CHAPTER TWO

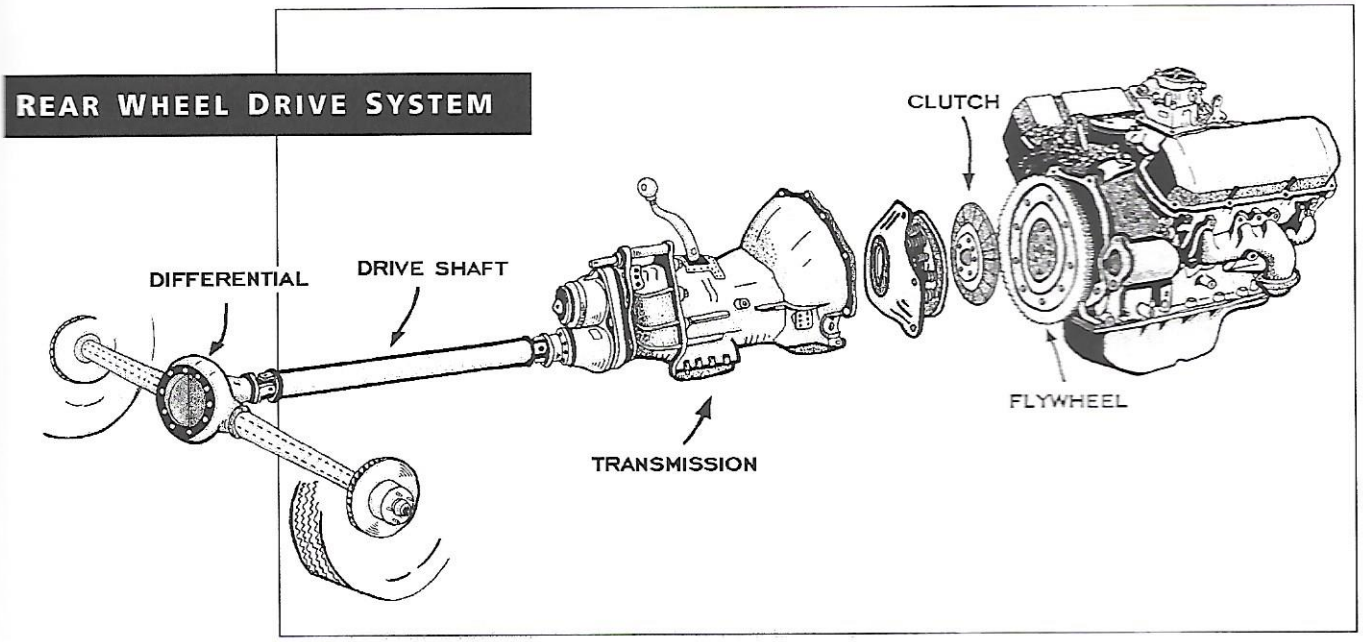
Drive Train

A *drive train* includes the many parts that transfer spinning motion from an engine to the wheels. A drive train begins at the rear of an engine, connecting to a crankshaft where it extends through a block. This connection must engage and disengage quickly, smoothly, and with enough force to move a car fast.

A drive train has three jobs:

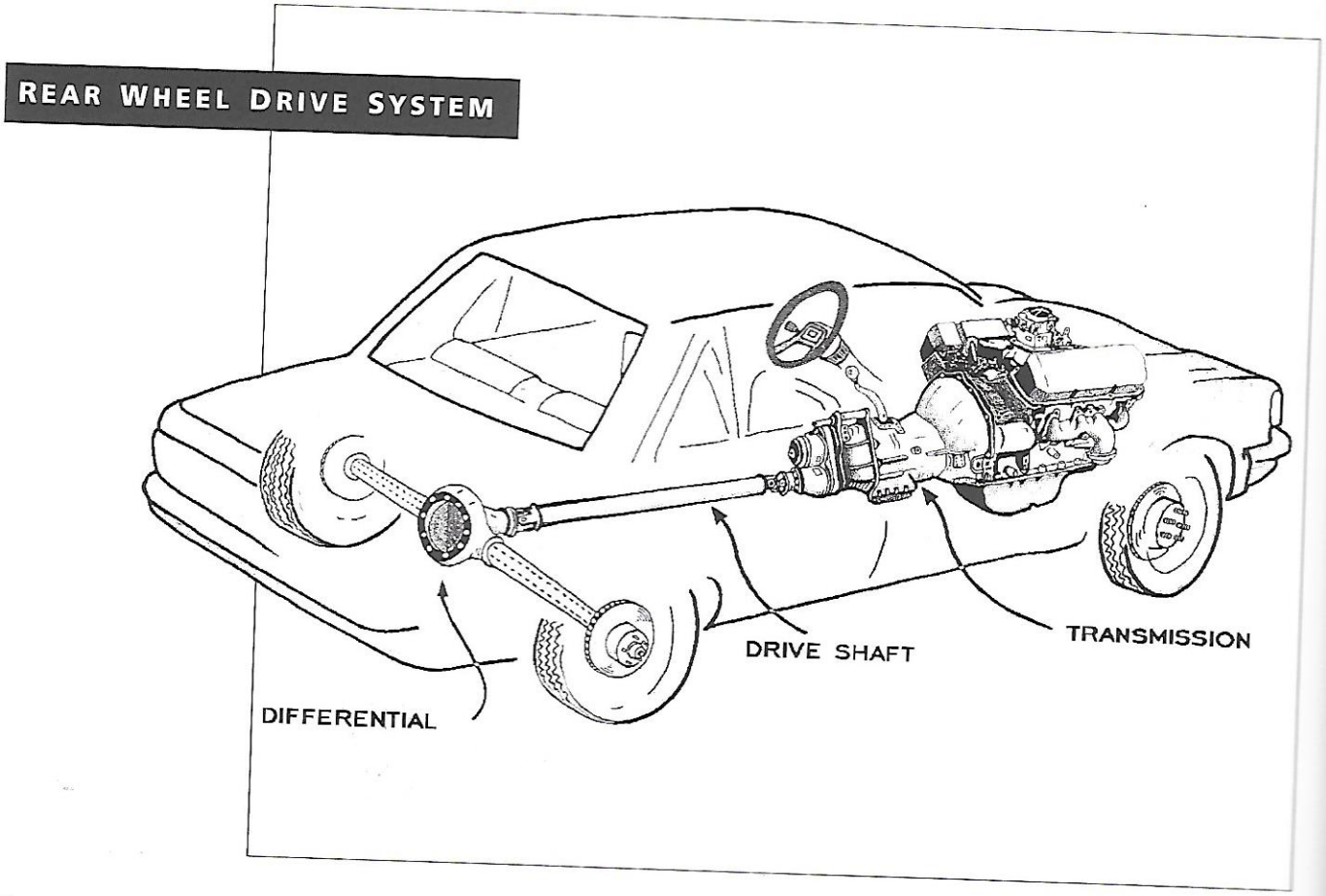
1. Transferring spin force from an engine to the wheels
2. Changing the rate of spin delivered to the wheels by shifting gears
3. Connecting and disconnecting an engine from the wheels in order to start or idle

There are many drive train arrangements used to accomplish these tasks including full-time four wheel drive systems and the new variable speed transmissions. The next two pages will cover the two most common types of drive trains: *rear wheel drive* and *front wheel drive.*



Rear Wheel Drive

In the conventional *rear wheel drive* system an engine is in the front of a vehicle. A *transmission* connects to the rear of the engine and a *drive shaft* connects to the rear of the transmission to extend the spin motion to a *differential*. A differential transfers the spin motion to the axle shaft which connects to the rear wheels. In most cars only one wheel receives spin power at a time. Almost all possibilities of engine placement and drive train design are used, with emphasis on placing weight over the drive wheels, saving space, and providing balanced cornering.



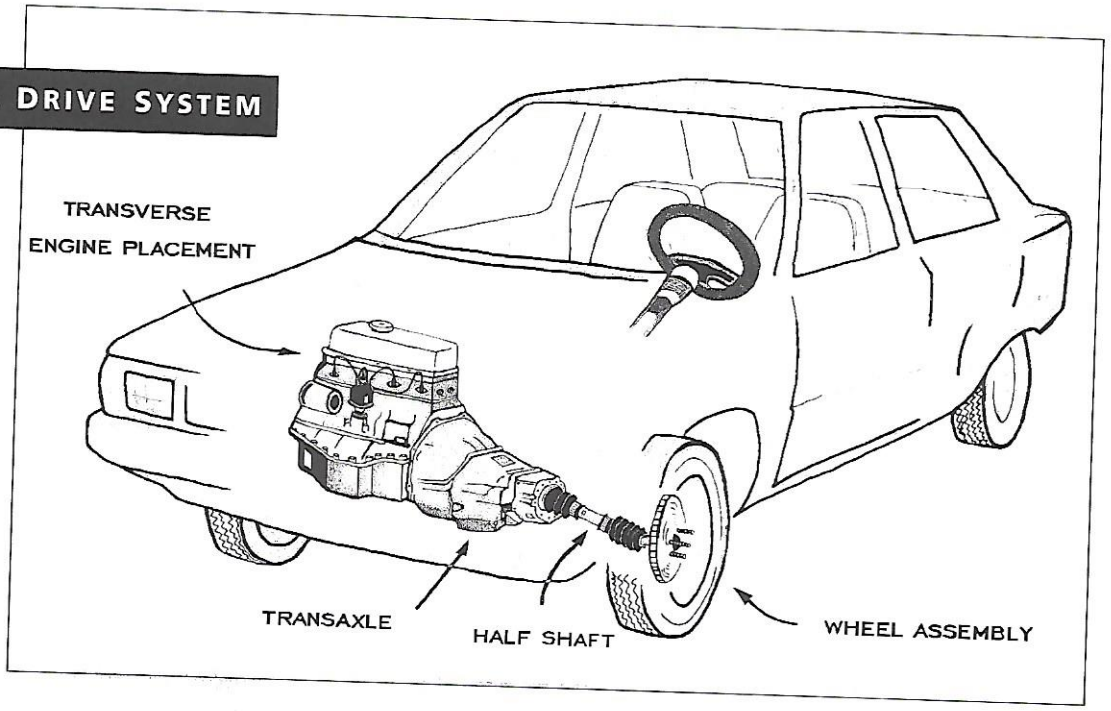
Front Wheel Drive

In the *front wheel drive* system all the parts necessary to transfer force to the wheels are in the front of the vehicle. With this arrangement a front wheel receives the spin power. This complicates matters because now the front wheels must receive the powerful spin force from an engine, plus turn right and left, and move up and down.

Front wheel drive systems often place an engine sideways in the engine compartment. This arrangement is called a *transverse* engine placement. Sideways placement saves space and eliminates the need for a separate differential and long *drive shaft;* here the crankshaft is aimed directly at the *wheel assembly*. A *transaxle* is often used in the front wheel drive arrangement as a combination transmission and differential.

Four wheel drive (FWD) is a third drive train variation combining rear and front wheel drive systems. With FWD, used on most sports utility vehicles (SUV), all four wheels receive spin power when needed for slippery conditions. Many manufacturers have introduced full time FWD drive or all wheel drive (AWD) systems, where computers monitor slipping wheels and automatically deliver the best drive wheel combinations for the conditions.

FRONT WHEEL DRIVE SYSTEM



Transmission

A *transmission* provides another way to change car speed besides the gas pedal or brakes. A transmission uses different-sized gears to change the speed of rotation delivered to the wheels.

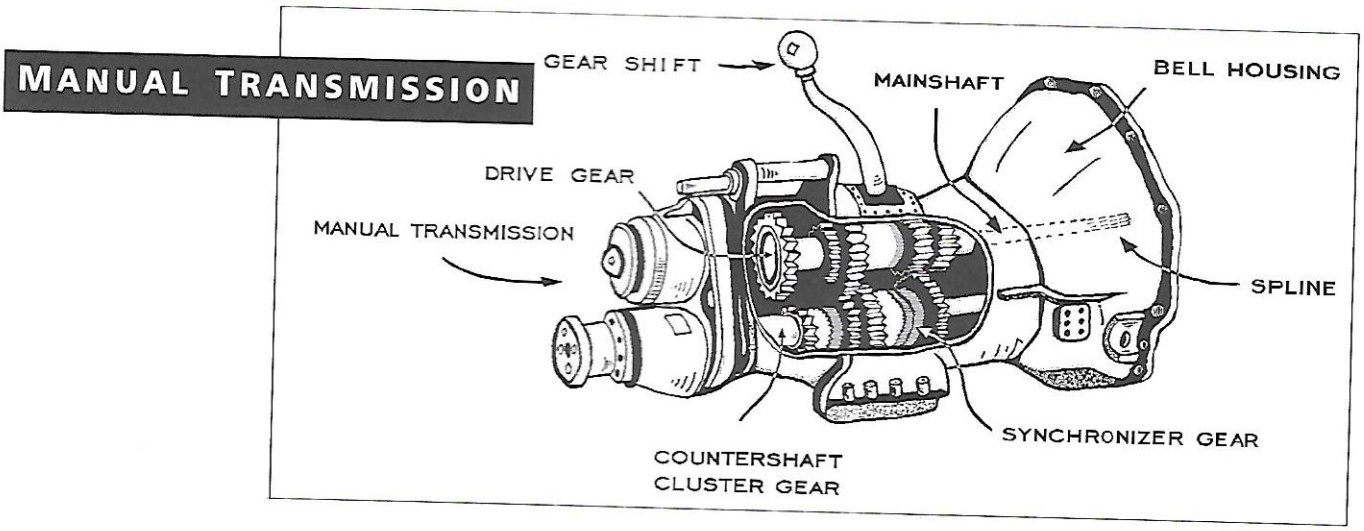
There are three types of transmissions:

1. Manual
2. Automatic
3. Continuously variable

With a *manual transmission*, often called a *stick shift*, the gears are changed by hand with the *gear shift lever*. This is done in conjunction with a clutch pedal. Spin force from an engine is transferred to a *mainshaft* and *drive gear*, which can be slid by hand along the *countershaft cluster gear* to change gear combinations. *Synchronizer* gears help slide one gear to another. Transmissions usually have from three to six different forward gears, each producing different speed/power combinations. Some transmissions are equipped with *overdrives* to provide an additional *high gear* for improving gas mileage during freeway driving. Big rig trucks often have 36 different gears.

An *automatic transmission* has automatic gear shifting and an automatic clutch mechanism as well. These transmissions feature a totally liquid connection to a crankshaft and in modern vehicles include the latest in electronic improvements.

A *continuously variable transmission* (CVT) provides automatic, seamless, shifting — gear shifting that cannot be felt. This new design is even mechanically simpler than a regular transmission. With another innovation, the *AutoShift* transmission, a driver can change between an automatic and manual transmission style while driving.



Clutch

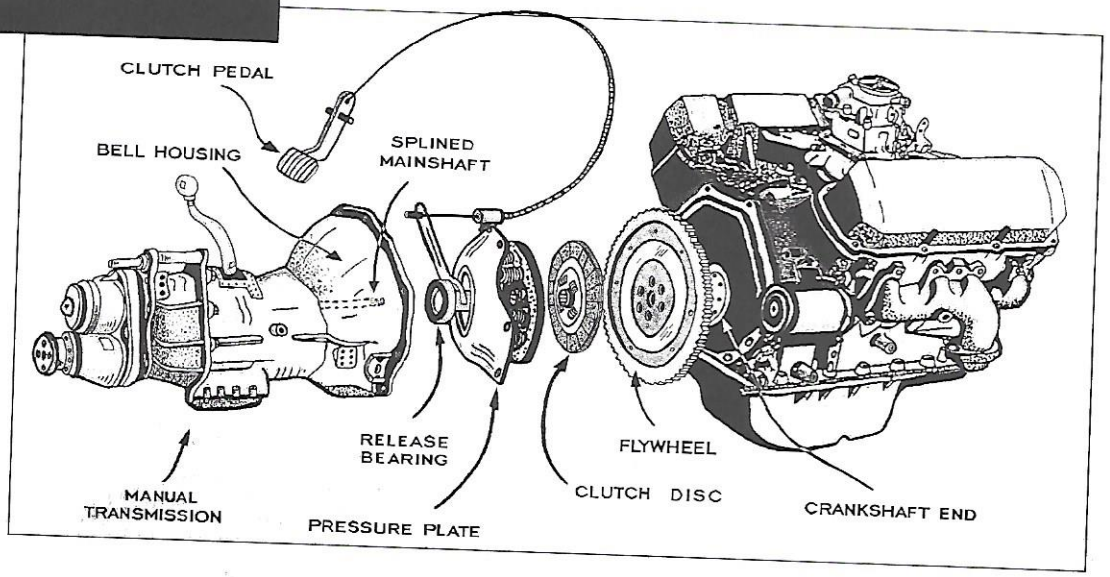
A *clutch* is always used with a manual transmission. Pushing in a *clutch pedal* separates the spinning part of an engine from the rest of a drive train allowing a driver to shift gears. This separation releases pressure on the gears, allowing them to slide easily from one gear combination to another. Separation of an engine from the rest of a drive train also provides a "neutral" position for starting and idling.

As a clutch pedal is eased-out, a *clutch disc* is slowly forced into contact with the spinning surface of a *flywheel*. Slipping and small vibrations occur at first and considerable heat is generated. With a clutch pedal all the way out, a clutch disc is pressed tight to a flywheel by the strong springs of a *pressure plate* and no slipping or clutch wear occurs; the transfer of spin power is complete.

A flywheel is bolted to a crankshaft at the rear of an engine. The large size and weight of a flywheel helps absorb rattling and vibrations as a clutch disc makes contact. A flywheel also quiets engine vibrations.

When assembled, the *splined* mainshaft extends through the center of the pressure plate and *release bearing*, sliding perfectly into matching notches in the center of a clutch disc. The *splined* end of a mainshaft secures and centers a clutch disc, which has no other attachment. A release bearing, sometimes called a *throw-out bearing*, reduces wear on a pressure plate when a clutch pedal is pushed down. A *bell housing* encloses all these parts to protect them from moisture and dirt.

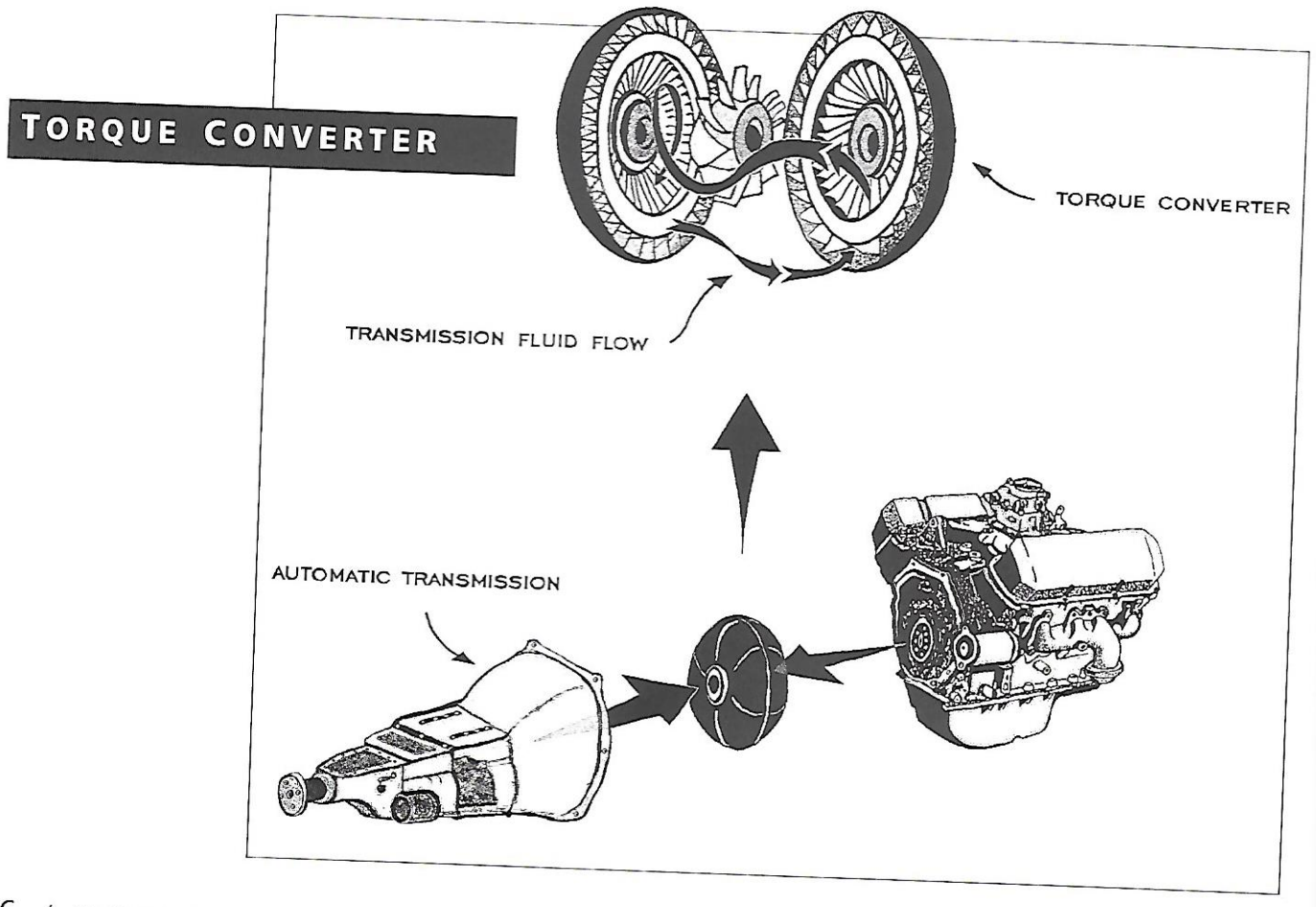
CLUTCH



Torque Converter

A *torque converter* serves as a clutch for an automatic transmission. With a torque converter there is no mechanical connection between an engine and drive train, no solid clutch disc. Instead, a torque converter uses a liquid connection to transfer spin force. With a torque converter the viscosity and kinetic energy of a liquid is used to transfer the spinning power of an engine to a drive train.

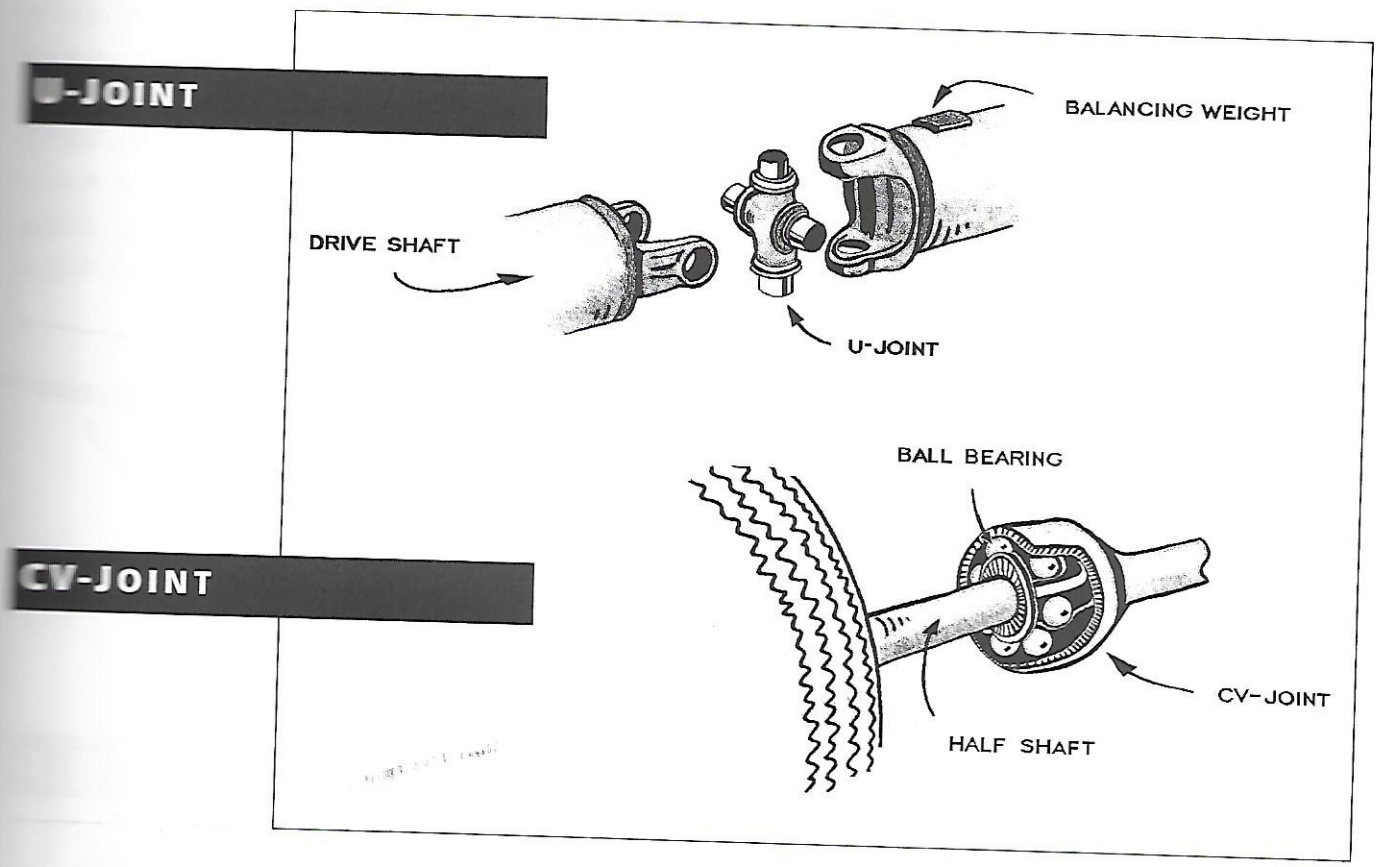
This concept can be demonstrated by placing two household fans facing each other. If only one is switched on, the other will soon spin at a similar rate. A torque converter uses this concept but employs liquid instead of air to make a stronger, more reliable connection. The liquid, called *transmission fluid*, also serves as a lubricant for all the moving parts in an automatic transmission.



Universal Joints

Universal joints, usually called *U-joints*, transfer spinning power through the changing angles from road bumps and the sway caused by steering around corners. The transfer of engine power must be smooth and continuous, despite these constantly changing angles. U-joints attach to each end of a drive shaft. U-joints are also used in some steering systems and in other automotive applications.

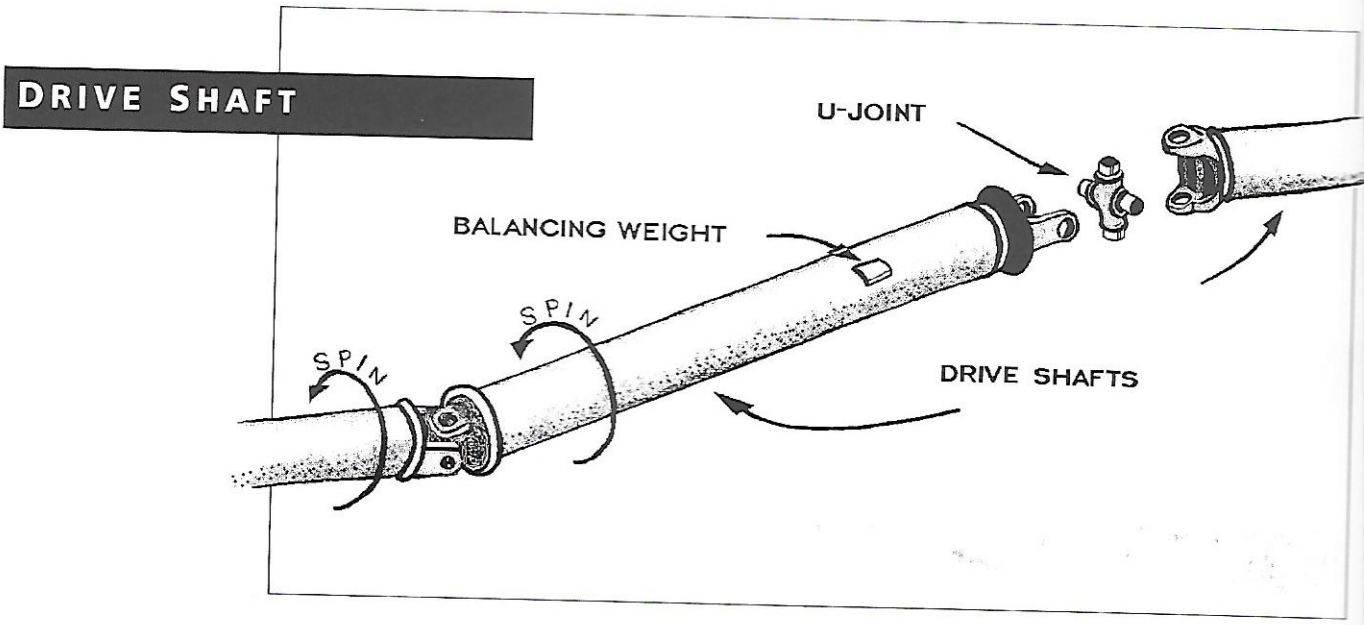
Because of the wider range of movement required by front wheel drive wheel assemblies, stronger, more flexible U-joint design is required. These U-joints, called *constant velocity joints* or *CV-joints*, use ball bearing mechanisms to reduce friction and provide the extra strength required to handle the complex forces and movements used in front wheel drive designs.



Drive Shaft

A *drive shaft* is a steel tube. In a rear wheel drive car, a drive shaft extends from the transmission to a differential with U-joints attached at each end. Small dents, or even mud, can affect the surprisingly delicate balance required. To avoid the balance sensitivity inherent in a long shaft, two short drive shafts are sometimes used instead, requiring an additional U-joint in the middle.

In a front wheel drive vehicle, *half shafts* are used in place of a long drive shaft. A half shaft is a short steel rod that connects a wheel assembly to a transaxle using CV-joints to make the connections. CV-joint assemblies are easily damaged by moisture or dirt and are protected by rubber "boots."



Differential

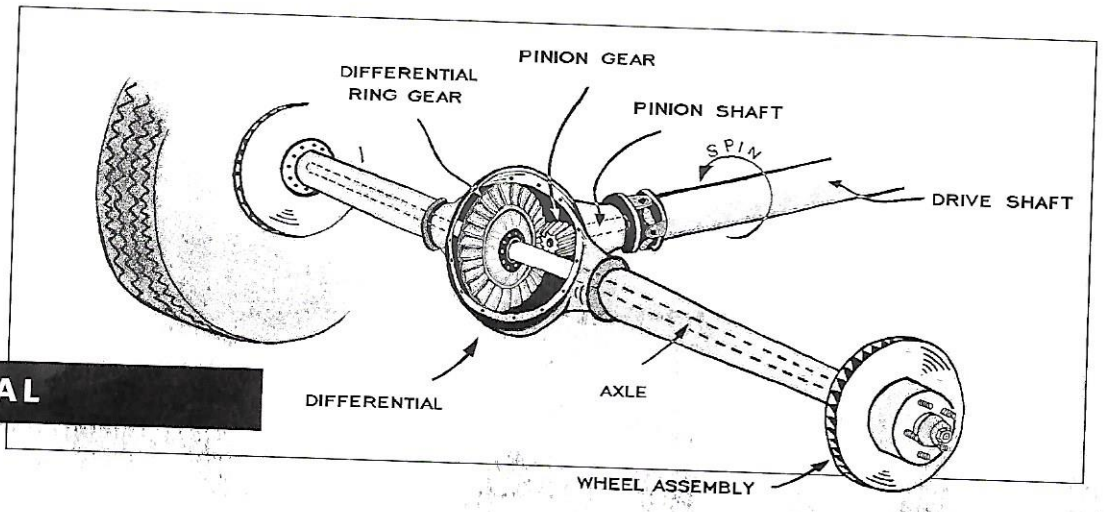
A *differential* is a watermelon-size part located between the two rear wheels. A differential is only used in rear wheel drive vehicles and contains the gears necessary to transfer spin force around a corner as well as mechanisms for several other important tasks. A differential has hollow arms extending to each rear *wheel assembly*. These arms enclose the *axles* which connect the wheels with the main rotating gears in a differential (shown below).

In most cars, only one wheel actually receives power, the *drive wheel*. This is adequate for most road surfaces, but in mud, sand, or snow a single drive wheel can easily slip, dig-in, and get stuck. A *limited slip differential* or *positraction* system helps eliminate this problem by automatically transferring power from a slipping drive wheel to the opposite wheel, doubling the chances of getting good traction.

A differential also allows the two rear wheels to rotate at different speeds. For example, when a car goes around a corner the outside wheels travel a slightly greater distance than the inside wheels, and the outside wheels must spin slightly faster to compensate. If a solid connection between both wheels remained, and they rotated at different speeds, something would break. A differential eliminates this problem.

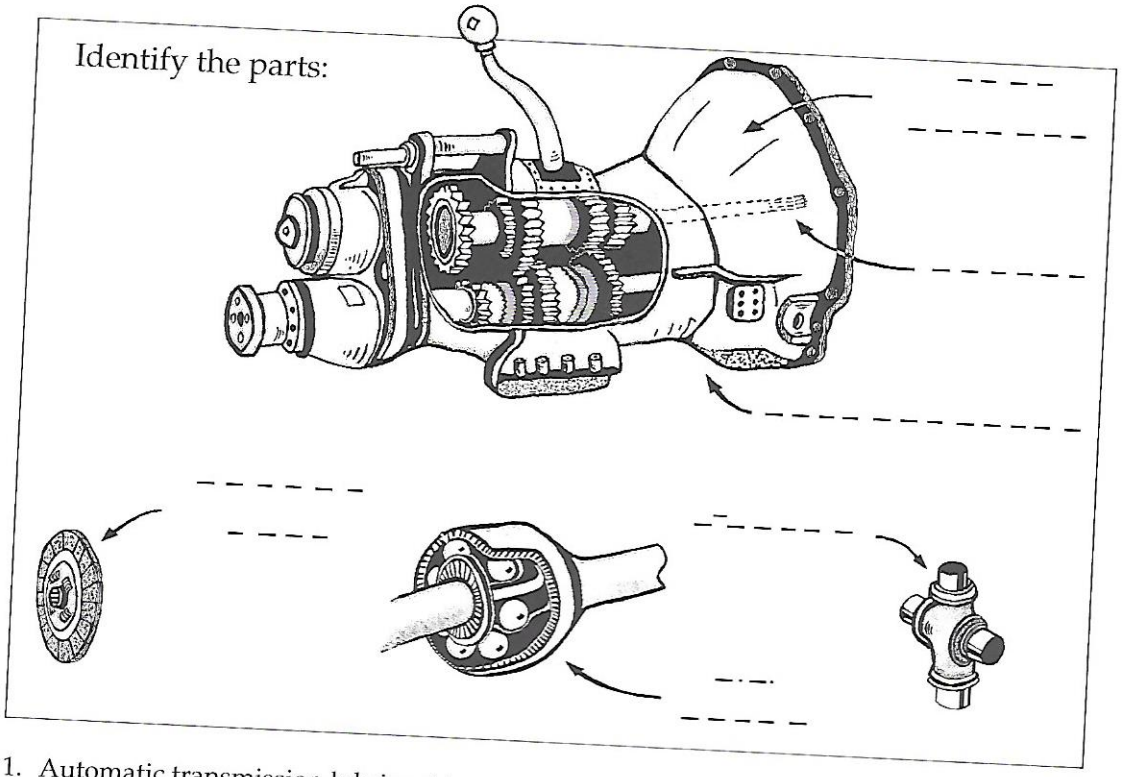
A front wheel drive vehicle uses a special differential called a *transaxle*. A transaxle is a combination differential/transmission.

A four wheel drive (FWD) vehicle has two differentials to supply power to all four wheels. Here a *transfer case* serves as a second differential for the front two wheels.



DIFFERENTIAL

DRIVE TRAIN TEST



1. Automatic transmission lubricant is called_____. *(p. 26)*

2. CV-joints are protected from dirt and moisture by_____. *(p. 28)*

3. Why is a flywheel heavy?
_____*(p. 25)*

4. An engine mounted sideways is called a _____engine placement. *(p. 23)*

5. _____ are used in place of drive shafts in front wheel drive vehicles. *(p. 28)*

6. Manual transmission: clutch
automatic transmission : _____ *(p. 26)*

7. Automobile wheels rotate at different speeds when cornering. (T) (F) *(p. 29)*

8. A _____connects a transmission to a differential. (p. 28)

9. A small_____ gear turns a large differential _____gear. *(p. 29)*

10. _____gears help to smoothly slide one gear to another. *(p. 24)*

11. A clutch disconnects an engine from a drive train by separating a clutch disc from a _____ *(p. 25)*

12. A drive train changes car speed by switching_____combinations. *(p. 21 & 24)*