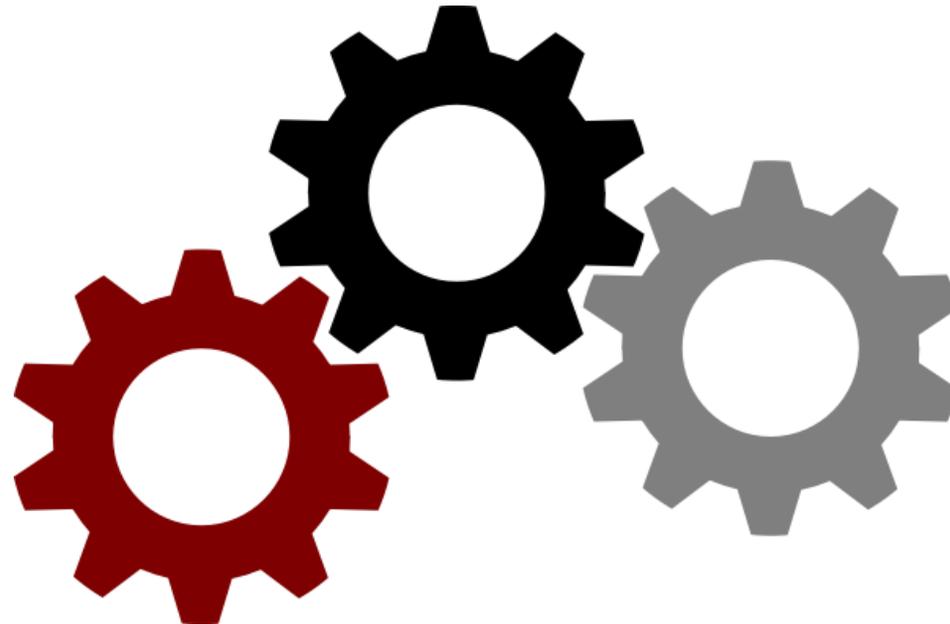


How a Manual Transmission Shifts Gears



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ENL 3030

Audience and Scope

The intended audience of this description set is people who want to know how a manual **transmission** works because they either, drive a manual transmission car and would like to know more about what goes on underneath them, or for people who are just curious. A secondary audience could be engineering students who are learning about transmissions and need to learn more about them. This is made for people who have little to no knowledge of transmissions and will have many definitions to help them along.

Introduction

Manual transmissions are the part of the machinery in a car which allows the car to move. In a manual transmission, the car relies on the driver to maintain movement and is more involved than pushing the **throttle**, also known as the gas pedal, or brake. A manual transmission car has three pedals, one of which is called the **clutch**. Cars with this type of transmission are less sought after due to the complexity of getting one to work accordingly. Most cars in the U.S. are automatic transmissions which serves the same purpose as a manual transmission but is all powered by the car itself.

⚙️ **Transmission:** the mechanism by which power is moved from an engine to the wheels of a motor vehicle

⚙️ **Clutch:** Pedal used to shift gears

Background

Manual transmissions were the first type of transmission developed on vehicles and are known to be more difficult to drive but less complex in their machinery compared to an automatic transmission. A manual transmission can use either a stick to change gears, controlled by the driver, or paddles on the steering column to shift gears, also controlled by the driver. The term 'manual' in manual transmission is eluding to the fact that the driver does the work to shift gears when it is time rather than the transmission doing shifting gears itself.

Most manual transmissions, have at least five gears, going up to six gears in a standard stick shift vehicle. Paddle shifters can have more due to them not needing the 'H' pattern gear shifter taking up space. It was not until the 1920's that the automatic transmission was created and the manual decreased in popularity. Today, manual transmissions will cost usually one to two thousand dollars cheaper than automatics but automatics are still more popular due to convenience for the driver. Even though the manual transmission is less sought after in a vehicle, they are still an option on many street cars and race cars today.

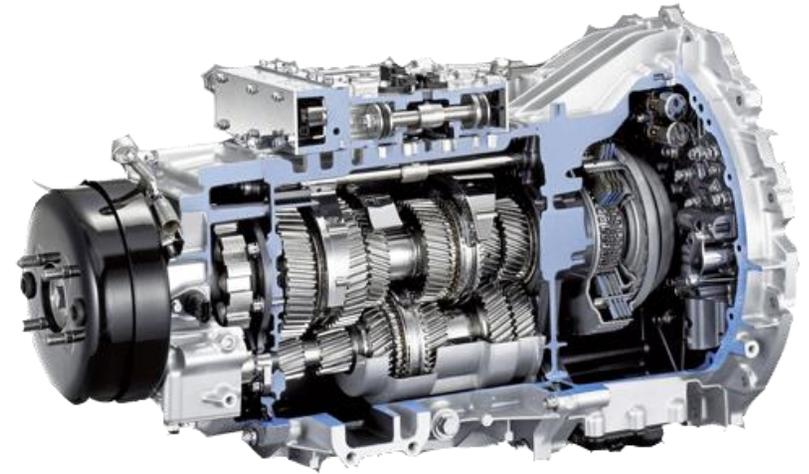


Figure 1: A car's transmission
(Source: AS Auto Parts Blog)

Key Parts to Know and Where They're Located

Transmission: Located at the end of the engine nearest the car's cabin and is where all the gear shifts occur

Throttle (Gas Pedal): Located at the driver's feet, furthest pedal on the right and is responsible for the action which accelerates the car

Clutch Pedal: Located at the driver's feet, furthest pedal on the left and causes the transmission to disconnect from the engine

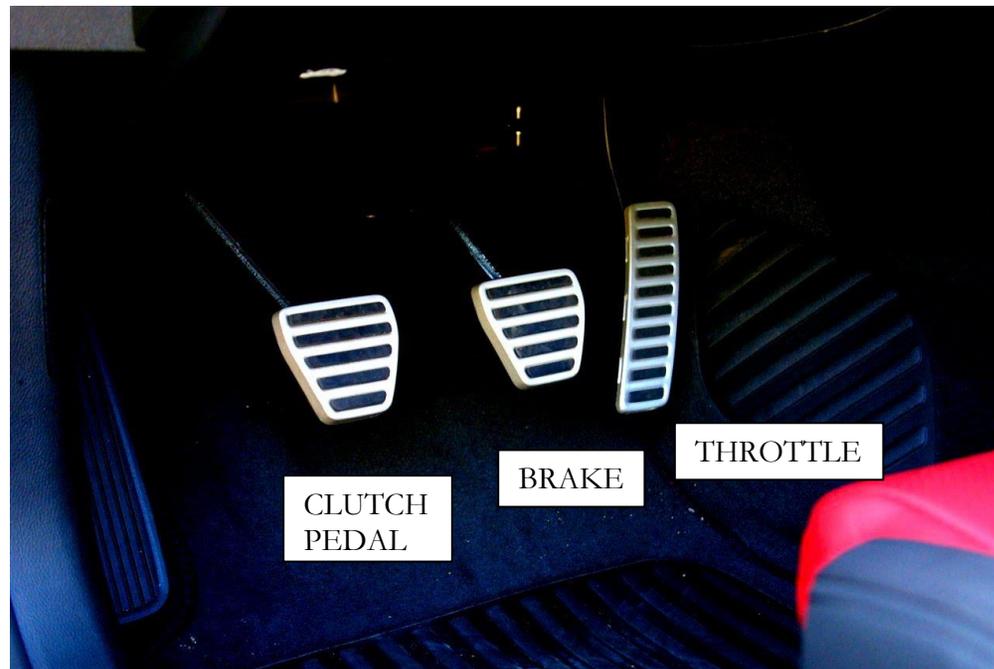


Figure 2: The locations of the three pedals in the driver's foot well (Source: YouTube)

Figure 3: The three pedals used by the driver, located in the cabin of the vehicle (Source: Quora)

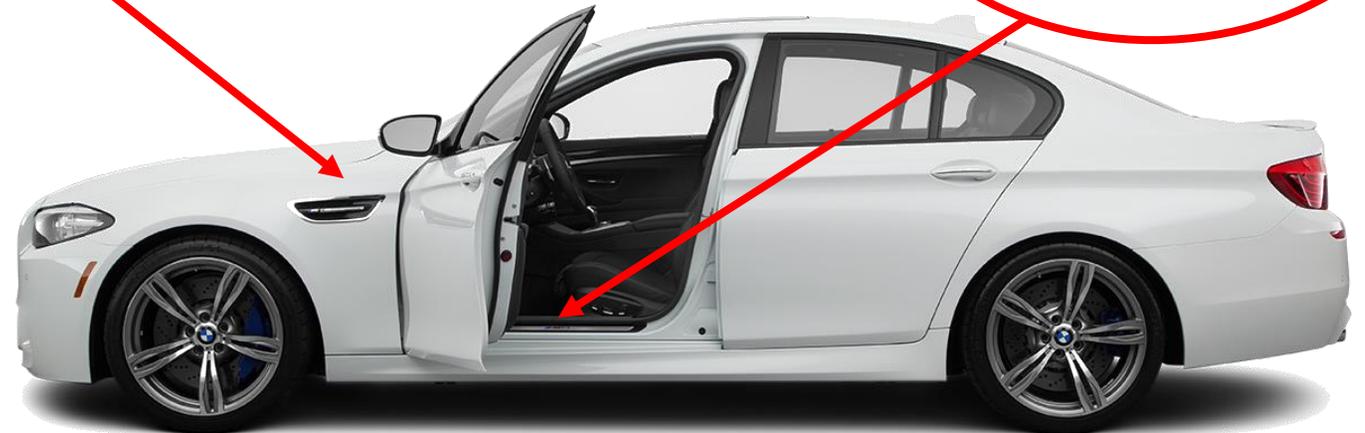
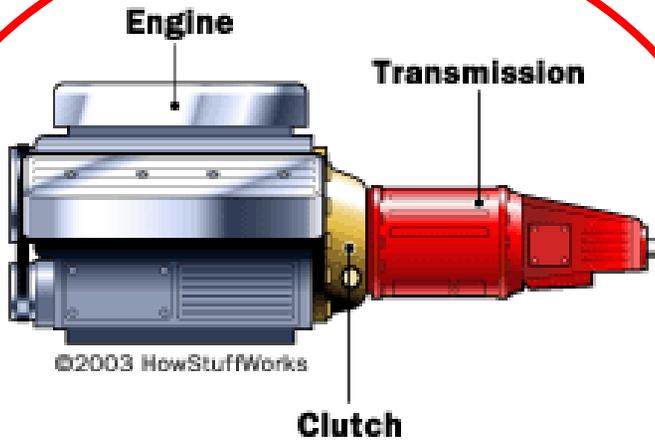


Figure 5: Side view of a car with the engine located in front (Source: CarNow)

Figure 4: The locations of the clutch and transmission in relation to the engine (Source: How Stuff Works)



Introduction to Process

The process of a manual transmission changing gears is a complex one. It starts with the clutch disengaging the engine and from there the gears can change. When the gears are done shifting then the clutch re-engages the engine and the car can continue its drive.

Shifting of Gears in a Manual Transmission

Driving at 2000 **RPMs** in first gear, the transmission is running at the correct level of power. When the throttle is pressed and the RPMs increase to 6500 (**redline**), the car needs to be shifted up a gear. (See figure 1)

- ⚙️ **RPM:** Revolutions per minute, in this case, of the pistons within the engine
- ⚙️ **Redline:** The point at which an engine needs to be shifted to the next gear to properly function

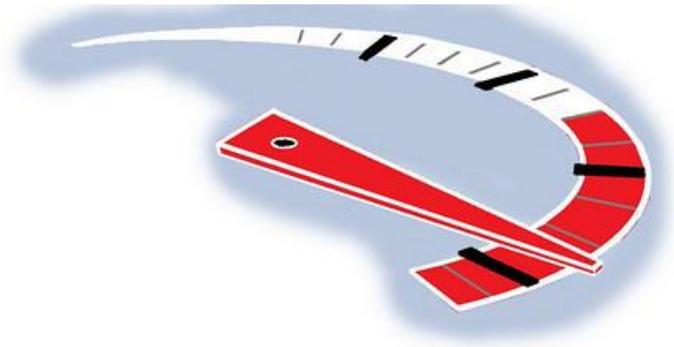


Figure 6: RPMs at redline as shown on tachometer

Step 1)

When the clutch is pushed, when the RPMs hit redline or slightly before, this causes the **pressure plate** to separate from the **flywheel** and the engine is disengaged from the transmission

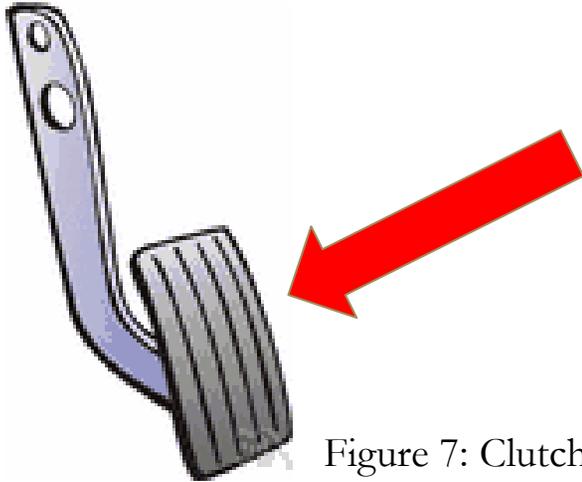


Figure 7: Clutch being pushed (Source: The Free Dictionary)

- ⚙️ **Pressure Plate:** Connects to the flywheel and transmission, engages with flywheel to allow car movement
- ⚙️ **Flywheel:** Connects to the pressure plate and engine, engages with pressure plate to allow car movement

Step 2)

Now, the **shifting knob** is moved from first gear to second gear, which allows the gears to change.

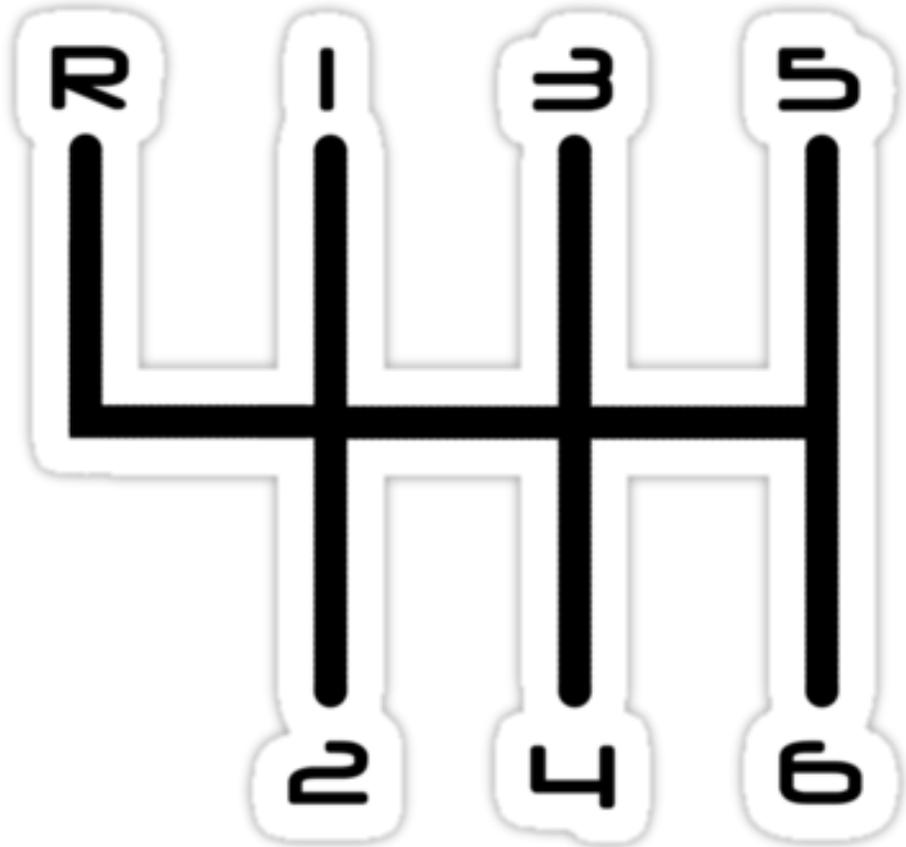


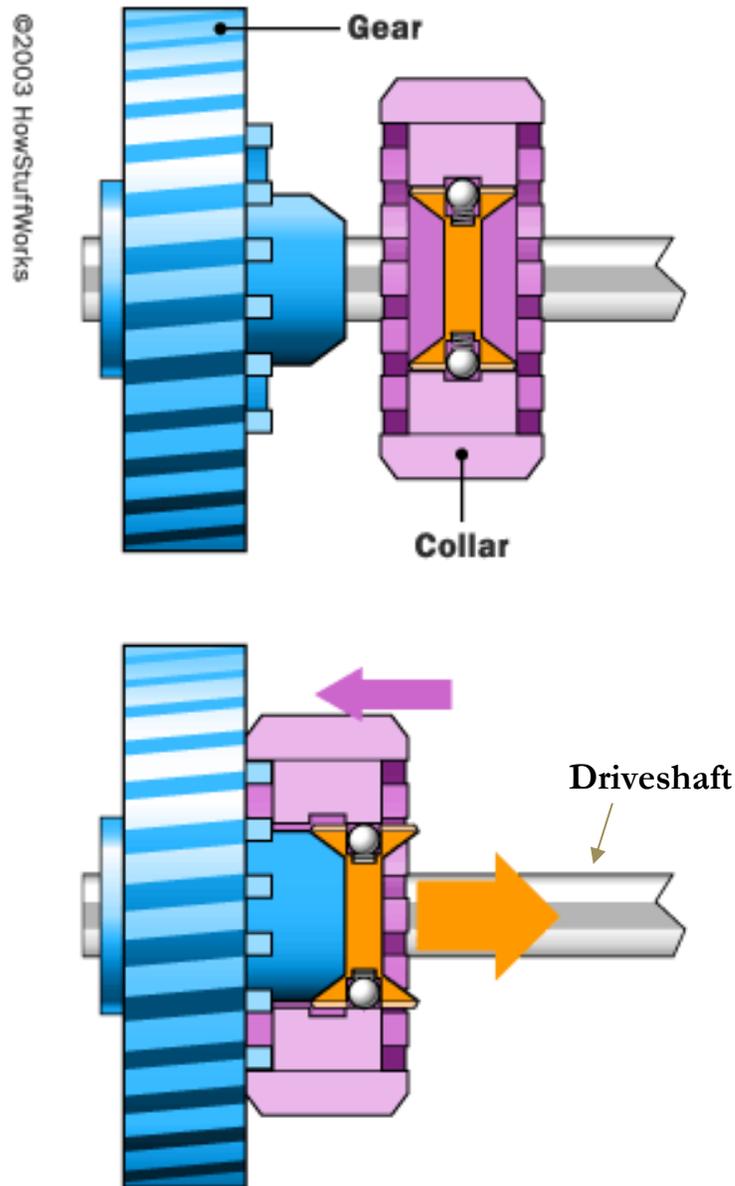
Figure 8: H pattern of a gearbox (Source: RedBubble)

NOTE: The **gearbox** is set up in an H pattern with 5-6 gears and a reverse to shift to (see figure 8)

- ⚙ **Shifting Knob:** The stick used by the driver to change gears
- ⚙ **Gearbox:** A box in the transmission that contains the gears

Step 3)

When the shifting knob is moved to second gear, the **collar**, which is on the **driveshaft**, connects to the corresponding gear. Meanwhile, the disengaged gears are spinning freely with no effect on the driveshaft.



⚙️ **Collar:** The gear used to connect one of the 6 gears to the driveshaft

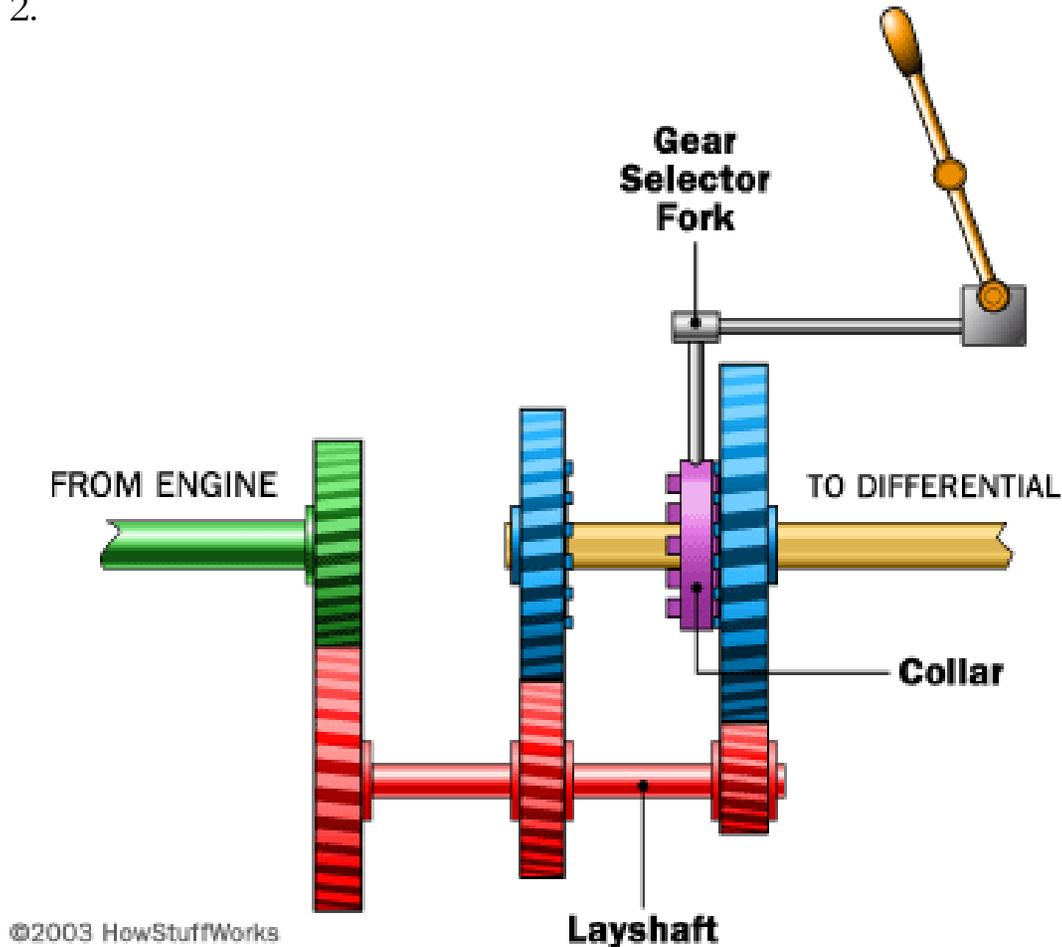
⚙️ **Driveshaft:** A rotating shaft that connects torque to the engine

Figure 9: The collar engaging with the gear (Source: HowStuffWorks 2003)

Step 4)

Once the collar engages the correct gear, the clutch is released which re engages the engine and delivers the **torque** to the engine; this completes the change of gears from gear 1 to gear 2.

⚙️ **Torque:** The force that rotates an object on its axis



Now that the engine has power and is reconnected to the transmission, the throttle can be pushed and the car can accelerate once more and go faster than previous to shifting gears. This process is repeated every time that the car needs to be shifted up or down a gear while driving.

Figure 10: The gearbox (Source: HowStuffWorks 2003)

Works Cited

Brain, Marshall. "How Manual Transmissions Work." *How Stuff Works*, How Stuff Works, auto.howstuffworks.com/transmission5.htm. Accessed 24 Mar. 2017.

Dunn, Brent. "How Does a Manual Transmission Work?." *Autobytel*, Autobytel, www.autobytel.com/car-ownership/technology/how-does-a-manual-transmission-work-123811/. Accessed 24 Mar. 2017

