

# ***AUTOMATIC TRANSMISSION IN CARS***

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## ABSTRACT

The modern automatic transmission is by far, the most complicated mechanical component in today's automobile. Automatic transmissions contain mechanical systems, hydraulic systems, electrical systems and computer controls, all working together in perfect harmony which goes virtually unnoticed until there is a problem. This article will help you understand the basic of the transmission, about automatic transmission, differences between manual and automatic transmission, the concepts behind what goes on inside these technological marvels and what goes into repairing them when they fail.

### *What is a transmission?*

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. 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.

## INTRODUCTION

One of the biggest things that has always separated drivers is whether they prefer an automatic transmission (sometimes known as a "slushbox", because of the characteristic "slushy" feel it creates when shifting between gears) or a standard transmission (often called, for more obvious reasons, a "stick shift").

There are a number of benefits to the standard transmission, but the prevailing reason that most people get them is because they prefer them. Car enthusiasts enjoy the feel of being able to control what gear they're in; it makes them feel closer to the vehicle. People who just want to drive and don't care much about how the car works usually prefer the automatic trannie.

If you have ever driven a car with an automatic transmission, then you know that there are two big differences between an automatic transmission and manual transmission:

- There is no clutch pedal in an automatic transmission car
- There is no gear shift in an automatic transmission car. Once you put the transmission into Drive, everything else is automatic!

### **The need to shift from manual to automatic transmission**

The key difference between a manual and an automatic transmission is that the manual transmission locks and unlocks different sets of gears to the output shaft to achieve the various gear ratios, while in an automatic transmission the same set of gears produces all of the different gear ratios. The planetary gear set is the device that makes this possible in an automatic transmission. Driving a manual transmission is especially painful in stop-and-go traffic, where you constantly have to change your gear state. You might also make the case that having to concentrate on shifting your transmission takes some of your attention away

from the actual driving, which is dangerous, because you might be concentrating on your tachometer or your gearshift when you really should be focusing on the traffic. An automatic transmission bypasses these problems entirely.

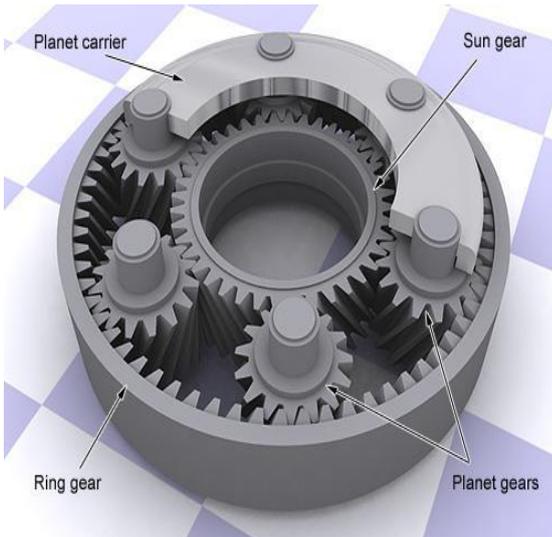
## COMPONENTS OF AUTOMATIC TRANSMISSION

When you take apart and look inside an automatic transmission, you find a huge assortment of parts in a fairly small space. Among other things, you see:

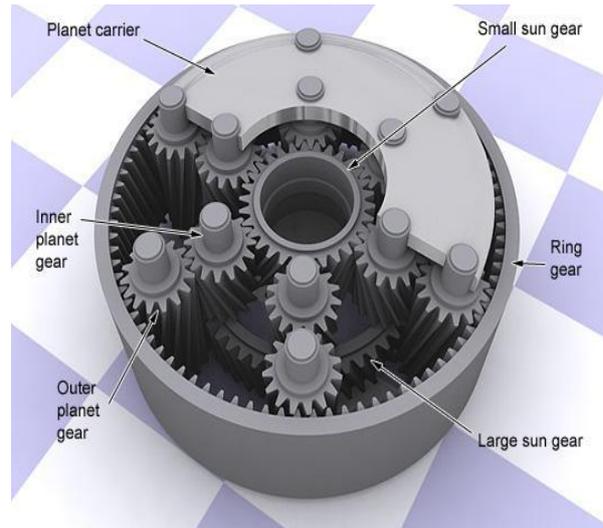
### ➤ Planetary gear sets

The automatic system for current automobiles uses a planetary gear set instead of the traditional manual transmission gear set. The planetary gear set contains four parts: sun gear, planet gears, planet carrier, and ring gear (see **Figure 1.**) Based on this planetary set design, sun gear, planet carrier, and ring gear spin centrifugally. By locking one of them, the planetary set can generate three different gear ratios, including one reverse gear, without engaging and disengaging the gear set.

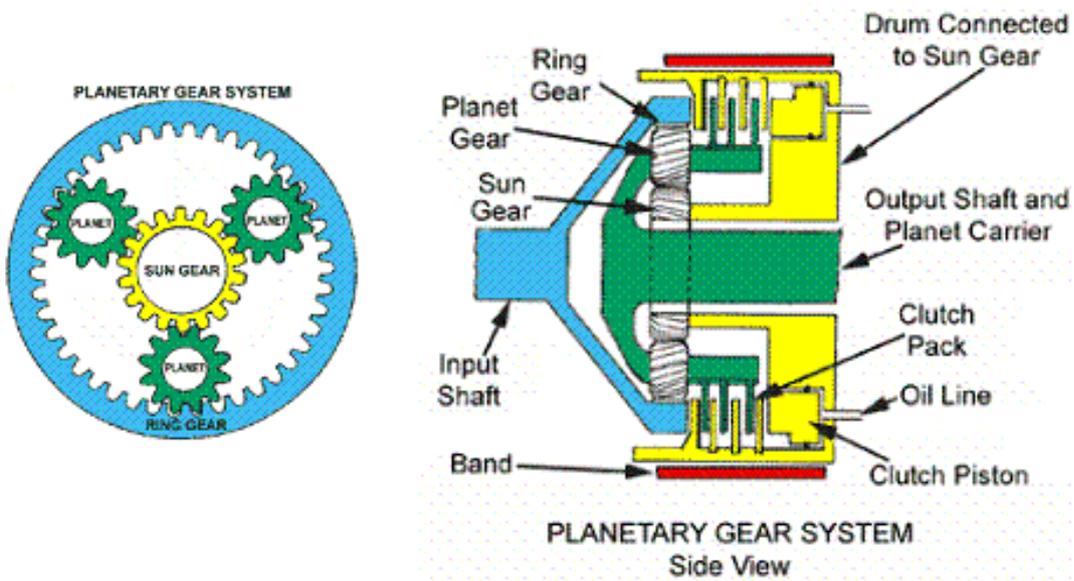
Normally an automatic transmission system has two planetary gear sets with different sizes of sun gears with their planet gears inter-meshed (see **Figure 2.**) Only one planet carrier is used to connect both sets of planet gears. This is called a compound planetary gear set. This design can generate four different gear ratios and one reverse gear.



**Figure 1 : Planetary Gear Set**



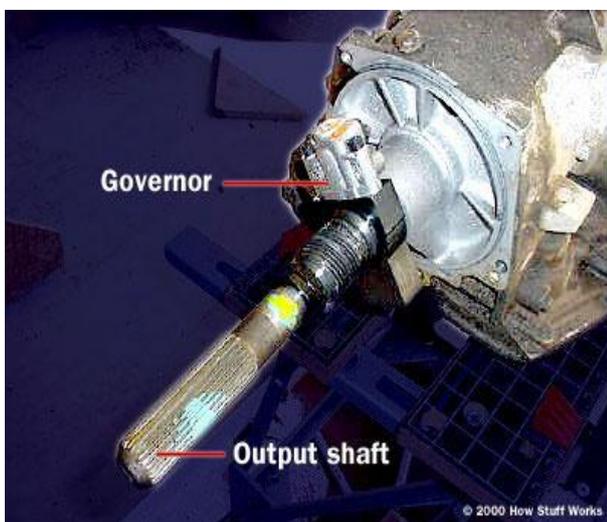
**Figure 2 : Compound Planetary Gear set**



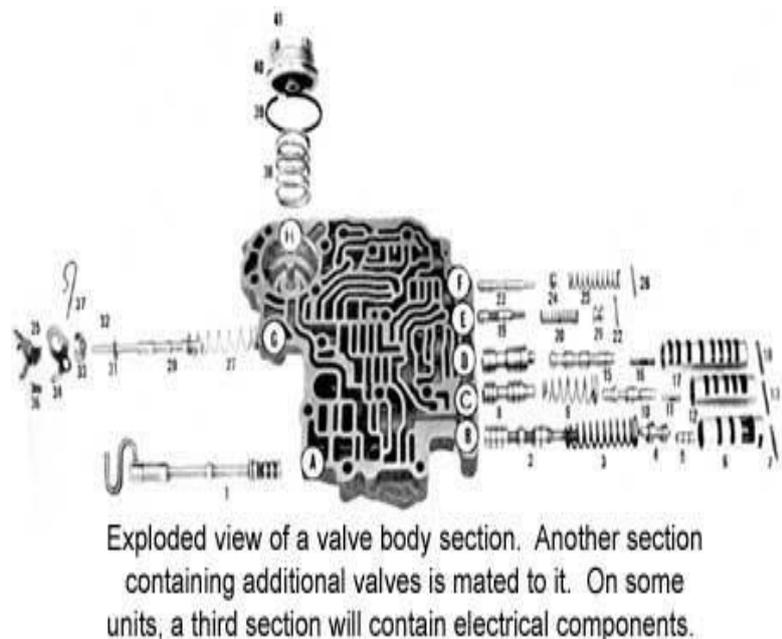
**Figure 3 : planetary Gear sets with Band and Clutch**

## ➤ Hydraulic System

It uses a special transmission fluid sent under pressure by an Oil Pump through the Valve Body to control the Clutches and the Bands in order to control the planetary gear sets. Both the band and clutch piston are pressurized by the hydraulic system. The part connecting the band or clutches to the hydraulic system is called the shift valve, while the one connecting the hydraulic system to the output shaft is called the governor (see **Figure 4**). The governor is a centrifugal sensor with a spring loaded valve. The faster the governor spins, the more the valve opens. The more the valve opens, the more the fluid goes through and the higher the pressure applied on the shift valve. Therefore, each band and clutch can be pushed to lock the gear based on a specific spin speed detected by the governor from the output shaft. To make the hydraulic system work efficiently, a complex maze of passages was designed to replace a large number of tubes (see **Figure 5**).



**Figure 4** :Governor

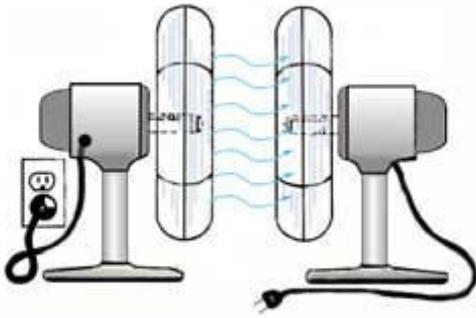


**Figure 5** :Hydraulic System with Maze structure

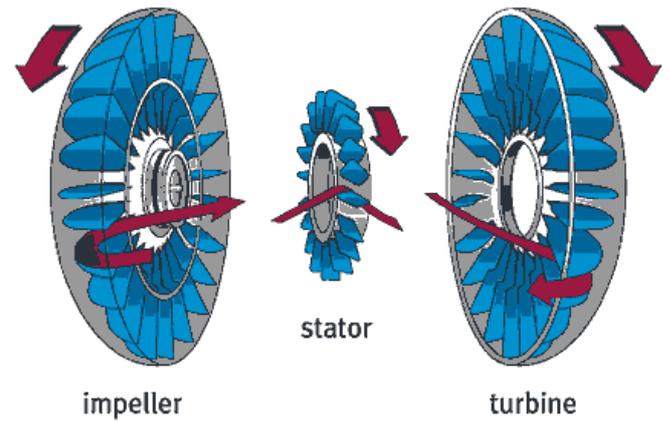
## ➤ **The Torque Converter**

Unlike a manual transmission system, automatic transmission doesn't use a clutch to disconnect power from the engine temporarily when shifting gears. Instead, a device called a torque converter was invented to prevent power from being temporarily disconnected from the engine and also to prevent the vehicle from stalling when the transmission is in gear. Consider two fans facing each other: when one of them is turned on and starts spinning, the other one will also start spinning at a lower speed (see **Figure 6**). That's because the first fan moves the air to drive the second fan to spin. This is the same idea as the torque converter of an automatic transmission system, except that it uses fluid instead of air as the transportation media.

A torque converter consists of four parts, a pump (impeller), turbine, stator, and transmission fluid (**Figure7**). The pump is connected to the engine and transfers engine power to the transmission fluid. The fluid causes the turbine, which is connected to the input shaft, to spin. The stator is used to redirect fluid returning from the turbine before it hits the pump, again to increase the efficiency. In this design, even when the vehicle is in gear but not moving (the turbine is forced to stop), the pump can still keep spinning without causing the engine to stall. When the vehicle speed is slow, the turbine is always spinning more slowly than the pump. However, when the vehicle moves at high speed, the turbine can spin at almost the same speed as the pump. Therefore, for modern cars, a "lock up" will occur between pump and turbine when the vehicle is at high speed in fourth gear, which makes the torque converter work more efficiently.



**Figure 6**



**Figure 7:** The Structure of a Torque Converter.

- **Tiptronic transmission** is a special type of automatic transmission with a computer controlled automatic shift. The driver can switch the transmission to manual mode, which lets the driver to shift the gear at his wish sequentially up (+) or down (-) (see **Figure 8**) without disengaging the clutch. This works just like a manual transmission; however, it still uses a torque converter to transfer power from the engine. Unfortunately, this is less efficient than a manual transmission.



**Figure 8 :** Tiptronic transmission.

## Spotting problems before they get worse

- Watch for leaks or stains under the car.
- Check fluid for color and odor.
- Be sensitive to new noises, vibrations and shift behavior.

## Precautions and Maintenance

- Transmission fluid should be changed periodically.
- According to 'B & M', the optimum operating temperature for automatic transmission fluid is 170 degrees. For every 10 degree increase in operating temperature, the useable life of the fluid is reduced by half.

## Advantages of automatic transmission

- It's a lot less work because you don't have to worry about juggling the gearshift with the clutch.
- You don't need to worry about stripping your gears.
- Car will never stall during gear shifting.

## Limitations of automatic transmission

- Indirect contact of the torque converter causes the power loss during transmission.
- The 'killer' of automatic transmissions is heat. Excessive heat causes the fluid to lose its ability to lubricate, which leads to higher internal-component friction, all resulting in rapid wear-and-tear and premature transmission failure.
- Complicated planetary structure makes the transmission heavy and easily broken.

## Conclusion

Being able to drive a stick-shift means more than just understanding your gears, however. That's because to shift gears, you usually don't just move the shift lever and be done with it. (You can do this sometimes, but it's not recommended in day-to-day driving, and we'll get to it later.) Instead, you have to press the clutch pedal while you shift. . Keeping the transmission and its fluid cool, and in the correct operating-temperature range is crucial for long life.