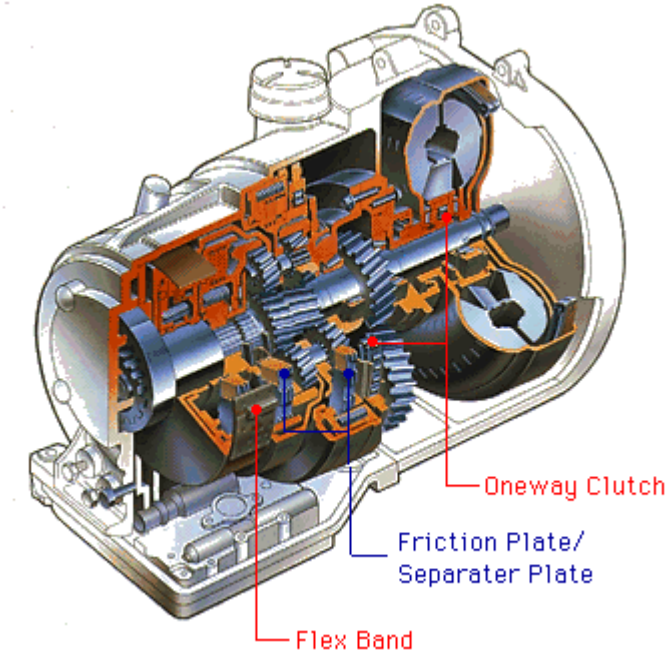
Transmission in Automobile

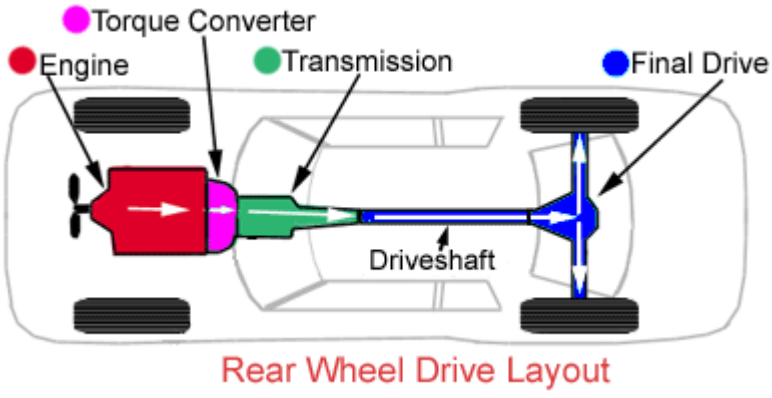
Introduction

The transmission is a device that is connected to the back of the engine and sends the power from the engine to the drive wheels.



Process

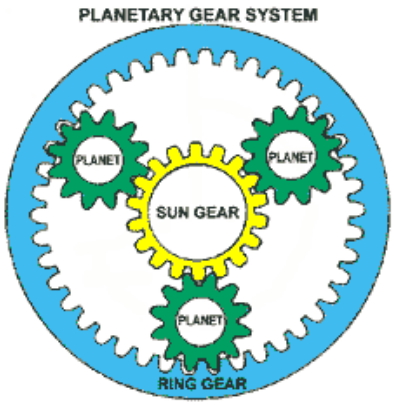
An automobile engine runs at its best at a certain RPM (Revolutions Per Minute) range and it is the transmission's job to make sure that the power is delivered to the wheels while keeping the engine within that range. It does this through various gear combinations. In first gear, the engine turns much faster in relation to the drive wheels, while in high gear the engine is loafing even though the car may be going in excess of 70 MPH. In addition to the various forward gears, a transmission also has a neutral position which disconnects the engine from the drive wheels, and reverse, which causes the drive wheels to turn in the opposite direction allowing you to back up. Finally, there is the Park position. In this position, a latch mechanism (not unlike a deadbolt lock on a door) is inserted into a slot in the output shaft to lock the drive wheels and keep them from turning, thereby preventing the vehicle from rolling.



Rear Wheel Drive Layout

The transmission is usually mounted to the back of the engine and is located under the hump in the center of the floorboard alongside the gas pedal position. A drive shaft connects the rear of the transmission to the final drive which is located in the rear axle and is used to send power to the rear wheels. Power flow on this system is simple and straight forward going from the engine, through the torque converter, then through the transmission and drive shaft until it reaches the final drive where it is split and sent to the two rear wheels.

Components for Transmission in Automobiles



Planetary Gear Sets: Automatic transmissions contain many gears in various combinations. In a manual transmission, gears slide along shafts as you move the shift lever from one position to another, engaging various sized gears as required in order to provide the correct gear ratio. In an automatic transmission, however, the gears are never physically moved and are always engaged to the same gears. This is accomplished through the use of planetary gear sets.

The basic planetary gear set consists of a sun gear, a ring gear and two or more planet gears, all remaining in constant mesh. The planet gears are connected to each other through a common carrier which allows the gears to spin on shafts called "pinions" which are attached to the carrier.

Hydraulic System

The Hydraulic system is a complex maze of passages and tubes that sends transmission fluid under pressure to all parts of the transmission and torque converter. The diagram at left is a simple one from a 3-speed automatic from the '60s. The newer systems are much more complex and are combined with computerized electrical components. Transmission fluid serves a number of purposes including: shift control, general lubrication and transmission cooling. Unlike the engine, which uses oil primarily for lubrication, every aspect of a transmission's functions is dependant on a constant supply of fluid under pressure. This is not unlike the human circulatory system (the fluid is even red) where even a few minutes of operation when there is a lack of pressure can be harmful or even fatal to the life of the transmission. In order to keep the transmission at normal operating temperature, a portion of the fluid is sent through one of two steel tubes to a special chamber that is submerged in anti-freeze in the radiator. Fluid passing through this chamber is cooled and then returned to the transmission through the other steel tube. A typical transmission has an average of ten quarts of fluid between the transmission, torque converter, and cooler tank. In fact, most of the components of a transmission are constantly submerged in fluid including the clutch packs and bands. The friction surfaces on these parts are designed to operate properly only when they are submerged in oil.

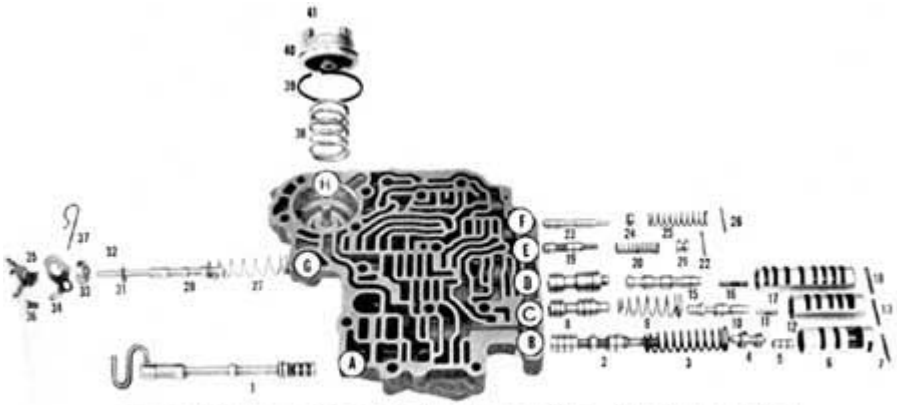
Oil Pump

The transmission oil pump (not to be confused with the pump element inside the torque converter) is responsible for producing all the oil pressure that is required in the transmission. The oil pump is mounted to the front of the transmission case and is directly connected to a flange on the torque converter housing. Since the torque converter housing is directly connected to the engine crankshaft, the pump will produce pressure whenever the engine is running as long as there is a sufficient amount of transmission fluid available. The oil enters the pump through a filter that is located at the bottom of the transmission oil pan and travels up a pickup tube directly to the oil pump. The oil is then sent, under pressure to the pressure regulator, the valve body and the rest of the components, as required.

Valve Body

The valve body is the control center of the automatic transmission. It contains a maze of channels and passages that direct hydraulic fluid to the numerous valves which then activate the appropriate clutch pack or band servo to smoothly shift to the appropriate gear for each driving situation. Each of the many valves in the valve body has a specific purpose and is named for that function. For example the 2-3 shift valves activate the 2nd gear to 3rd gear up-shift or the 3-2 shift timing valve which determines when a downshift should occur.

The most important valve and the one that you have direct control over is the manual valve. The manual valve is directly connected to the gear shift handle and covers and uncovers various passages depending on what position the gear shift is placed in. When you place the gear shift in Drive, for instance, the manual valve directs fluid to the clutch pack(s) that activates 1st gear. it also sets up to monitor vehicle speed and throttle position so that it can determine the optimal time and the force for the 1 - 2 shift. On computer controlled transmissions, you will also have electrical solenoids that are mounted in the valve body to direct fluid to the appropriate clutch packs or bands under computer control to more precisely control shift points.



Exploded view of a valve body section. Another section containing additional valves is mated to it. On some units, a third section will contain electrical components.

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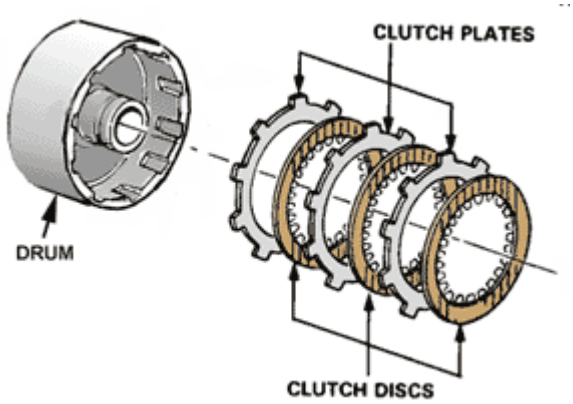
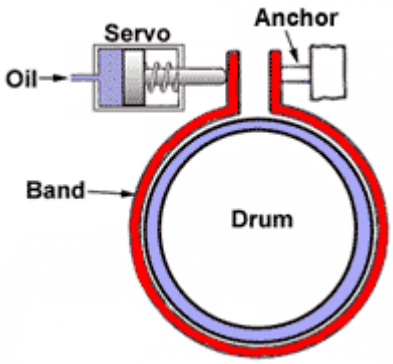
Clutch Packs

A clutch pack consists of alternating disks that fit inside a clutch drum. Half of the disks are steel and have splines that fit into groves on the inside of the drum. The other half have a friction material bonded to their surface and have splines on the inside edge that fit groves on the outer surface of the adjoining hub. There is a piston inside the drum that is activated by oil pressure at the appropriate time to squeeze the clutch pack together so that the two components become locked and turn as one.



Bands

A band is a steel strap with friction material bonded to the inside surface. One end of the band is anchored against the transmission case while the other end is connected to a servo. At the appropriate time hydraulic oil is sent to the servo under pressure to tighten the band around the drum to stop the drum from turning.



Seals and Gaskets

An automatic transmission has many seals and gaskets to control the flow of hydraulic fluid and to keep it from leaking out. There are two main external seals: the front seal and the rear seal. The front seal seals the point where the torque converter mounts to the transmission case. This seal allows fluid to freely move from the converter to the transmission but keeps the fluid from leaking out. The rear seal keeps fluid from leaking past the output shaft.

A seal is usually made of rubber (similar to the rubber in a windshield wiper blade) and is used to keep oil from leaking past a moving part such as a spinning shaft. In some cases, the rubber is assisted by a spring that holds the rubber in close contact with the spinning shaft.

A gasket is a type of seal used to seal two stationary parts that are fastened together. Some common gasket materials are: paper, cork, rubber, silicone and soft metal.

Aside from the main seals, there are also a number of other seals and gaskets that vary from transmission to transmission. A common example is the rubber O-ring that seals the shaft for the shift control lever. This is the shaft that you move when you manipulate the gear shifter. Another example that is common to most transmissions is the oil pan gasket. In fact, seals are required anywhere that a device needs to pass through the transmission case with each one being a potential source for leaks.

Governor, Vacuum Modulator, Throttle Cable

These three components provide the inputs that tell the transmission when to shift. The Governor is connected to the output shaft and regulates hydraulic pressure based on vehicle speed. It accomplishes this using centrifugal force to spin a pair of hinged weights against pull-back springs. As the weights pull further out against the springs, more oil pressure is allowed past the governor to act on the shift valves that are in the valve body which then signal the appropriate shifts.

Vehicle speed is not the only thing that controls when a transmission should shift, the load that the engine is under is also important. The more loads you place on the engine, the longer the transmission will hold a gear before shifting to the next one.

There are two types of devices that serve the purpose of monitoring the engine load: the Throttle Cable and the Vacuum Modulator. A transmission will use one or the other but generally not both of these devices. Each works in a different way to monitor engine load. The Throttle Cable simply monitors the position of the gas pedal through a cable that runs from the gas pedal to the throttle valve in the valve body.
The Vacuum Modulator monitors engine vacuum by a rubber vacuum hose which is connected to the engine. Engine vacuum reacts very accurately to engine load with high vacuum produced when the engine is under light load and diminishing down to zero vacuum when the engine is under a heavy load. The modulator is attached to the outside of the transmission case and has a shaft which passes through the case and attaches to the throttle valve in the valve body. When an engine is under a light load or no load, high vacuum acts on the modulator which moves the throttle valve in one direction to allow the transmission to shift early and soft. As the engine load increases, vacuum is diminished which moves the valve in the other direction causing the transmission to shift later and more firmly.

Reference:

www.familycar.com