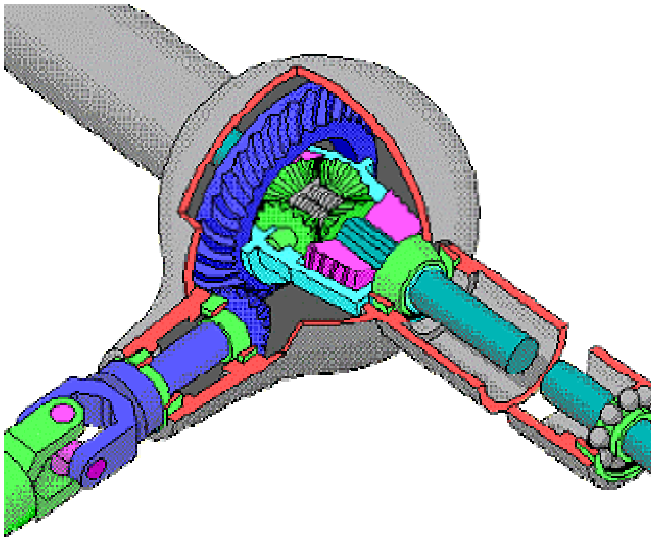
Rear Axle Operation



Below is an overview of rear axle operation

The Differential

The differential is the thing that works both drive axles at the same time, but lets them rotate at different speeds so that the car can make turns. When a car makes a turn, the outer wheel has to turn faster than the inner wheel, due to the difference in the length of the paths they take. The differential is located between the two wheels, and is attached to each wheel by a half-shaft rotated through a bevel gear. Four-wheel drive cars have a separate differential for each pair of wheels.

A grooved, or splined, axle side gear is positioned on the splined end of each axle. The side gears are driven by "spider" gears, which are little gears mounted on a shaft attached to the differential case. As it is supported by the differential case, the side gear can turn inside the case.

The differential case can be turned, revolving around the axle gears. The differential pinion (a pinion is a small gear that either drives a larger gear or is driven by one) shaft turns the ring gear, which is fastened to the differential case. The propeller shaft (drive shaft) connects the transmission output shaft to the differential pinion shaft. The turning differential case is mounted on two large bearing holders. These bearings are called carrier bearings.

The propeller shaft rotates the ring gear pinion, and the pinion turns the ring gear. The ring gear then turns the differential case and pinion shaft, but the axle side gears will not turn. By passing the differential pinion shaft through two differential pinion gears that mesh with the side gears, the case will turn and the axle side gears will turn with it. During turns, the side gears turn at rates dictated by the radius of the turns, and the spider gears then turn to allow the outer wheel to turn faster than the inner one.

Differential Fluids

For lubrication fluid, a very heavy oil, must be used in rear axle housings. Special hypoid oils are used in the differential case. Even another type of fluid, or oil must be used in a positraction type differential.

The oil is circulated by the ring gear, and flung all over all the parts. Special troughs, or gullies are used to bring the oil back to certain spots, like the ring and pinion area and the piston bearings. The fluid is kept in with gaskets and oil seals. The bottom of the housing has a drain plug, and another filler plug is located part way up the housing. The housing must never be filled above this plug.

The housing fluid lubricates some of the outer bearings, but others have lubrication fittings for the injection of wheel bearing grease. A hand gun, not a pressure grease gun must be used to grease these bearings (sparingly). A pressure grease gun could inject grease into the brakes-- greasy brakes are inefficient at best!

Finally, some bearings are filled with grease at the factory and are sealed. These never require attention unless they are defective.

Positraction Differentials

A positraction differential is a special traction differential. Its purpose is to improve the way your differential performs under adverse conditions. When one wheel starts to slip, these differentials transfer the torque to the wheel that is not slipping. The car can then continue to go forward. There are several different kinds of positraction differentials, but all of them are based on a friction device to provide resistance to normal differential operation.

A positraction differential provides better traction, which is handy when roads are slippery. It also lends itself to fast acceleration.

One type uses four differential pinions instead of two, with two pinion shafts. It also uses a series of four clutch discs. The differential pinions run into resistance when they try to turn the axle side gears. The resistance gets transferred to the pinion shafts driving the pinions. The shafts are forced to slide up little ramps. This action moves both shafts outward. The pinions cause the clutches to lock.

Other types use cone clutches, or disc clutches under pressure from coil springs. By restricting the differential action, torque is delivered to the slipping wheel.

The Drive Shaft

The drive shaft, or propeller shaft, connects the transmission output shaft to the differential pinion shaft. Since all roads are not perfectly smooth, and the transmission is fixed, the drive shaft has to be flexible to absorb the shock of bumps in the road. Universal, or "U-joints" allow the drive shaft to flex (and stop it from breaking) when the drive angle changes.

Drive shafts are usually hollow in order to weigh less, but of a large diameter so that they are strong. High quality steel, and sometimes aluminum are used in the manufacture of the drive shaft. The shaft must be quite straight and balanced to avoid vibrating. Since it usually turns at engine speeds, a lot of damage can be caused if the shaft is unbalanced, or bent. Damage can also be caused if the U-joints are worn out.

There are two types of drive shafts, the Hotchkiss drive and the Torque Tube Drive. The Hotchkiss drive is made up of a drive shaft connected to the transmission output shaft and the differential pinion gear shaft. U-joints are used in the front and rear. The Hotchkiss drive transfers the torque of the output shaft to the differential. No wheel drive thrust is sent to the drive shaft. Sometimes this drive comes in two pieces to reduce vibration and make it easier to install (in this case, three U-joints are needed).The two-piece types need ball bearings in a dustproof housing as center support for the shafts. Rubber is added into this arrangement for noise and vibration reduction.

The torque tube drive shaft is used if the drive shaft has to carry the wheel drive thrust. It is a hollow steel tube that extends from the transmission to the rear axle housing. One end is fastened to the axle housing by bolts. The transmission end is fastened with a torque ball. The drive shaft fits into the torque tube. A U-joint is located in the torque ball, and the axle housing end is splined to the pinion gear shaft. Drive thrust is sent through the torque tube to the torque ball, to transmission, to engine and finally, to the frame through the engine mounts. That is, the car is pushed forward by the torque tube pressing on the engine.

The Universal Joint (U-joint)

The Universal joint (U-joint) is used to connect the drive shaft to the transmission output shaft and the differential pinion gear shaft. This joint must be flexible enough to allow changes in the driving angle (road incline) and the drive shaft. This way, the torque is constantly transmitted when the rear axle is moving up and down. Smaller U-joints are used to route the turning motion of the steering wheel through the steering column to the steering box.

There are two types of U-joints, the cross and roller type and the ball and trunnion type. The cross and roller type is used the most; it allows the drive shaft to bend. The ball and trunnion type less frequently used; it allows the drive shaft to bend and also permits backward and forward motion of the drive shaft.

Constant Velocity Joints (CV Joints)

Front wheel drive cars need u-joints which not only allow up and down motion, but steering motion as well. the angle at which they turn requires a different design than the standard U-joint.

Constant velocity, or CV joints are universal joints that are able to transfer torque at large angles efficiently. These joints transfer power very smoothly. They are comprised of four basic parts: 1. The outer section, which has grooves machined on its inner surface, 2. the bearings, which are usually in a "cage", 3. the inner ball,

which has grooves on its outer surface for the bearings to ride in, and 4. a rubber boot to protect the unit from dirt and moisture.

A common cause of CV joint failure is cracks in the CV boot. As dirt enters the CV joint, its parts grind themselves until a clicking noise is heard when turning, or until they fail completely. The boots should be replaced as soon as cracking is visible in their rubber folds.