How Differential works
**Parts**

**Pinion Drive Gear**: transfers power from the driveshaft to the ring gear.

**Ring Gear**: transfers power to the Differential case assembly.

**Side/spider gears**: help both wheels to turn independently when turning.

**Differential case assembly**: holds the Ring gear and other components that drive the rear axle.

**Rear drive axles**: steel shafts that transfer torque from the differential assembly to the drive wheels.

**Rear axle bearings**: ball or roller bearings that fit between the axles and the inside of the axle housing.

**Axle housing**: metal body that encloses and supports parts of the rear axle assembly.
Power flow

• Drive shaft spins the Pinion gear.

• Pinion gear turns the larger ring gear to produce gear reduction.

• Ring gear attached to differential case, hence it rotates with the ring gear.

• Differential case spins the sun gears which are attached to the axles.

• Axles transfer the power to the wheels.

http://auto.howstuffworks.com/differential2.htm
Function

• Transfers power from driveshaft to the wheels.

• Provides final gear reduction.

• Splits amount of torque going to each wheel.

• Allow the wheels to rotate at different speeds in turns.
Hypoid gear

• Most of the modern differentials have Hypoid Gears.

• Pinion gear sits offset, lowered from the centerline of ring gear.

• Improved gear mesh because of larger gear tooth contact area.

• Improves gear life and reduce gear noise.
Pinion Gear

• One side is attached to the ring gear and the other to yoke (drive shaft).

• Either a crushable sleeve or shims are used to preload the pinion bearings.

• **Preload**: a small amount of pressure applied to the bearings to remove play and excess clearance.

• Ring gear and pinion gears are a matched set.
Differential carriers

Removable carrier:
can be serviced at a workbench.

Integral or unitized carrier
formed as a part of axle housing.
Limited slip/posi-traction Differential

• Provides driving force to both wheels at all times, whereas conventional differential will lose traction on slippery surface.

• Transfers a portion of torque to both slipping wheel and the driving wheel.

• Under high torque, pinion gears push on side gears. Side gears push on clutch discs, thus locking it.

• Under normal turning the clutch discs slip.
Breather tube

• Breather tube vents pressure or vacuum in or out of the rear axle as temperature changes.

• If blocked lubricant could blow out the axle seals or pinion drive gear seals.
• Uses 80W-90 hypoid oil (distinct smell).

• Remove fill plug (mostly with 3/8” ratchet) insert finger; if you are able to touch oil, level is good.
Removing rear axle

• **Integral carrier**: remove the center pin, use a magnet and remove the c-clips holding the axle on to the sun gears, and remove the axle.
• **Removable carrier type:** Remove the bolts holding the axle flange to the drum/disc backing plate and pull the axle.
Differential Problems

**Caution:** when using stethoscope to listen for rear axle noise, stay away from the spinning tires and axles.

**Bearings** (humming sound gets louder with higher speeds)

- Lift the vehicle on the hoist.
- Put it in gear and spin the wheels at approx. 50 Km/hr.
- Use a stethoscope to listen for a humming sound by the carrier bearings and the pinion bearings.
Differential Problems

**Caution**: when using stethoscope to listen for rear axle noise, stay away from the spinning tires and axles.

**Ring and Pinion Problems**

- Will show up as whining or howling noise that changes when going from acceleration to deceleration.
- Lack of service or low fluid can cause this problem.
- If *backlash* (clearance) between ring gear and pinion gear is too great, a clunking sound can be produced, especially when an automatic transmission is shifted into gear.
Differential adjustment

Ring and pinion gear backlash refers to the amount of space between the meshing teeth of the gears.

- Backlash is needed to allow for the heat expansion and lubrication.

- Too little backlash will cause the gears to jam and too much backlash will cause gear noise (whirring, roaring, or clunking).

- Hydrate ferric oxide (yellow oxide of iron) is used to check the contact pattern between pinion and ring gear.

- To increase move the ring gear away from the pinion gear. To decrease move the ring gear toward the pinion gear (controlled by case bearing nuts or shims).
Transaxles

• Combination of transmission and differential in one unit is called transaxle.

• Transaxles are found both front wheel and rear wheel vehicles, but are common on Front wheel vehicles.

• Transaxles are both automatic and manual.

**Advantages** include:
  • Reduced drive train weight.
  • Improved traction.
  • Smoother ride.
  • Quieter operation.
  • Increased passenger compartment space.
**Transaxle Axle Shaft**

**Inner Sub Shaft** a short shaft splined to the side differential gear and connected to the inner universal joint.

**Outer Stub Shaft** a short shaft connected to the outer universal joint and the front wheel hub.

**Interconnecting Shaft** the center shaft that fits between the two universal joints.
Universal Joints

- Universal Joints in the front drive vehicles allow the front wheels to turn and spin.
- Are normally called CV Joints (Constant Velocity Joints).
**Universal Joints**

**Rzeppa (ball-and-cage)** is normally the outer joint and is a fixed (non sliding) joint.

Outer CV Joint transfers power from the axle shaft to the hub assembly.

Locking nut is used on the hub side.
Universal Joints

• **Plunging (sliding) tripod Joint** is commonly used on the inner joint.

• Acts as a slip joint in a drive shaft for rear wheel drive vehicles.

• As the front wheel moves up and down over the humps, the axle shaft must change total length.

• The plunging action of the inner CV Joint allows for a change in distance between the transaxle and the hub.
CV Joint Boot

• Boots are used to keep road dirt out of the CV-joints (made of rubber).

• Prevent loss of grease.

• Flex with movement of the joint.

• Once damaged, will make a clicking sound while accelerating and turning.

Tools to install clamps on the CV-joint Boot
Removing Axle from Hub

In order to remove the axle (splines) from the hub sometimes special tools like a puller or a slide hammer is required.

Often a prybar is used to release the inner joint (held by a C-clip) from the transaxle.

Caution: Oil might spill when inner joint is removed from the transaxle.
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