

Automechanics Fourth Year

Module 5 Horse Power

What this module is about

This module includes three systems namely: power train, transmission, differential and axle assembly. These systems have different functions in vehicle operation. The main purpose of the clutch system under power train is to connect and disconnect power from the engine to the rear wheels. The function of the transmission with different speed gears is to transmit engine power efficiently and smoothly to the rear wheels and axles in various situations and at different paces of speed.

This module aims to do the following:

1. Explain the operation principles of the clutch assembly.
2. Identify the parts of the clutch assembly.
3. Adjust clutch free play.
4. Adjust the clutch pedal.
5. Explain the function of a transmission system.
6. Discuss the types of transmission systems.
7. Identify the external and internal parts of the transmission system.
8. Trace the flow of power in the different gears.
9. Explain the function of the differential and axle assembly.
10. Identify the internal parts of the differential and axle assembly.
11. Diagnose the troubles and remedies of the differential and real axle assembly.

PRETEST

Directions: Write on the blank before each number the letter of the corresponding answer to each question.

- _____ 1. A thin metal enclosing the different parts of the clutch.
a. clutch pressure plate
b. clutch cover
c. clutch pressure spring
d. clutch lining
- _____ 2. Friction materials usually made of asbestos bonded or riveted to the cushion spring.
a. torsional spring
b. adjusting screw
c. clutch pressure plate
d. clutch lining
- _____ 3. Adjusts the uniform clearance between the disc and the pressure plate.
a. clutch lining
b. adjusting screw
c. clutch disc assembly
d. clutch fork
- _____ 4. It is riveted through a flange at the center of the disc in the cushion spring.
a. clutch lining
b. spline hub or clutch hub
c. adjusting screw
d. release lever
- _____ 5. A design to draw the pressure plate away from the clutch disc when the clutch pedal is depressed during shifting of the transmission gear.
a. clutch lining
b. release lever or clutch finger
c. adjusting screw
d. torsional spring
- _____ 6. The 1-2 synchronizer which is moved to the right, for its internal teeth to engage the external teeth.
a. first gear
b. fourth gear
c. reverse gear
d. shifting fork
- _____ 7. The 1-2 synchronizer which is moved to the left so its internal teeth can engage the external teeth.

- a. second gear
- b. reverse gear
- c. third gear
- d. pilot gear

- _____ 8. A device in the transmission that synchronizes the gear about to be meshed to prevent any gear clash.
- a. synchronizer
 - b. reverse gear
 - c. fourth gear
 - d. idler gear
- _____ 9. An additional gear that must be meshed to obtain the reverse gear.
- a. reverse idler gear
 - b. second gear
 - c. spur gear
 - d. third gear
- _____ 10. The shaft in the transmission which is driven by the clutch gear.
- a. counter shaft gear
 - b. gear shaft
 - c. main shaft
 - d. shifting shaft

Lesson 1 The Clutch System

The clutch is a very important part of an automobile because it engages and disengages power from the engine to the rear wheels.

The clutch has different parts such as the clutch cover, clutch pressure plate, clutch pressure spring, release lever or clutch fingers, adjusting screw, clutch disc assembly, clutch lining, torsional springs, spline hub or clutch hub, clutch shaft or main drive shaft.

1. The clutch cover - a thin metal cover enclosing the different parts of the clutch.
2. The clutch pressure plate - a thin plate made up of cast iron, the smooth side of which presses the clutch disc against the surface of the flywheel.
3. The clutch pressure spring - holds the clutch firmly against the surface of the flywheel.
4. Release lever or clutch fingers - these draw the pressure plate away from the clutch disc when the clutch pedal is depressed during the shifting of transmission gear.

5. The adjusting screw - used to adjust the correct level of the release lever or clutch finger to achieve uniform clearance between the disc and the pressure plate.
6. The clutch disc assembly - located between the flywheel assembly and the pressure plate and attached to the main drive shaft or clutch shaft by means of spline.
7. Clutch lining - this material is usually made of asbestos bonded or riveted to the cushion spring.
8. Cushion spring - compresses the clutch, acts like a cushion and produces smoke.
9. Torsional spring - this spring absorb torsion vibration between the driving members when the clutch pedal is partially released and partially engaged, the torsional spring compress and absorb the twisting force exerted by the driving members.
10. Spline hub or clutch hub - riveted through a flange at the center of the disc in the cushion spring.
11. Clutch shaft or main drive shaft - carries the power from the clutch to the transmission.

Adjusting clutch free play and clutch pedal have the following procedures. Prepare the tools and materials needed in the operation. Below are the tools and materials to be used:

| Tools | Materials |
|----------------------------|---------------|
| set of box wrench | clean rags |
| set of open-ended wrenches | cotton pin |
| pliers | pan (working) |
| measuring tools | gasoline |

Operating Steps When Adjusting the Clutch Pedal Free Play

1. Loosen the specification for clutch pedal free play adjustment for the particular clutch.
2. Loosen the adjusting rod lock nut.
3. Turn adjusting rod lock nut until the desired free play of the clutch.
4. Hold the adjusting nut permanently and tighten the adjusting rod lock nut.
5. Recheck the clutch free travel.

Activity 1

1. Make a list of steps required to remove and replace a clutch. File this list in your notebook.
2. Prepare a set of 3 x 5 inch trouble diagnosis cards based on the trouble - diagnosis chart.
3. List down customer complaints, condition found, repairs performed and special tools used.

Activity 2

1. List down the four causes of clutch slippage.
2. Check the causes of clutch noise when the clutch is engaged.
3. Dismantle and assemble the clutch assembly attached to the engine assembly.

Self-check:

1. How did you made a list of the steps required to remove and replace a clutch?
2. Did you record in your notebook the trouble-diagnosis of a clutch?
3. Did you list down customer complaints, condition found, repairs done and special tools used?
4. Did you list down the four causes of clutch slippage?
5. Did you check the causes of clutch noise when it is engaged?
6. Did you dismantle and assemble the clutch assembly attached on the engine assembly?

Lesson 2 Transmission

Most cars with manual transmissions have a four-speed transmission. It has four forward speeds and reverse. In some four-speed transmissions, the fourth gear is actually overdrive. It has three shafts and eight spur gears of varying sizes. Four of the gears are rigidly connected to the countershaft. These are the driven gear, second speed gear, the first-speed gear and the reverse gear.

The main function of the transmission is to connect and disconnect power from the engine to the rear wheels. It engages and disengages power from the engine to the rear wheels.

Parts and Functions of the Transmission Assembly

1. First Gear - The 1-2 synchronizer is moved to the right to make the internal teeth engage the external teeth.
2. Second Gear - The 1-2 synchronizer has been moved to the left so its internal teeth engage the external teeth.
3. Third Gear - The 3-4 synchronizer is moved to the right to make its internal teeth engage the external teeth.
4. Fourth Gear - The 3-4 synchronizer has been moved to the left for its internal teeth to engage the external teeth.
5. Reverse - The reverse gear is moved to the left, so it engages the reverse idler gear.
6. Gearshift linkage - A typical linkage between the floor mounted gearshift lever and the transmission. This is the “four on the floor” arrangement. It carries the movement to the reverse parts that moves the reverse gear.

7. Countershaft - The shaft in the transmission which is driven by the clutch gear; gears on the countershaft drive gear on the main shaft when the latter are shifted into gear.
8. Synchronizer - A device in the transmission that synchronizes gears about to be meshed to prevent any gear clash.
9. Reverse Idler Gear - In a transmission; an additional gear that must be meshed to obtain the reverse gear, a gear used only in reverse and is idle when the transmission is in another position.

Activity 3

1. Make a list of car models and types of manual transmission.
2. Examine disassembled transmission parts.
3. Trace power flow of the different speed gear positions.
4. Draw the first, second, third and fourth gears.
5. Count the turns of the main transmission shaft.

Self-check:

1. Did you make a list of car models and types of manual transmission?
2. Did you examine a disassembled transmission part?
3. Did you trace the power of the different speed gear positions?
4. Did you draw the first, second, third and fourth gear?
5. Did you count the turns of the transmission shaft main shaft?

Lesson 3 The Differential

The parts and function of the differential and axle are to allow one rear wheel to turn faster than the other. Whenever the car goes around a turn, the outer rear wheel travel a longer distance than the inner rear wheel. The pinion gear rotate on their shaft and send more rotary motion to the outer wheel.

When the car moved down a straight road, the pinion gear do not rotate on their shaft. They apply equal torque to the bevel gear. Hence, both rear wheels rotate at the same speed.

There are two basic types of axles, the dead axle and live axle. The dead axle does not rotate. The wheel rotates on it. A common example is the axle of a horse-drawn in gear. Live axles are attached to the wheel to make the wheel and the axle rotate together.

Parts of Differential and Axle Assembly

The rotation of the ring gear makes the differential rotate. When the differential case rotates, the two pinion gears and their shaft move around in a circle with the differential case. The two differential side gears are meshed with the pinion gears, and the differential side gears rotate.

The outer rear wheel turns faster than the inner rear wheel as the car rounds a curve. As the differential case rotates, the pinion gears have to rotate on their shafts.

The differential can allow one rear wheel to turn faster than the other. Whenever the car goes around a turn, the outer rear wheel travels farther distance than the inner rear wheel.

Parts and Functions of the Differential and Axle Assembly

1. Ring gear - a large gear carried by the differential case member will all in driven by the drive pinion.
2. Axle - a crowbar supporting a vehicle and on which one or more wheel turn.
3. Differential case - the metal unit that encases the differential pinion and side gear, and to which the ring gear is attached.
4. Drive Pinion - a rotating shaft used in the differential to transmit torque to another gear.
5. Bearing - a part that transmits a load to a support, thus absorbing the friction of moving parts.

Activity 4

1. Make a drawing of parts of the differential and axle assembly.
2. List down the different axle ratios in differential and axle assembly.

Self-check:

1. Did you draw the different parts of the differential and axle assembly?
2. Did you list down the different axle ratios in differential and axle assembly?

Lesson 4 Differential and Axle Assembly, Troubles, Causes and Remedies

The differential carries the driving power from the propeller shaft to the rear axle shafts. It transmits power from the engine at various angles and allows the rear wheels to turn at different speed or even one wheel running independently of the other wheel. As the propeller shaft rotates, power from the propeller shaft is transmitted to the differential ring gear by means of the drive pinion gear as these are in constant mesh.

Troubles, causes and remedies of the differential and axle assembly are as follows:

1. Noise when pulling straight ahead.

| Causes | Remedies |
|--|----------------------|
| Not enough grade of oil | Check gear oil |
| Strong grade of oil | Check gear oil |
| Poor quality of oil | Use quality oil |
| Ring gear pinion with excessive backlash | Check adjustments |
| Ring gear and pinion worn-out | Adjust pinion worn |
| Pinion shaft bearings worn-out or loose | Replace |
| Excessive pinion shaft end play | Check clearance |
| Warped ring gear | Replace |
| Differential bearings worn-out or loose | Replace |
| Loose ring gear rivet or screw | Tighten loose rivets |

2. Intermittent noise and its causes:

| Causes | Remedies |
|---|----------|
| Warped ring gear | Replace |
| Loose ring gear rivets or screw | Replace |
| Improperly installed ring gear on the differential due to dirt or burn between meshing gear | Adjust |

3. Knocks or clicks

| Causes | Remedies |
|---|------------------|
| Flat spot ring gear or pinion tooth, tooth chipped or particle of metal lodged on the tooth | Check and adjust |
| Loose axle shaft | Check and adjust |
| Loose splined shaft | Check and adjust |

4. Noise on turn

| Causes | Remedies |
|---|-------------------|
| Differential pinion or side gears chipped scuffed or broken teeth | Replace or adjust |
| Excessive backload between pinion and side gear | Adjust |
| Excessive axle shaft end play | Adjust |

Activity 5

1. Note the possible causes of the troubles of the differential and axle assembly.

Self-check:

1. Did you note down possible causes and troubles of the different and axle assembly?

LET'S SUMMARIZE

This module discusses various power train, transmission, differential axle assembly troubles, causes and remedies and comes up with remedial action to remedy vehicle trouble. A variety of troubles in the service system takes the driver to the mechanic. The driver can always detect these troubles and refers these to the mechanic.

The various lessons and activities enable you to know the troubles, causes and remedies to be applied in the actual job during shopwork. A good mechanic provides quality performance, particularly in the replacement of vehicle parts.

After learning from this module, you now know how to trouble shoot vehicle units when these are in troubles.

POSTTEST

Directions: Write the letter of the correct answer on the line before each number.

- _____ 1. This is a design to draw the pressure plate away from the clutch disc when the clutch pedal is depressed in shifting the transmission gear.
- a. clutch lining
 - b. release lever or clutch fingers
 - c. adjusting screw
 - d. torsional spring

- _____ 2. It is riveted through a flange at the center of the disc in the cushion spring.
- clutch lining
 - spline or clutch hub
 - adjusting screw
 - release lever
- _____ 3. It is used to adjust the uniform clearance between the disc and the pressure plate.
- clutch lining
 - adjusting screw
 - clutch assembly
 - clutch fork
- _____ 4. Friction materials are usually made of asbestos bonded and riveted to which part?
- torsional spring
 - adjusting screw
 - clutch pressure plate
 - clutch lining
- _____ 5. A thin metal enclosing the different parts of the clutch.
- clutch pressure plate
 - clutch cover
 - clutch pressure spring
 - clutch lining
- _____ 6. The shaft in the transmission which is driven by the clutch gear.
- counter shaft gear
 - gear shaft
 - main shaft
 - shifting shaft
- _____ 7. An additional gear that must be meshed to obtain reverse gear.
- reverse idler gear
 - second gear
 - spur gear
 - third gear
- _____ 8. A device in the transmission that synchronizes the gear about to be meshed to prevent gear clash.
- synchronizer
 - reverse gear
 - fourth gear
 - idler gear
- _____ 9. The 1-2 synchronizer which is moved to the left for its internal teeth to engage the external teeth.

- a. second gear
- b. reverse gear
- c. third gear
- d. pilot gear

- _____ 10. The 1-2 synchronizer which is moved to the right, for its internal teeth to engage the external teeth.
- a. first gear
 - b. fourth gear
 - c. reverse gear
 - d. shifting fork

KEY TO CORRECTION

Pretest

- 1. b
- 2. d
- 3. b
- 4. b
- 5. b
- 6. a
- 7. a
- 8. a
- 9. a
- 10. a

Posttest

- 1. b
- 2. b
- 3. b
- 4. d
- 5. b
- 6. a
- 7. a
- 8. a
- 9. a
- 10. a