UNIT 3

Gear Box

HEXU9

Contents

Learning objectives

1. Understanding different types of gear boxes used in the automobile vehicle.
2. Understanding different gear teeths are used in gear boxes.
3. Understanding the problems occurred in gear boxes and methods to rectify those problems.

3.0 Introduction

The road conditions are not uniform whenever we are in travel in the vehicle. Moreover we do not drive the vehicle always at the same speed. The vehicle must be operated at lower speed when it needs more pulling power. Moreover based on the operating conditions, the vehicle requires different speed and torque. To perform this, a box containing different gears, shafts and bearings is required. This box is called as the gear box. It can be also called as teeth wheel box. By using this box, the driver can achieve different speeds and torques for a vehicle. Gear box is the one which comprises of various teethed gears for different vehicle speed conditions.

3.1 Gear box location

Gear box is located at the second place of the vehicle's transmission system. In the vehicle after the engine, clutch is located. After the clutch gear box is located. It is located in between the clutch and the propeller shaft.

3.2 Gears

The commonly used gears and their arrangements can be seen in this section. With a help of teethed wheels we can transmit the energy in rotational, parallel and in perpendicular directions. In machines gears are used in places wherever the transmission of rotational force is taking place. Moreover the gears are used to transmit the rotational force without any slip. It is used in places where there is a small distance for transmitting the rotational force (torque).

3.2.1 Types of gears

Gears are of many different types. The following are some of the important gears

1. Spur gear
2. Helical gear
3. Double helical gear
4. Bevel gear
5. Rack and pinion gear
6. Worm and worm gear
7. Internal gear
8. Sprocket wheel

3.2.1.1 Spur gear

It is like a circular shaped one made on a cylindrical metal having teeth cut in parallel to the axis of the cylinder. It is called as spur gear.

Figure 3.2.1.1 Spur gear

This gear is used to transmit the rotary power only between two parallel shafts. It is capable of transmitting moderate force and speed. A smaller gear is called as pinion. Normally in gear box this type of gear is used for first and reverse gear speed operations.

3.2.1.2 Helical gear

It is also a circular shaped metal made on a cylindrical metal having the teeth cut not parallel to the axis but in helical shaped cut at certain angle inclined to the cylinder's axis. This type of gear is called as the helical gear.

Figure 3.2.1.2 Helical gear

We can transmit the rotational power to two shafts which are either parallel or non parallel through the helical gear. Compared to straight spur gears more power can be transmitted through helical gears. This type of gear is used in synchromesh gear box and constant mesh gear box.

3.2.1.3 Bevel gear

In this gear the teeth are cut on the top surface of the shaft in tapper. This type of gear is generally used to connect the shafts which are perpendicular to each other and transmit the power in the perpendicular i.e. at 90° angle direction. Bevel gear is capable of withstanding more power than other gears. The bevel gear is used in differential, pinion, crown, wheel, planet and sun gears.

Figure 3.2.1.3 Bevel gear

3.2.1.4 Rack and pinion gear

In this arrangement teeth are cut on a long flat metal bar called as rack. A small wheel called as pinion is in mesh with rack. In this way the rotating power of the pinion is transformed into a straight line or reciprocating motion. This type of gears are used in the gear boxes in the steering system and in many mechanical machines.

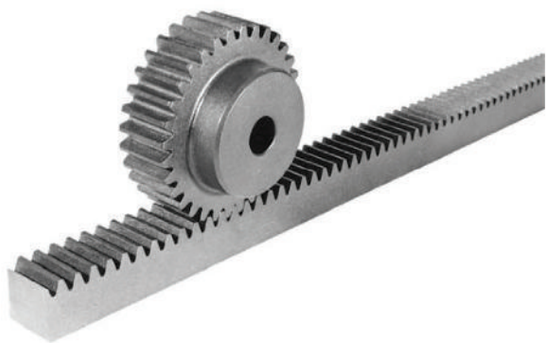

Figure 3.2.1.4 Rack and pinion gear

3.2.1.5 Worm and worm gear

It is used to transmit the rotational power by connecting two shafts that are

perpendicular to each other. The gear which looks like a spur gear is called as the worm. The small shaft with the single start thread or multi start thread cut made on it is called the worm shaft. This type of gear is used in places where high speed reduction and high power transmission are obtained. It is used in steering gear box in automobiles.

Figure 3.2.1.5 Worm and worm gear

3.2.1.6 Double helical gear or herringbone gear

On the circular periphery of the cylindrical metal teeth are cut in the shape of the English letter "V". This gear is called as double helical gear or herringbone gear. This type of gear is used where more rotational power (torques) is transmitted.

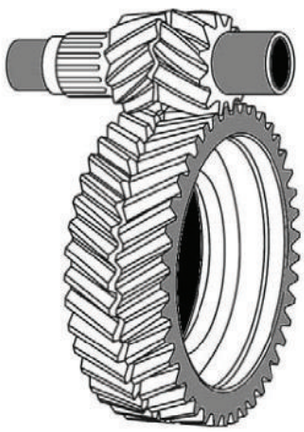

Figure 3.2.1.6 Double helical gear of herringbone gear

3.2.1.7 Internal gear

The internal gear is the one in which the teeth are cut internally on the inner circular metal pipe. This is called as the internal gear. This gear could transmit more power in short places. They are strong in structure. They are used in a small mechanisms and tractor mechanism.

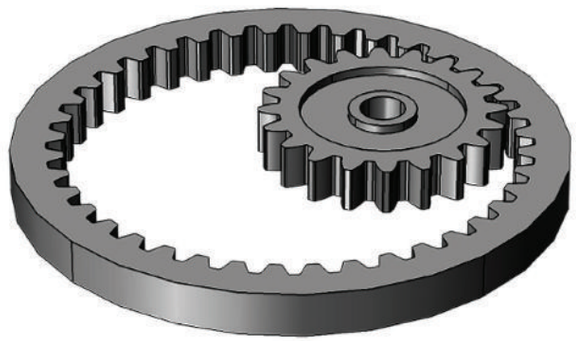

Figure 3.2.1.7 Internal gear

3.2.1.8 Sprocket wheel

On a rounded metal wheel plate teeth are cut outside. This wheel is not in direct contact with the other wheel. In between the two wheels a chain is placed and the rotational power is transmitted through the chain. It is used in timing gears. Moreover it is also used in motor cycles.

Figure 3.2.1.8 Sprocket wheel

3.3 Needs of gear box

1. For reducing the engine speed and increasing the torque.
2. For reducing the engine torque and increasing speed.
3. For the selection of speed levels according to the driver's requirement.
4. For pushing the vehicle in the backward direction.
5. For neutralizing the vehicles when there is no need to transmit the engine power.

3.4 Principle of gear box mechanism

Gear box works on the principle of lever mechanism.

3.5 Types of gear box

The following are the gear boxes used in automobiles,

1. Sliding mesh gear box
2. Constant mesh gear box
3. Synchromesh gear box
4. Epicyclic gear box
5. Automatic gear box

There are many types of gear boxes available. The important gear boxes are discussed below.

3.5.1 Sliding mesh gear box

Sliding mesh gear box was used in earlier day's vehicles. Figure 3.5.1 presents the details of the sliding mesh gear box. In this gear box spur gears are present. This box is suitable for heavy vehicles. By sliding the gears this type of gearboxes move the gears and mesh them and hence it is called as sliding mesh gear box.

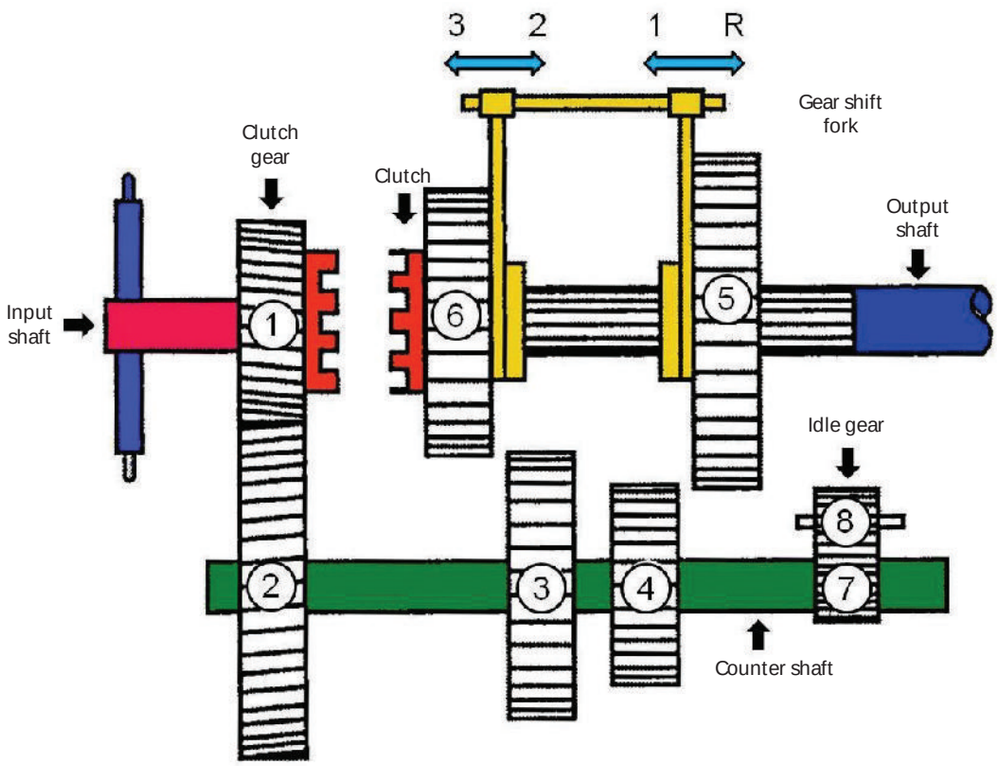

Figure 3.5.1 Sliding mesh gear box

DO YOU KNOW?

An exciting car fact is that cars that do not require drivers should be on the roads by 2020. Google has already developed a driverless car, and many other prototypes are in the works. It is believed that these driverless cars will reduce the frequency of accidents, and will reduce the number of vehicles needed on the road.

Construction

In the gear box, lay shaft or counter shaft is present. This shaft is supported by the bearings in the gearbox. The gear teeth are fixed as stationary in this lay shaft. In the main shaft, splines are made in such a way that the gears are free to move on the slots. The gear teethed wheel (1) in the clutch shaft is always in mesh with the gear in the lay shaft wheel (2). The gear (7) in the lay shaft is always in mesh with the idler gear (8). A three speed sliding mesh gear box is shown in Figure 3.5.1.

Working principle

a) Neutral position

The gear teeth (1) in the input (clutch) shaft is in mesh with the counter shaft gear 2. Hence the counter shaft rotates. However the gears (3 or 4) are not in mesh with the output shaft gears (5 or 6) as shown in Figure 3.5.1.1. Hence the power will not be transmitted to the output shaft. This condition is called as neutral position.

b) First gear

The gear (1) in the clutch shaft is in mesh with the gear in the counter shaft (2). As the gears 3 and 4 are in the counter shaft they also rotate. When the gear shift fork is moved towards left as shown in Figure 3.5.1.1 to engage the gear 5 in the output shaft with the gear 4 in the lay shaft, then the output shaft rotates. The rotary power is now transmitted to the output shaft from gear 1-2-4-5. Now we can get first gear ratio 3:1.

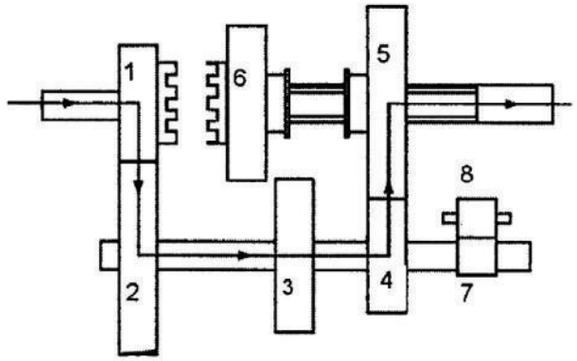

Figure 3.5.1.1 First gear power transmission

c) Second gear

During second gear, the gear shift fork is moved right as shown in Figure 3.5.1.2 to mesh the gear 6 in the output shaft with gear 3 in the lay shaft gear 1, 2, 3 and 6 will get contact and rotate. Now the power is transmitted from the gear 1-2-3-6. Now the speed becomes more than the first gear and the gear ratio of 2:1 is achieved.

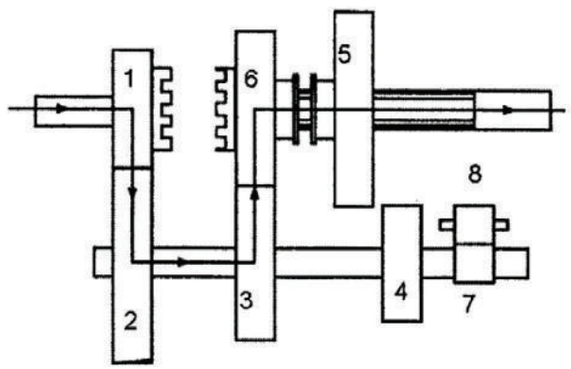

Figure 3.5.1.2 Second gear power transmission

d) Third gear

Dog Clutch is located on the gear 1 in the input (clutch) shaft and the gear 6 in the output shaft as shown in

Figure 3.5.1.3. Now by moving the gear shift fork on the left as shown in Figure the dog clutch is allowed to mesh with the dog clutch in the clutch shaft.

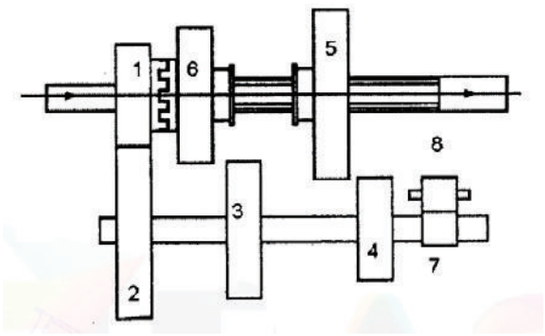

Figure 3.5.1.3 Third gear power transmission

Now the output shaft rotates at the speed same as the clutch (main) shaft. This is the maximum speed and the gear ratio in this condition is 1:1. The rotational power is now directly transmitted from the clutch shaft to the output shaft.

e) Reverse gear

For reverse gear, the gear shift fork is moved towards the right direction as shown in the Figure 3.5.1.4. Hence the gear 5 in the output shaft is in mesh with the gear 8 in the lay shaft which is the idler gear. Now the power transmission is from gear 1-2-7-8-5 to the output shaft.

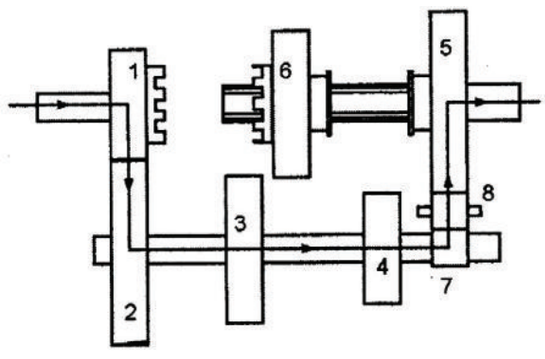

Figure 3.5.1.4 Reverse gear power transmission

Advantages of sliding mesh gearbox

1. Simple in construction
2. Simple in maintenance
3. Suitable for heavy vehicles
4. Low cost
5. Higher mechanical efficiency
6. Production cost is low

Disadvantages

1. Gear changing is difficult
2. Noisy in operation
3. Experience is required for changing gear
4. The edges of teeth wear rapidly.

3.5.2 Constant mesh gear box

In constant mesh gear box the teeth in the main shaft and lay shaft are always in constant mesh with each other. Hence it is called as constant mesh gear box. Helical gears are used in this type of gear box. The gear arrangements in the constant mesh gear box can be seen in Figure 3.5.2.

Construction

In the constant mesh gear box the gears 6, 7 and 8 in the output shaft are always in mesh with the gears 5, 4 and 3 in the lay shaft. In the clutch shaft and in the lay shaft there are gears 1 and 2 respectively which are always in mesh with each other. The gears in the main shaft are supported by bushes. Gear 5 in the lay shaft is in mesh with an idler gear. After the clutch gear in the clutch shaft and before the reverse gear in the main shaft there are dog clutches (D_2 and D_1 respectively) present. These dog clutches

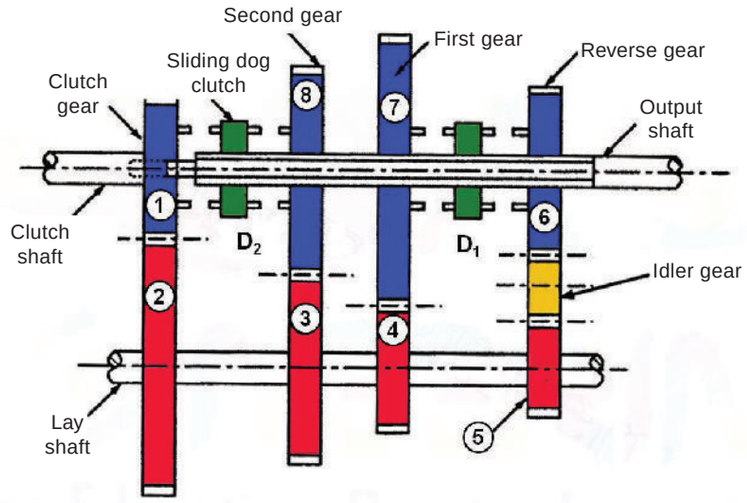

Figure 3.5.2 (a) Gear arrangements in the constant mesh gear box

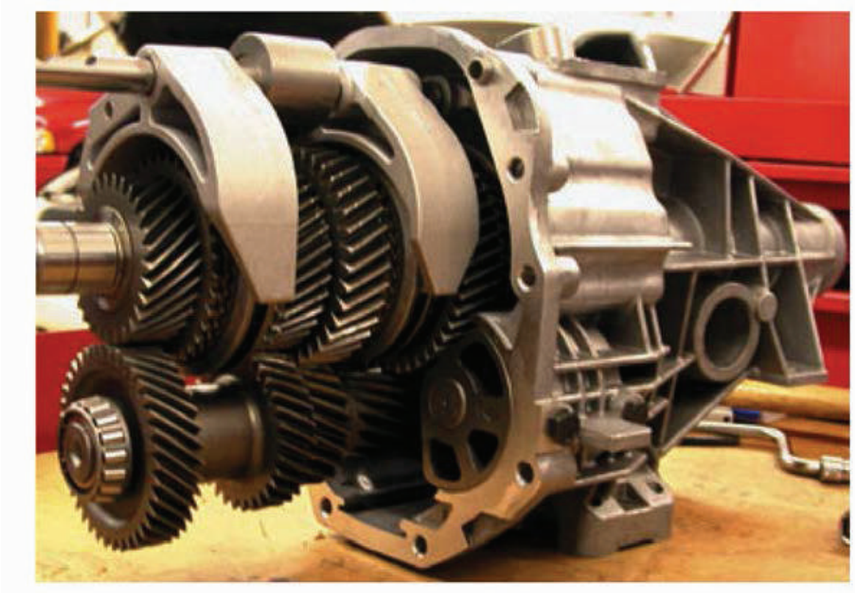

Figure 3.5.2 (b) Constant mesh gear box

are allowed to move on the slots made on the main output shaft. All the shafts in the gear box are supported by the bearings in the housing.

Working principle

Neutral position

During neutral condition both the dog clutches (D_1 and D_2) are not in mesh with any gears as shown in Figure. All gears in the shafts 1,2 & 3,4 & 5,6 & 7,8,9 rotate. However the main output shaft does not rotate as the dog clutches are not in engagement with any of the gears. Hence rotational power is not transmitted.

First gear

By actuating the gear shift lever, the dog clutch D_1 is moved towards left

side to engage gear 7 in the main shaft as shown in Figure. Now the rotational power is transmitted to the main shaft through the dog clutch. Now the speed is low. The power transmission from the clutch shaft to the output shaft is by gear1-2 is means rotational power is transmitted to main shaft by 1-2-4-7-D_1.

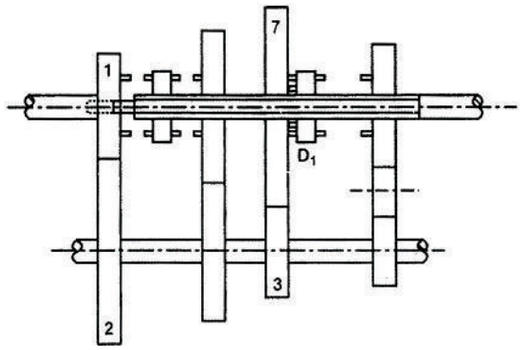

Figure 3.5.2.1 Power transmission in first gear

Second gear

For obtaining the second gear, by actuating the gear shift lever, the dog clutch D_2 is moved towards right as shown in Figure to engage the gear 8 in the output main shaft. Now the rotational power is transmitted to the main shaft through the dog clutch D_2. Now the speed of the main shaft is higher than the speed of the first gear. The power transmission from the clutch shaft to the output shaft is through the gears1-2-3-8-D_2.

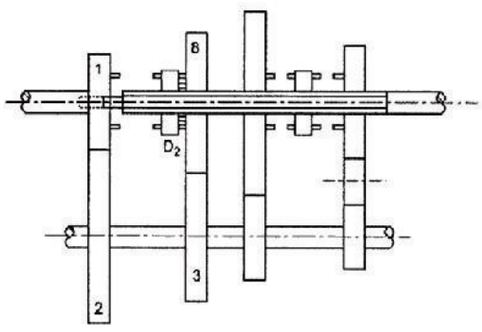

Figure 3.5.2.2 Power transmission in second gear

Third gear

To achieve the third gear the dog clutch D_2 is moved left to engage with the clutch shaft gear directly. Now the output shaft rotates at the speed same as the clutch shaft speed. The rotational power is transmitted to the main shaft directly through the gear1-D_2.

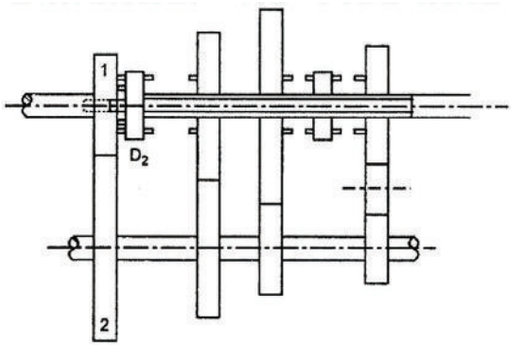

Figure 3.5.2.3 Power transmission in third gear

Reverse speed

To obtain the reverse gear, the dog clutch D_1 is actuated to move right towards the reverse gear 6 to engage as shown in Figure 3.5.2.4. As the idler gear is placed between the gears 5 in the lay shaft and 6 in the main shaft the idler gear changes the direction of rotation of the gear 6 in the main shaft. Now the vehicle moves in the reverse direction. The power transmitted from the cluth shaft to the main shaft is through gears 1-2-5-Idler-6-D_1.

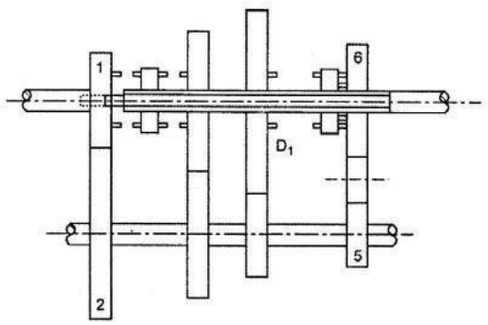

Figure 3.5.2.4 Power transmission in reverse gear

Advantages of constant mesh gear box

1. Gear changing is simple
2. Less noise
3. Less chance for the teeth of the gears to break up.
4. Smoothness in operation
5. Low maintenance

Disadvantages

1. For changing gears from one speed to other speed, double de clutching has to be done.
2. More wear
3. Possibility of wear in dog clutch.

3.5.3 Synchromesh gear box

Synchromesh gear box is similar in construction as constant mesh gear box but differs slightly. Instead of dog clutch used in constant mesh gear box, a synchronizing unit is used in synchromesh gear box. In the synchromesh mesh gear box the gears 6, 7 and 8 in the output shaft are always in mesh with the gears 5, 4 and 3 in the lay shaft. In the clutch shaft and in the lay shaft there are gears 1 and 2 respectively which are always in mesh with each other. The gears in the main shaft are supported by bushes. Gear 5 in the lay shaft is in mesh with an idler gear. After the clutch gear in the clutch shaft and before the reverse gear in the main shaft there are synchronizers (S_2 and S_1 respectively) present. These synchronizers are allowed to move on the slots made on the main output shaft. All the shafts in the gear box are supported by the bearings in the housing.

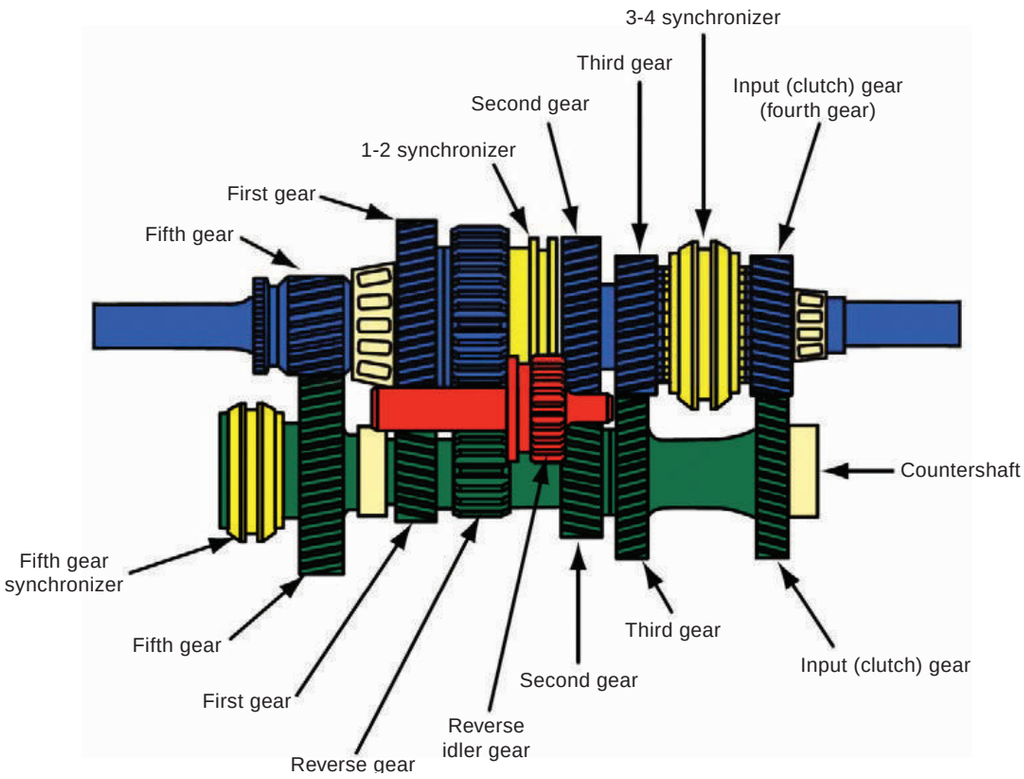

Figure 3.5.3 (a) A view of gear arrangements of a 5 speed synchromesh gear box

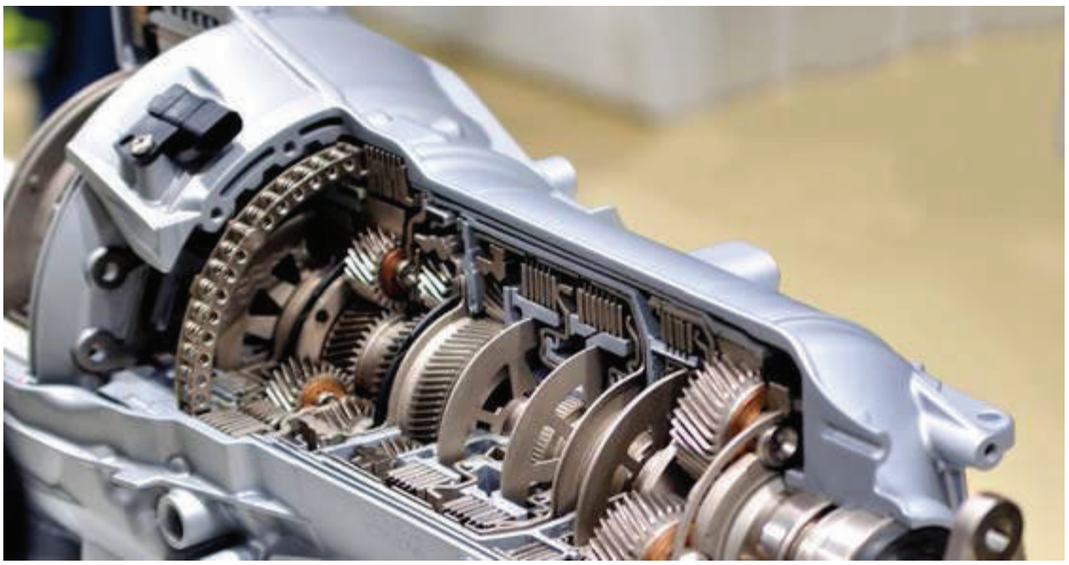

Figure 3.5.3 (b) The photographic view of a synchromesh gear box

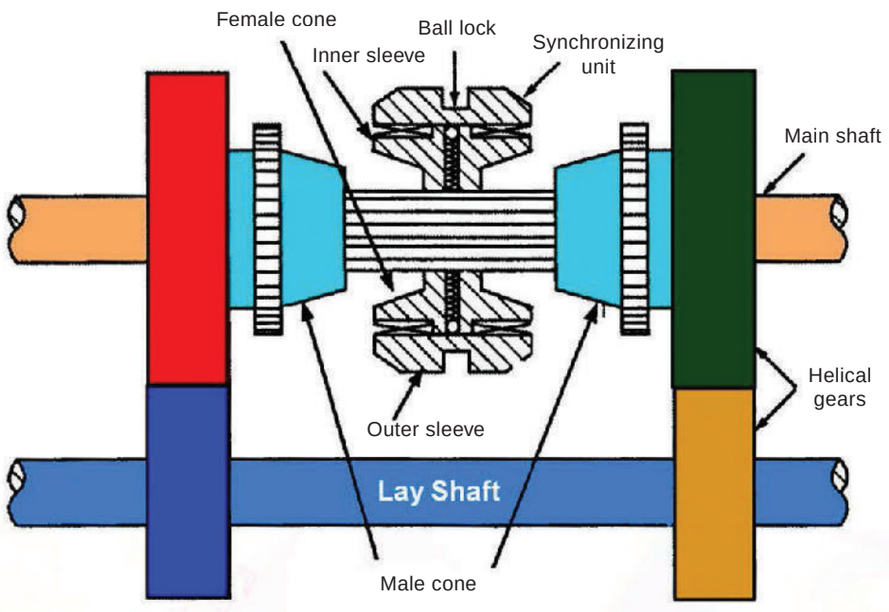

Figure 3.5.3 (c) Layout of a synchromesh gear box

The photographic view of a synchromesh gear box can be seen in Figure.

Working principle

The layout of the synchromesh gear box is shown in Figure. The operation of the synchromesh gear box for different vehicle speed is explained below.

Neutral position

During neutral condition both the synchronizers (S_2 and S_1) are not in mesh with any gears as shown in Figure.

All gears in the shafts 1,2& 3,4 & 5,6 & 7,8,9 rotate. However the main output shaft does not rotate as the dog clutches are not in engagement with any of the gears. Hence rotational power is not transmitted.

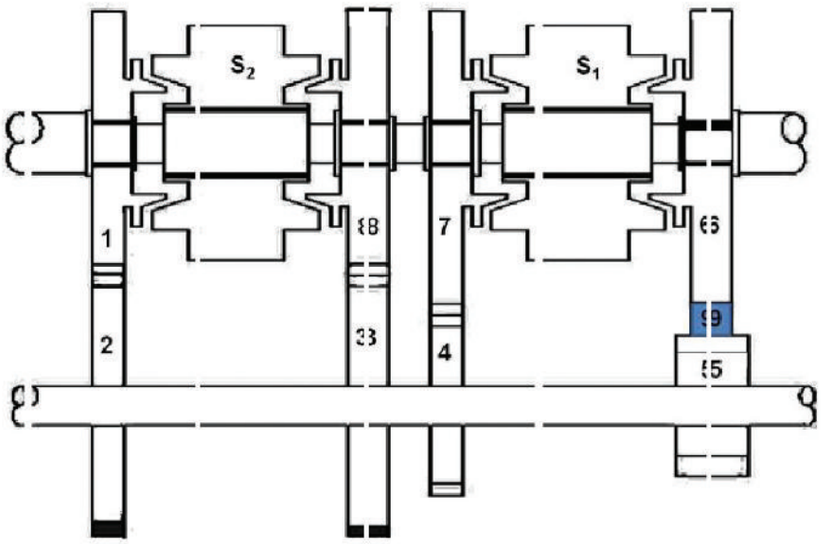

Figure 3.5.3.1 Neutral condition S1 and S2 are held stationary

First gear

By actuating the gear shift lever, the synchronizer S_1 is moved towards left side as shown in Figure 3.5.3.2 to engage gear 7 in the main shaft.

Now the rotational power is transmitted to the main shaft through the dog clutch. Now the speed is low. The power transmission from the clutch shaft to the output shaft is by gear 1-2 is

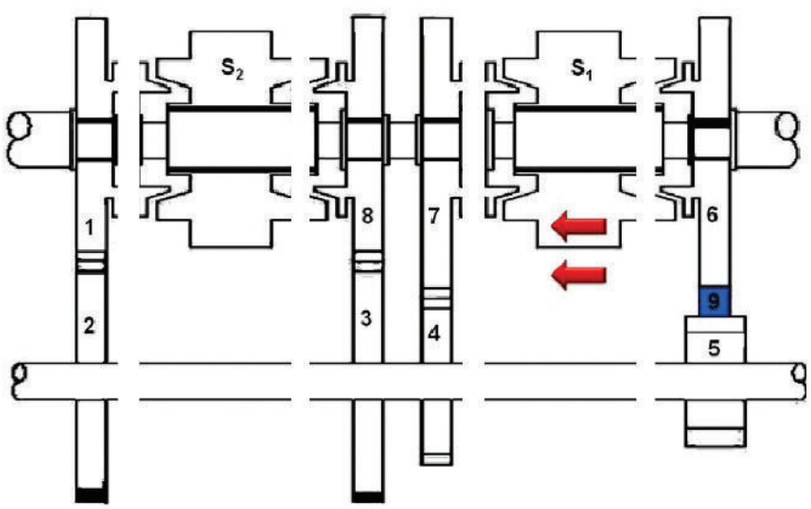

Figure 3.5.3.2 First gear condition

means rotational power is transmitted to main shaft by 1-2-4-7-S_1.

Second gear

For obtaining the second gear, by actuating the gear shift lever, the synchronizer S_2 is moved towards right to engage the gear 8 in the output main shaft. Now the rotational power is transmitted to the main shaft through the synchronizer S_2. Now the speed of the main shaft is higher than the speed of the first gear. The power transmission from the clutch shaft to the output shaft is through the gears 1-2-3-8-S_2.

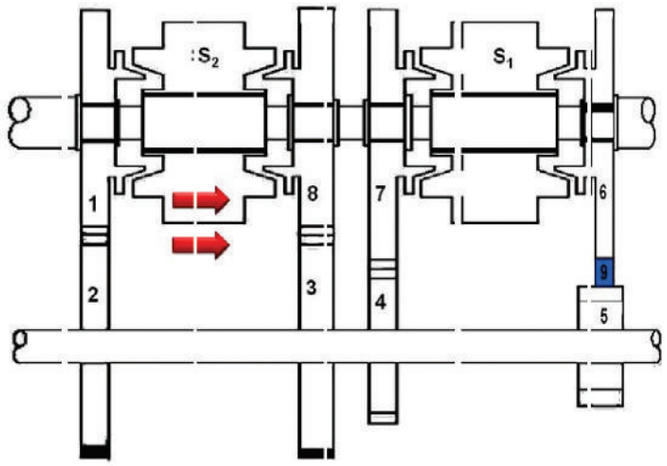

Figure 3.5.3.3 Second gear condition

Third gear

To achieve the third gear the synchronizer S_2 is moved left to engage with the clutch shaft gear directly. Now the output shaft rotates at the speed same as the clutch shaft speed. The rotational power is transmitted to the main shaft directly through the gear 1-S_2.

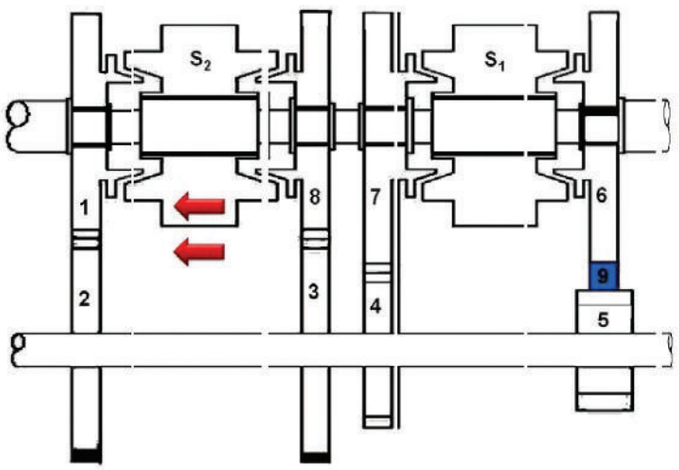

Figure 3.5.3.4 Third gear condition

Reverse Speed

To obtain the reverse gear, the synchronizer S_1 is actuated to move right towards the reverse gear 6 to engage as shown in Figure 3.5.3.5. As the idler gear is placed between the gears 5 in the lay shaft and 6 in the main shaft the idler gear changes the direction of rotation of the gear 6 in the main shaft. Now the vehicle moves in the reverse direction. The power transmitted from the clutch shaft to the main shaft is through gears 1-2-5-Idler-6-S_1.

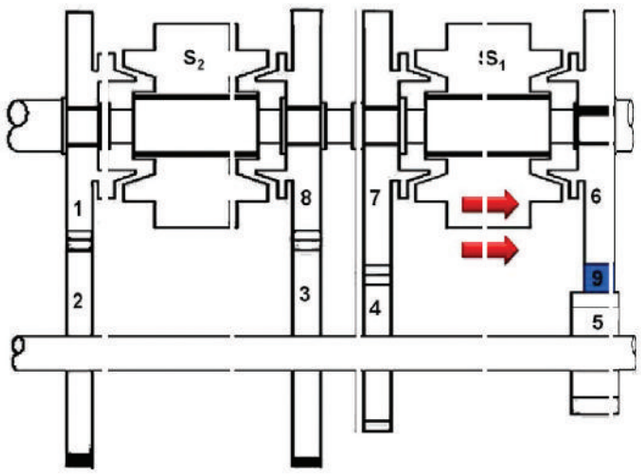

Figure 3.5.3.5 Reversed gear condition

3.5.4 Synchronizing unit

In synchronizing unit two cone shaped parts are present. One cone is a part of the collar and the second cone is a part of the gear. Both the cones rotate at different speeds. An exploded view of the synchronizer unit is shown in Figure.

When the cone 2 is rotated, cone 1 start to rotate and move towards the cone 2 and be in contact with the cone 2. Because of this action friction occurs in the contact area of the cones and hence it increases the speed of gear. Now the both cone speeds come to the same. Further moving the collar makes the outer drum to contact with the dog clutch in the gear. Now the rotational power is transmitted to the main shaft. By the same way it moves on left hand side and contacts with the another gear and transmits the power to the main shaft. The cone 2 is locked under different states by the ball and spring in the cone 1. It is connected to the gear changing fork in the slot which is located in the outer sliding sleeve.

Uses of synchromesh unit

1. For operating the gears smoothly by synchronizing two different speeds of the gears.
2. For changing gears easily
3. No need of double de clutching
4. For transmitting power efficiently
5. Gears will not wear rapidly
6. Less noise in operation

De merits of synchromesh unit

1. Low cost
2. Maintenance is difficult
3. Difficult repair

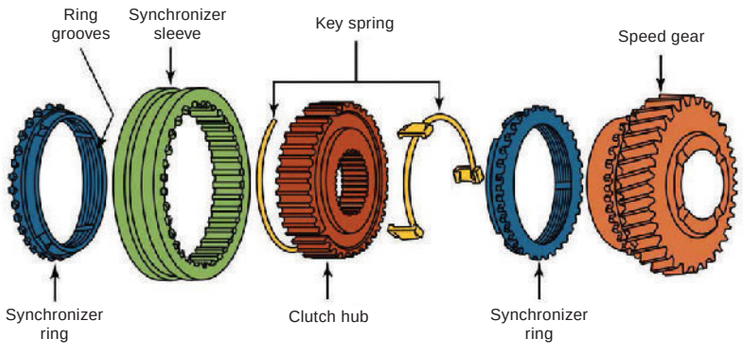

Figure 3.5.4 Exploded view of a synchronizer unit

3.6. Properties of gear box

1. Gear box should have long life.
2. Noise should be lower in the gear box.
3. Fitting the gears in the gear box should be simple.
4. Replacing the worn out and broken parts should be easy in the gear box.
5. It should transmit the torque and speed according to the requirement.

3.7 Gear Ratio

The ratio between the speed of the driver gear to the speed of the driven gear is called as the gear ratio or it is a ratio between number of gear teeth in the driver gear to the number of gear teeth in the driven gear.

$$r_G = \frac{N_2}{N_1} \text{ or } \frac{T_2}{T_1}$$

Gear ratio = clutch shaft speed / main shaft speed

$$\text{Gear ratio} = \frac{speed\ of\ the\ driven\ gear}{speed\ of\ the\ driven\ gear} \text{ or}$$

$$\frac{\text{No of teeth's in driven gear}}{\text{No of teeth's in driven gear}}$$

Where,

r_G = Gear Ratio

N_1 = speed of the Driver gear

N_2 = speed of the Driven gear

T_1 = No of teeth's in driver gear

T_2 = No of teeth's in driven gear

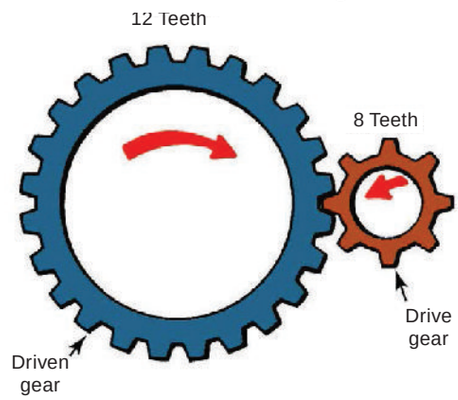

Figure 3.7 Gear ratio

3.8 Over drive

The method of increasing the speed of propeller shaft more than that of the engine speed is called as the over drive. A view of the overdrive can be seen in Figure 3.8 (a).

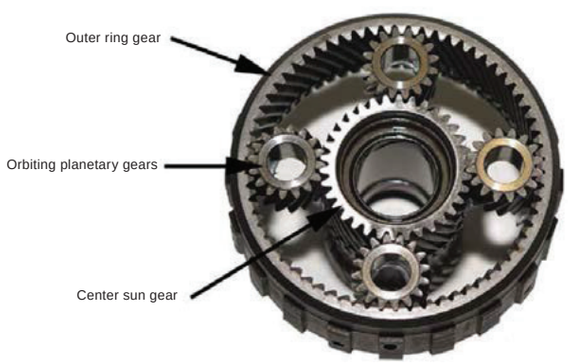

Figure 3.8 (a) A view of automobile overdrive

DO YOU KNOW?

One two-wheeler comes out of the production line every two seconds in India

The part which performs this action is called as the overdrive unit. If the main shaft in the gear box rotates at higher speed than the clutch shaft, then the transmission system is said to be with the over drive. Over drive unit is fixed next to the gear box. It is placed in between the gear box and the propeller shaft.

Construction

In over drive two shafts are present. They are input shaft and output shaft.

Input shaft is the main shaft of gear box. Output shaft is the propeller shaft. The parts of the overdrive can be seen in Figure 3.8 (b).

Figure 3.8 (b) Parts of overdrive

An epicyclic gear train is mounted on the input shaft. In this epicyclic gear train, a sun gear, three planet gears, a planet carrier and a ring gear are present. This can be seen in the above Figure.

Working Principle

The casing is stationary when the sun gear is locked with casing. Now the overdrive unit starts functioning and the speed of the output shaft is increased. When the sun gear is locked with the planet carrier, the usual input shaft speed is given to the output shaft.

Advantages of overdrive

1. Engine life is increased
2. Achieves reduction in fuel consumption.
3. Less vibration
4. Low noise
5. Excess gear ratio can be achieved
6. Wear of engine is lower.
7. Connecting over drive unit is easy.

Trouble shooting of gear box

1. Gear box noise

Causes	Remedies
1. Bearing may get damaged	Need to change bearing
2. Lubricating oil level may be low	Fill the required amount of lubricating oil
3. Teeth's may be broken in the gear	Need to change the gear
4. Misalignments between gearbox and engine	Need to correct it

2. Hard Gear Shift

Causes	Remedies
1. Improper clutch adjustments	Need to correct it
2. The spring in the gear changing arrangement may not working	Need to change with a new spring
3. There may be sticking or jamming in the main shaft	Should correct the shaft
4. There may be a sticking of fork in the gear shifting system	Need to clean and lubricate.

3. Gear slip

Causes	Remedies
1. Fork in the gear shifting mechanism may not be working	Have to correct it
2. Dog clutch in the gearbox or synchronizer may have worn out	Need to change with a new one
3. Spring in the gear shifting mechanism may have loosened	Have to change the spring
4. Gears in the main shaft may have worn out	Need to change the gear with a new one

4. Lubricating oil leakages in the gear box

Causes	Remedies
1. Fault in the oil seal in the gear box	Have to change with a new oil seal
2. Lubricating oil level may be higher than the required amount	Need to discharge the excess oil
3. Oil leakage seal may be broken	Need to change with a new one
4. There may be loosen in bolts on the Gear box cap	Need to tighten it

3.9 Parts of the gear box

3.9.1 Gear box housing

The Box like arrangement where the bearings (which support the shafts) are mounted, filler plug with air vent hole, oil drain plug are present is called as the gear box housing. This box is generally made of cast iron as shown in Figure 3.9.1.

Figure 3.9.1 Gear box housing

3.9.2 Gear box input or clutch shaft

It is connected with the clutch plate at one end supported by the flywheel and a gear fitted at the other end. The view of input shaft can be seen in Figure 3.9.2.

Figure 3.9.2. Gear box input shaft

3.9.3 Lay shaft

It is mounted at the bottom of the gear box casing. Different gears are mounted on the lay shaft depending on the speed of the gear box. The picture of lay shaft can be seen in Figure 3.9.3.

Figure 3.9.3 The picture of a lay shaft of an automobile gear box

3.9.4 Gear box output shaft or main shaft

It is located at the top of the gear box casing at straight line with the input shaft. Slots are present in this shaft. Through this shaft the power is transmitted to the propeller shaft.

3.9.5 Reverse gear shaft

The smallest shaft in the gear box is the reverse gear shaft which has only one gear called as the idler gear. It is fitted on the gear box casing. This shaft is used for transmitting the power from the lay shaft to the main shaft.

3.9.6 Speedometer drive

Skew gear is connected with the main shaft. With the skew gear a cable with a small gear is connected at one end and the other end of the cable is fitted at the dashboard of the driver. This drive is used for knowing the speed of the vehicle. The picture of a speedometer drive can be seen in Figure 3.9.6.

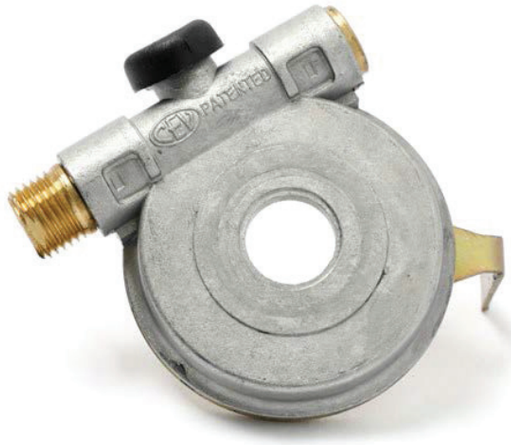

Figure 3.9.6 A picture of a speedometer drive

3.9.7 Gear selector mechanism

On the top of the gear box, an arrangement with a lever with a gear knob, selector rod and shifting fork are connected. This arrangement is called as the gear (shifting) selecting mechanism. Gear selector mechanism is used for selecting the required gear for the required speed of the vehicle. The picture of a gear selector mechanism can be seen in Figure 3.9.7.

Figure 3.9.7 Gear selector mechanism

Types of gear shift mechanisms

1. Floor gear shifting Mechanism
2. Steering Gear Shifting Mechanism

Floor gear shifting mechanism

If the gear shifting mechanism is located at the top of the gearbox, then it is called as the floor gear shifting mechanism

Steering gear shifting mechanism

If the gear shifting mechanism is located at the sideway of the steering column, then it is called as the steering gear shifting mechanism

3.10 Gear box lubrication

1. In the gear box, lubricating oil of SAE 90 has to be filled.
2. The lubricating oil must be filled until the lay shaft is (dipped) covered by the oil. The lubricating oil must be highly viscous.
3. When the gears are rotating, the lubricating oils is sprayed on all the parts of the gear box and lubricated.
4. After 1000 kilo meters of the vehicles run lubricating oil top up must be done.
5. After 10000 kilometers of the vehicle the lubricating oil must be completely replaced by the new lubricant.
6. To pour the oil filler cap is provide on the top of the gear box. An air vent is also provide to allow the atmospheric air to enter.
7. A drain plug is provided at the bottom of the gear box to drain the lubricating oil.

3.11 Transfer case

The arrangement used for transmitting the engine's power to all the four wheels is called as the transfer case.

The transfer case is fitted on the vehicles with four wheel drive. This arrangement is generally used in military vehicles and jeeps. A photographic view of an automobile transfer case can be seen in Figure 3.11.1.

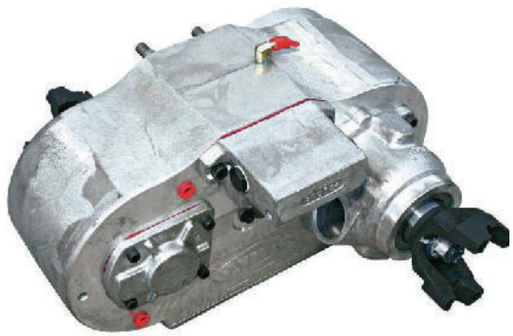

Figure 3.11.1 Photographic vie of an automobile transfer case

Construction

In the main shaft of the gear box two gears are present. Between the two gears a sliding gear is present. The gear in the main shaft is in mesh with the idler gear. With this front axle drive gear and rear axle drive gear are connected. A clutch is fitted with the front axle drive gear. The important parts of the transfer case can be seen in Figure 3.11.2.

Operation

With the help of the gear shift mechanism when the sliding gear in the main shaft is shifted to right or left, through the idler gear the power is transmitted to the front or rear wheels with low or high speeds. In addition to this, when there is no need for drive power to the front wheels, with the help of the clutch arrangement the drive power can be disengaged. If necessary the four wheel drive can be also obtained.

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Figure 3.11.2 Important parts of a transfer case

Student Activity

1. To collect news papers, owners manual and service manual and submit the information regarding the gear box.
2. Ask the students to visit nearby workshop to collect and submit the trouble shooting procedure of the gear box used in two wheelers.
3. Ask the students to visit nearby heavy vehicle workshop to collect and submit the gear ratio, number of speed and type of gear box used in the heavy vehicles.

Glossary

1.	Gear	–	பற்சக்கரம்
2.	Gear box	–	பற்சக்கர பெட்டி
3.	Lever	–	சுண்டி
4.	Shaft	–	தண்டு
5.	Axis	–	அச்சு
6.	Idle Gear	–	பயனற்ற பற்சக்கரம்
7.	Main Shaft	–	முக்கிய தண்டு
8.	Link	–	இணைப்பு
9.	Cable	–	வடம்
10.	Gear Ratio	–	பற்சக்கர விகிதம்
11.	Counter Shaft	–	இடைச் சுழல் அச்சு
12.	Spur Gear	–	நேர் பற்சக்கரம்

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Evaluation

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PART - A

One mark questions

Choose the correct answer

1. The basic principle involved in gear box operation is.
   a) Friction
   b) Faraday's Lay
   c) Pascal's Law
   d) Lever

2. The type of gear used in sliding mesh gear box is.
   a) Bevel Gear
   b) Spur Gear
   c) Worm Gear
   d) Helical Gear

3. Top Gear Ratio is.
   a) 2:1
   b) 1:2
   c) 1:1
   d) 1.5:1

4. The method of increasing the vehicle speed than the engine speed is called as.
   a) Power change method
   b) Overdrive
   c) Gear Ratio
   d) Synchronizing

5. The lubricating oil used in gear box is.
   a) SAE 50
   b) SAE 60
   c) SAE 90
   d) SAE 120

6. The second component of the transmission system is.
   a) Clutch
   b) Gear Box
   c) Propeller shaft
   d) Universal Joint

7. Reducing the rotational speed and increasing the torque is done by.
   a) Clutch
   b) Gear Box
   c) Propeller shaft
   d) Universal Joint

8. The gear oil must be replaced for every _____ kilometers.
   a) 1000
   b) 2000
   c) 5000
   d) 10000

9. The gear Box which transfers the power through the dog clutch is.
   a) A Sliding mesh Gear Box
   b) Constant Mesh Gear Box
   c) Synchromesh Gear Box
   d) Epicyclic Gear Box

10. The part in between the clutch and propeller shaft.
    a) Engine
    b) Gear box
    c) Differential
    d) Real axle

PART – B

Three mark questions

1. List out the types of gears used in gear boxes.
2. What is the need of gear box?
3. Where is the location of gear box?
4. Explain the advantages of sliding mesh gear box.
5. What are all the general types of gears?
6. What are all the types of gear boxes?
7. What is meant by gear ratio?
8. What is meant by over drive?
9. What is called gear box?
10. What are the disadvantages of sliding mesh gear box?

Part - C

Five mark questions

1. Describe about spur gear.
2. Explain the advantages and disadvantages of constant mesh gear box.
3. Describe about synchromesh Unit.
4. What are the advantages and disadvantages of synchromesh gear box?
5. Write about Bevel gear?

Part - D

Ten mark questions

1. Explain the sliding mesh gear box construction and working principle with neat diagram.
2. Explain the Constant mesh gear box construction and working principle with neat diagram.
3. Explain the synchromesh gear box construction and working principle with neat diagram.