- Normally, the differential is of any one of the following type.
- 1. Conventional differential
- 2. Limited slip differential
- 3. Non slip differential
- 4. Double reduction differential.
- .Conventiona lDifferential
- The conventional differential is shown in Figure 3.50 shows
- the pictorial representation of the differential.
- The principle of operation is same as described earlier.

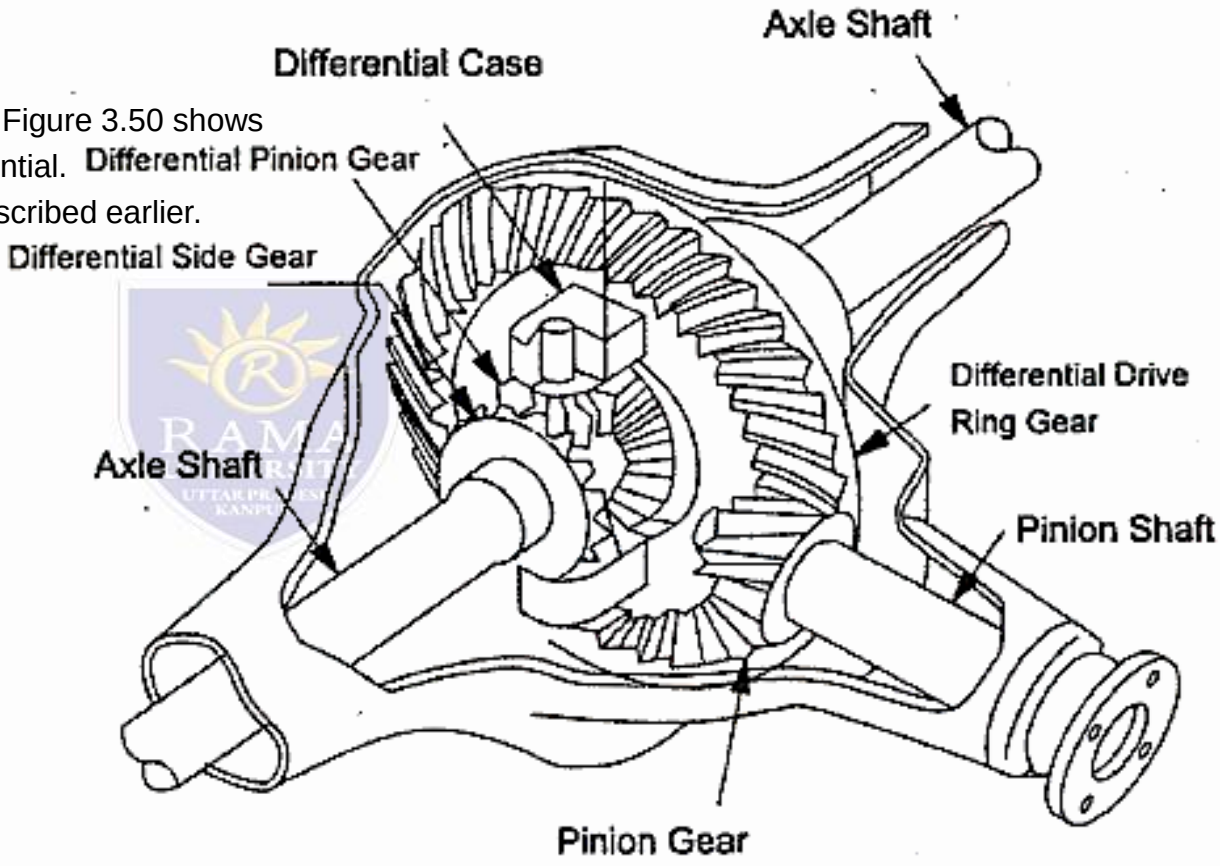


Figure 3.50 Pictorial view of differential