Department of Automobile Engineering

Lab Manual

Automotive Transmission System Lab (ATS)

(PC 15)

Laboratory Location: 1st floor of workshop 2, Room no-

Parala Maharaja Engineering College, Berhampur

A Government Engineering College affiliated to
Biju Patnaik University of Technology, Odisha, Rourkela, India
ପାରଳା ମହାରାଜା ଯାନ୍ତ୍ରିକ ମହାବିଦ୍ୟାଳୟ, ବ୍ରହ୍ମପୁର
(ସରକାରୀ ଯାନ୍ତ୍ରିକ ମହାବିଦ୍ୟାଳୟ)

Safety in the Lab

- You are only allowed in the laboratory when there is a 'responsible person' present such as a demonstrator or the laboratory staff.

- Do not touch any equipment or machines kept in the lab unless you are asked to do so.

- A tidy laboratory is generally safer than an untidy one, so make sure that you do not have a confused tangle of electrical cables. Electrical equipment is legally required to be regularly checked, which means it should be safe and reasonably reliable: do not tamper or attempt to repair any electrical equipment (in particular, do not rewire a mains plug or change a fuse - ask one of the laboratory staff to do it). Never switch off the mains using the master switches mounted on the walls. Please make yourself aware of the fire exits when you first come into the lab. When the alarm sounds please leave whatever you are doing and make your way quickly, calmly and quietly out of the lab. You must always follow instructions from your demonstrators and the laboratory staff.

- You must keep walkways clear at all times and in particular coats and bags must be stowed away safely and must not pose a trip hazard.

- It is important that you make a point of reading the "Risk Assessment" sheet included in the manuscript of each experiment before you start work on the experiment.

- Please take notice of any safety information given in your scripts. If an experiment or project requires you to wear PPE (personal protective equipment) such as gloves and safety glasses, then wear them.

- Always enter the lab wearing your shoes. It is strictly prohibited to enter the lab without shoes.

- There must be NO smoking, eating, drinking, use of mobile phones or using personal headphones in the laboratory. This last point is not because we dislike your choice of music but because you must remain aware of all activity around you and be able to hear people trying to warn you of problems.

- Keep the lab neat and clean.

List of Experiments

Sl. No.	Name of the Experiment	Page no.	Remark
01	Study, dismantling & assembling of Single plate clutch (coil spring and diaphragm spring),		
02	Study, dismantling & assembling of Multi-plate clutch		
03	Study, dismantling & assembling of Centrifugal and semi centrifugal clutch		
04	Study, dismantling & assembling of Sliding mesh gear box		
05	Study, dismantling & assembling of Constant mesh gear box		
06	Study, dismantling & assembling of Synchromesh gear box		
07	Study of different parts of torque converter		
08	Study, dismantling & assembling of Wilson gear box		
09	Study, dismantling & assembling of Chevrolet “turbo-glide” transmission system		

EXPERIMENT – 01

STUDY, DISMELTLING AND ASSEMBLY OF SINGLE PLATE CLUTCH

Aim of the experiment: To study the working principle of singe plate clutch with their advantages and disadvantages.

Apparatus required:

Model of single plate clutch

Theory:

In vehicles with a manual transmission or manual transaxle the power flows through a clutch. This device engages and disengages the manual transmission or transaxle and the engine. When the driver pushes the clutch pedal down, the clutch disconnects or disengages from the engine flywheel. No engine power can flow to the transmission or transaxle. When the driver releases the clutch pedal the clutch engages. This allows power to flow to the transmission. The clutch fulfils a number of different tasks.

The three main operating functions are:

1. It connects/disconnects the drive between the engine and the gearbox.
2. It enables the drive to be taken up gradually and smoothly.
3. It provides the vehicle with a temporary neutral.

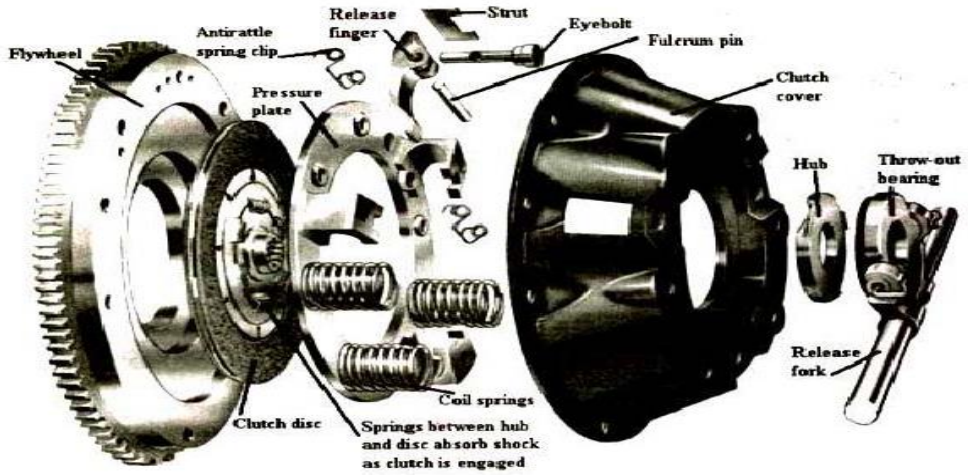
Construction and Working of Single plate Clutch:

Construction:

Driving Members: The flywheel and pressure plate are the driving members. They attach to and rotate with the engine crankshaft. The pressure plate, with one or more springs, attaches to the clutch cover. This pressure –plate assembly bolts to the flywheel and rotates with it. Spring force holds the friction disc against the flywheel while the clutch is engaged.

Driven Member: The driven member consists of a disc or plate called clutch plate. It is about 12 inches and splined to the clutch shaft. Both must turn together but the friction disc can slide back and forth on the shaft splings.

Operating Members: The operating members consists of a foot pedal, linkage, release or throw out bearings . The release bearing, which provides the bearing surface which, when the driver operates the clutch pedal, disconnects the drive between the engine and the gearbox.



Precautions to be followed

• Refer the appropriate service manual.

• Use Specified tools, special tools and other equipments.

Procedure:

• **Dismantling**

1. Remove the clutch assembly from demonstration model.

2. Place the clutch assembly on the arbor press with the wooden block across the cover apply pressure with the press or clutch spring compressor to compress the springs.

3. Loosen the lock nuts while holding the eye bolt with screw driver.

4. Remove all the lock nuts and eye bolts to take out the parts.

• **Inspection:**

1. Inspect clutch disc for wear or damage: Using a vernier caliper , measure the depth between the lining surface and the rivet head .

2. Measure the pressure plate flatness across the centre using a straight edge and a feeler gauge.

3. Turn the collar while applying force in the axial direction and inspect bearing for sticking , excessive resistance, and an abnormal noise.

4. Inspect the cushioning and torsion springs on the clutch plate. In case they are found to be cracked or weak, complete plate has to be replaced

• **Assembling:**

1. Keep the pressure plate inverted and place the pressure/thrust springs on it in a vertical position seating them on their locating bosses.

2. Assemble the release levers, eyebolt and pin; lay the cover over the parts keeping the springs in position.

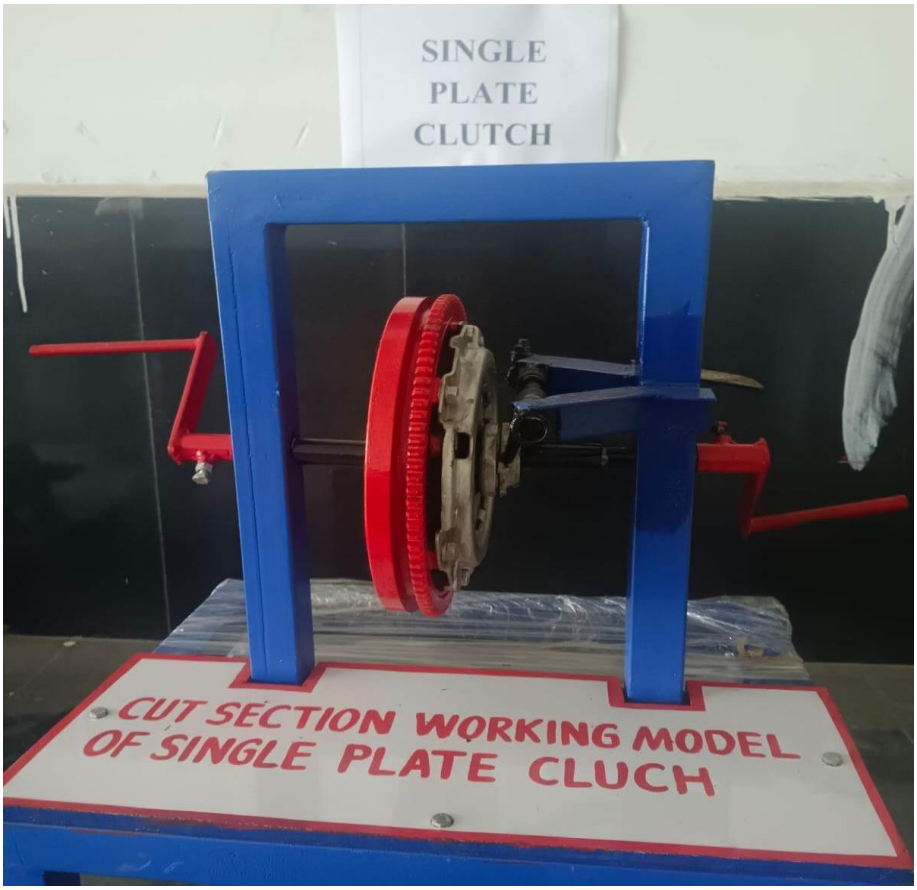
3. Place the wooden block across the cover and apply pressure with the press or clutch spring compressor to compress the springs, at the same time guiding the eyebolts and pressure plate lugs through the correct holes in the cover.

4. Make sure that the thrust springs are seated properly.

5. Tighten the lock nuts while holding the eye bolt with screw driver.

6. Mount the clutch plate and pressure plate assembly on the stand.

7. Check the operation of clutch for engagement and disengagement.



Advantages of Single Plate Clutch:
The main advantages of this clutch include its simplicity, easy gear changing, better heat dissipation from the single plate, smooth operation, and better load withstanding capacity.

Disadvantages of Single Plate Clutch:
The main drawback of this clutch is that its size is large and requires force to disengage the driving shaft from the driven shaft.

Conclusion:

Experiment – 02

STUDY, DISMANTLING & ASSEMBLING OF MULTI-PLATE CLUTCH

OBJECTIVE: Study, dismantling and assemble of Multiple Clutch of an automobile.

EQUIPMENT – Model of Multiple plate clutch

THEORY – Introduction- The power developed by the engines is delivered to the driving wheels of the automobile by the power train. The transmission is the major part of the power train. In the manual transmission, clutch is a device used to connect and disconnect engine power flow to the transmission the will of the driver.

The driver operates the clutch via a clutch pedal inside the vehicle. When the clutch pedal is depressed, the three main clutch assembly components – flywheel, friction disc and pressure plate are disengaged, interruption of the power flows. As the clutch is release, the pressure plate moves closer to the clutch disc.

Functions of Clutch –

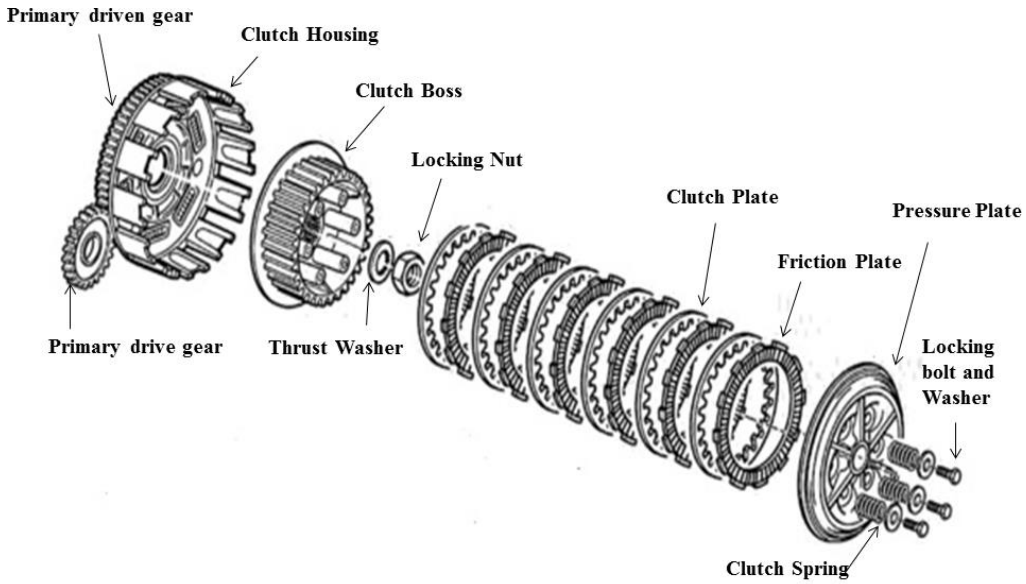
1. To permit the engagement or disengagement of a gear when the vehicle is stationary and engine is running.

2. To transmit the engine power to the road wheels smoothly without shock / jerk to the transmission system.

3. To permit the engaging of gears when the vehicle is in motion without damaging the gear wheels.

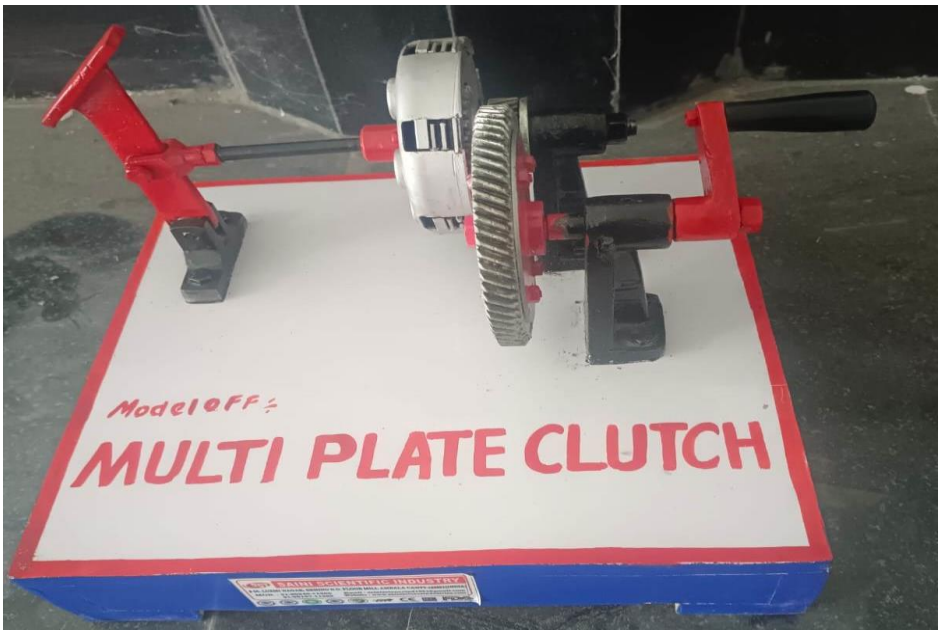
WORKING PRINCIPLE – The working principle of clutch is based on friction .When the two friction surfaces re brought in contact with each other and pressed they are united due to friction between them .If now one is resolved ,the other will also resolve. One surface is considered as a driving member and other as driven member. The driving member is kept rotating .

When the driven member is brought in contact with the driving member, it is also starts rotating .When the driven member is separated from the driving member, and it stops revolving. The driving member of clutch is the flywheel mounted on crankshaft, the driven member is a pressure plate mounted on the transmission shaft.



MULTIPLE CLUTCHES: A multi plate clutch consists of more than one clutch plate. As the numbers of clutch plates are increased, the friction surface also increases. The increased number of friction surfaces increases the capacity of the clutch to transmit torque. The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by the strong coil springs and assembled. Each of the alternate plate slides on splines on the pressure plate.

A multi plate clutch works in the same way as a single plate clutch while the flywheel is rotating, the pressure plate rotate and press against the friction plate. This causes the clutch plate to rotate, which in turn rotate the clutch shaft. When the pedal is pressed, the flywheel continues to rotate but the clutch plate is released. This happens because they are not fully pressed by the pressure plates. Thus the clutch shaft also stops rotating. A multi plate clutch may be dry or wet. When the clutch is operated in an oil bath, it is called as a wet clutch. When the clutch is operated dry, it is called dry clutch.



Procedure

Dismantling

1. Park the motorcycles on ground level.
2. Loosen the drain plug and drain out the lubricant.
3. Disconnect clutch cable and remove the clutch cover.
4. Remove the throw out bearing.
5. Loosen the clutch spring bolts using clutch puller and spanner.
6. Take out springs ,inner drum, metallic plates, friction plates etc
7. Take out the clutch drum.

- **Inspection :**

1. Inspect friction discs, clutch plates for excessive wear and overheating.
2. Measure friction disc lining thickness with micro meter or calliper.
3. Measure free length of pressure spring with venire calliper.

- **Assembling:**

1. Placetheclutchdrumonclutchshaft.Assemblethefrictionplates,metallic plates and springs on the inner drum using clutch puller and spanner.
2. Insert this assembly on the clutch shaft.
3. Connect the throw out bearing and clutch cover. Connect the clutch cable.
4. Fill gear oil in the gear box up to the required level.
5. Check the functioning of the clutch.

Advantages:

1. The number of friction surfaces increases the capacity of the clutch to transmit torque. Therefore, considering the same torque transmission the overall diameter of the multiplate clutch is reduced when compared to a single plate clutch.

2. It is used in scooters, motorcycles, where there is space problem.

3. As it can transmit more torque, it can be used in heavy vehicles and racing cars.

Conclusion: From the above experiment we have successfully studied about the working of multiple plate clutch of an automobile.

EXPERIMENT – 03

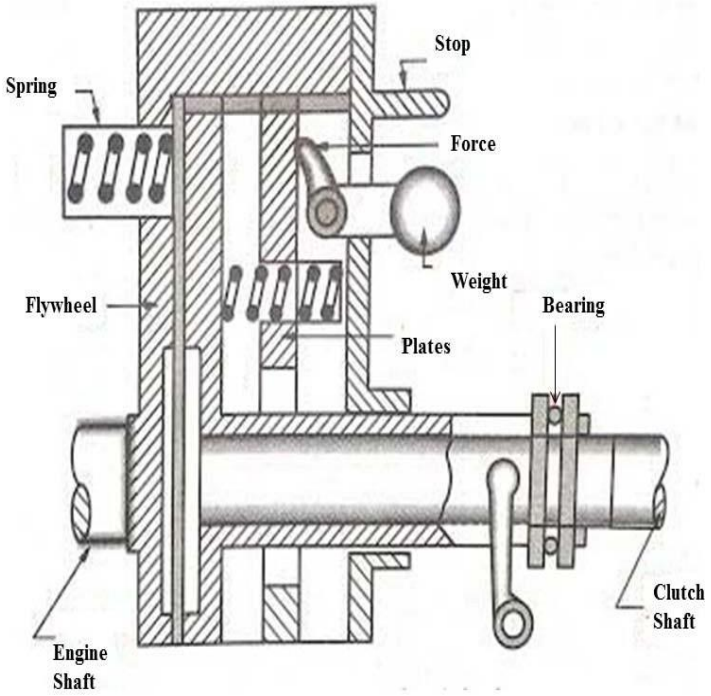
STUDY, DISMELTLING AND ASSEMBLY OF CENTRIFUGAL CLUTCH

Aim of the experiment: To study the working principle of centrifugal clutch with their advantages and disadvantages.

Apparatus required:

Model of centrifugal clutch

Theory:



In this type of clutch, the springs are eliminated altogether and only centrifugal force is used to apply the required pressure for keeping the clutch in engagement position. The advantage of the centrifugal clutch is that no separate clutch pedal is required. The clutch is operated automatically depending upon the engine speed. Similarly while starting, the driver can first select the gear, put the car into the gear and simply press the accelerator pedal. This makes driving very comfortable and easy.

Construction and Working of centrifugal Clutch:

Construction:

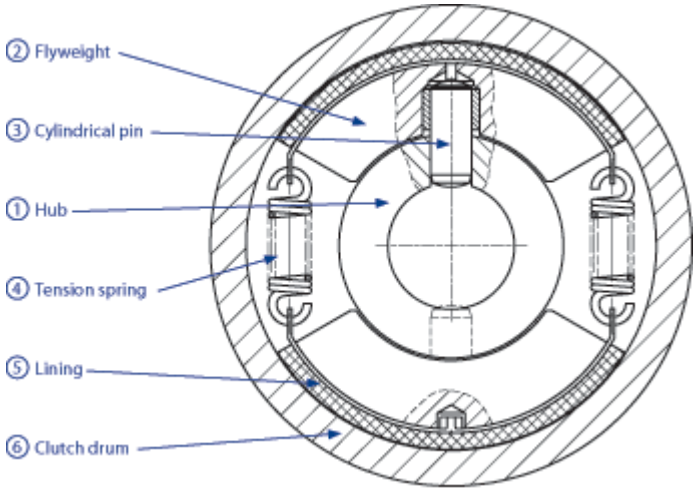
Centrifugal clutch works on the principle of centrifugal force. When the engine is started, the speed of the driving shaft is less, so the centrifugal force is also less. Therefore, shoes (flyweights) do not move outwards and torque is not transmitted to the rear wheel. As the speed of engine increases, the centrifugal force also increases.

At certain engine speed, the shoes fly off outwards due to increased centrifugal force and they come in contact with the driven member. Now both the driving and driven members rotate together and the clutch is said to be engaged. Thus the engine torque is transmitted to the rear wheel. When the engine speed decreases, the centrifugal force also decreases. Now the shoes return back to their original position due to spring force which results in a disengagement of the clutch and torque is not transmitted to rear wheel.

Precautions to be followed

• Refer the appropriate service manual

• Use Specified tools, special tools and other equipments.



Procedure :

• Dismantling

1. Remove kick starter pedal, if necessary

2. Remove right side crankcase cover screws using impact screwdriver

3. Remove crankcase side cover.

4. Remove gear change release mechanism

5. Remove nut from end of crankshaft

6. Slide clutch unit off of crankshaft end

7. Compress clutch release springs by pushing an Clutch plates and discs using press or vise

8. Remove large plate snap ring using: snap ring pliers.

9. Remove plates and discs

10. Remove the primary drive gear and clutch.

11. Remove Centrifugal weights.

12. Compress clutch drive plate and clutch cover together to release spring tension on the cover plate attaching bolts using press or vise.

13. Remove bolts and separate drive plate and cover

• **Inspection:**

1. Clean and visually inspect all parts for obvious wear or damage.

2. Measure the thickness of the disc lining using the micrometer and compare with specified value.

3. Measure the free length of all clutch springs using and compare with specified value.

• **Assembling:**

1. Install damper springs and assemble drive plate, and clutch cover and compress in press or vise

2. Install clutch 'cover bolts and tighten- to specifications

3. Install- centrifugal weights.

5. Install clutch plates and friction discs

6. Compress clutch release springs with a press or vise and install clutch plate retaining ring

7. Slide cutch unit onto crank-shaft

8. Install lock washer and nut on crankshaft and tighten it

9. Install gear change release mechanism

10. Install crankcase side cover and tighten screws with impact screwdriver

11. Install kick start pedal if necessary.

Advantages of Centrifugal Clutch

- This type of mechanical clutch is automatic, so no kind of control mechanism is necessary
- Centrifugal clutch is fairly cheap compare to normal type of clutch.
- If tuned properly, centrifugal clutch will tend to keep the engine at or near the torque peak of the engine.
- It prevents engine from stalling… In other words it minimizes engine braking force.
- It is very helpful in various speed ranges compared to direct drive system.
- It is easier for the user/driver since the operation becomes simpler.

Disadvantages of Centrifugal Clutch

- This clutch is not appropriate for transferring significant torque or power because they can slip if loaded heavily.
- Sometimes the centrifugal clutch does not engage or disengage reliably and therefore can cause a safety hazard.
- As centrifugal clutch remains idle you need to be very careful that it's in off condition while performing maintenance operation.

Conclusion:

Experiment-4

STUDY, DISMANTLING & ASSEMBLING OF SLIDING MESH GEAR BOX

Aim of the experiment:

- To understand working principle of sliding mesh gear box with its advantages and limitation.
- To study dismantling and assembling process.
- To identify key components and their functions.

Equipment required :

Manual gearbox with sliding gears for changing speed ratios.

- Main Shaft
- Lay Shaft (Counter Shaft)
- Gears (Constant mesh gears and sliding gears)
- Selector Forks
- Gear Lever

Dismantling Procedure

Tools Required: Wrenches, screwdrivers, gear pullers, circlip pliers, and a mallet.

1. Prepare the Work Area:
    - Ensure the workspace is clean and have a tray for components.
2. Drain the Gear Oil:
    - Remove the drain plug and empty the oil into a container.
3. Remove the Gearbox from the Vehicle:
    - Disconnect the propeller shaft, clutch linkage, and mounting bolts.
4. Open the Gearbox Casing:
    - Unscrew the bolts holding the gearbox cover and remove the casing.
5. Dismantle the Shafts:
    - Take out the main and lay shafts by removing their respective bearings.
    - Slide off gears, spacers, and washers carefully.
6. Remove Selector Mechanism:
    - Take out the selector forks and gear lever assembly.
7. Inspect the Components:
    - Check gears, bearings, shafts, and synchronizers for wear and damage.

Assembling Procedure

1. Clean the Components:
    - Wash all parts with cleaning fluid and dry thoroughly.
2. Reassemble the Shafts:
    - Fit the gears and spacers onto the main and lay shafts in their correct order.
    - Install bearings securely.
3. Install the Selector Mechanism:
    - Place selector forks and connect the gear lever assembly.
4. Reassemble the Gearbox Casing:
    - Close the casing and secure with bolts.
5. Refit the Gearbox to the Vehicle:
    - Reconnect the propeller shaft, clutch linkage, and mounting bolts.
6. Fill with Gear Oil:
    - Use the manufacturer's recommended gear oil and fill to the correct level.
7. Test the Gearbox:
    - Check gear shifting, noise levels, and oil leaks.

Key Precautions:

- Label components during dismantling to avoid confusion.
- Use correct tools to prevent damage.
- Follow the service manual for specific torque values and gear arrangements.

Conclusion:

Experiment-5

STUDY, DISMANTLING & ASSEMBLING OF CONSTANT MESH GEAR BOX

Aim of the experiment:

- To understand working principle of contact mesh gear box with its advantages and limitation.
- To study dismantling and assembling process.
- To identify key components and their functions.

Tools and equipment required:

- Spanners
- Screwdrivers
- Torque Wrench
- Circlip Pliers
- Safety Gear (Gloves, Safety Glasses)

Introduction:

The constant mesh gearbox is a classic and widely used type of manual transmission system found in numerous vehicles. This robust and reliable gearbox design has stood the test of time, offering efficient and smooth gear shifting for decades. Unlike other transmission systems, all gears in a constant mesh gearbox remain engaged with their respective shafts.

The key to its seamless operation lies in its ingenious design, which employs sliding gears into place while rotating, avoiding the need for clutch disengagement during gear changes. This enduring technology has played a crucial role in enhancing driving experiences, providing drivers with greater control and ease of operation on the road.

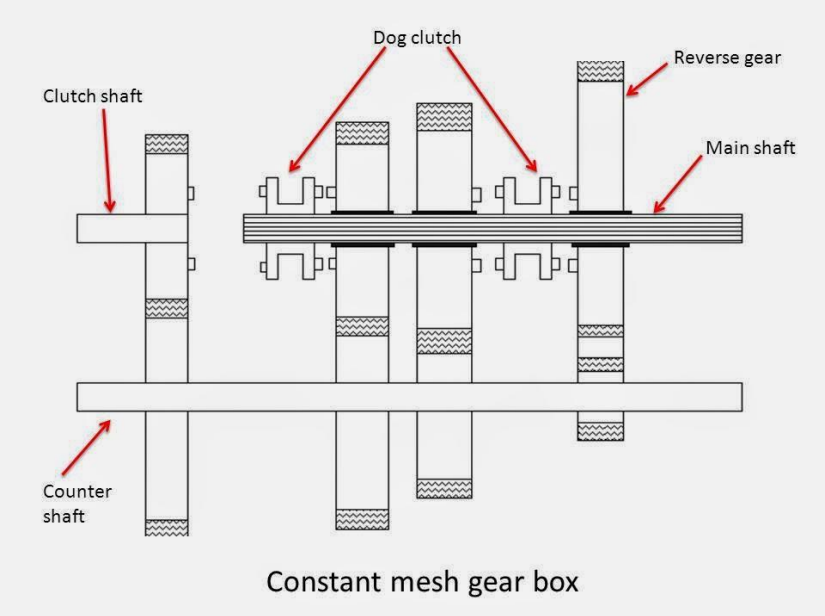
Components of contact mesh gear box:

- Gears: Spur, Helical, Bevel
- Shafts: Input Shaft, Output Shaft, Countershaft
- Bearings and Bushings
- Synchronizers
- Clutch Mechanism
- Gear Lever and Linkages

Dismantling procedure:

- Safety Precautions: Wear protective gear and disconnect power.
- Preparation: Drain lubricating oil and secure the gearbox.
- Disassembly Steps:

- Remove the gearbox cover.
- Detach the input and output shafts.
- Take out gears, bearings, and synchronizers sequentially.
- Inspect components for wear and damage.



Assembly Procedure

1. Clean Components: Ensure parts are free from dirt and oil.
2. Reassemble Components:
    - Fit bearings and shafts.
    - Assemble gears and synchronizers as per the manufacturer's layout.
    - Reattach the gearbox cover and tighten bolts to the specified torque.
3. Lubrication: Fill with recommended lubricating oil.

Results and Observations

- Record assembly time, issues faced, and solutions applied.
- Document wear and damage identified during the inspection.

EXPERIMENT – 06

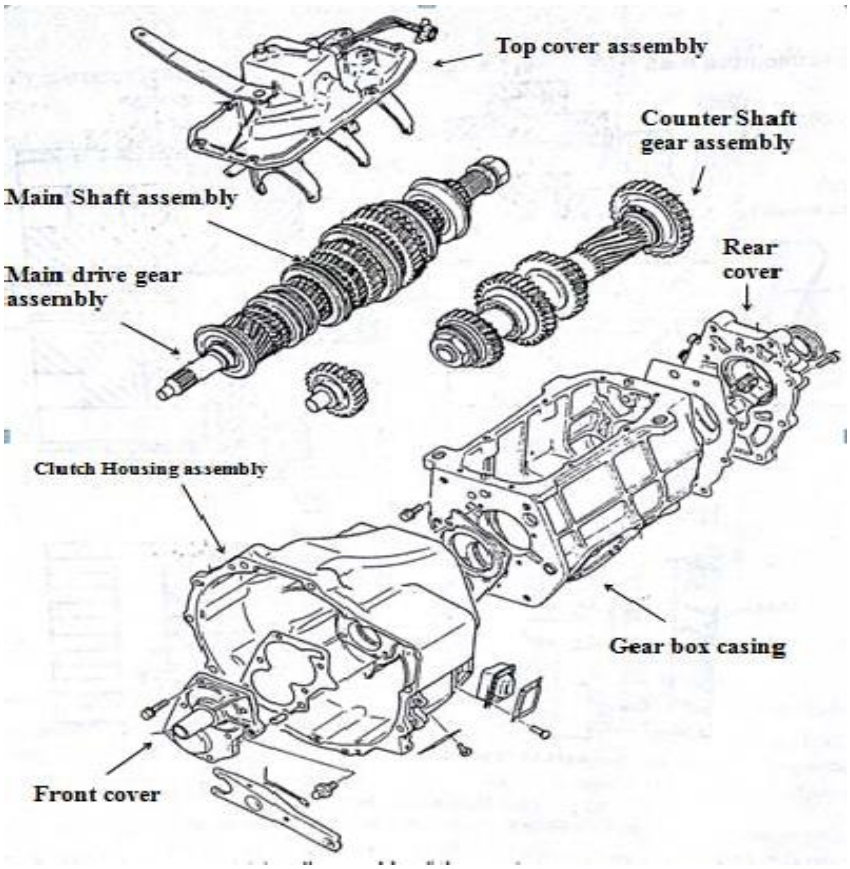
STUDY, DISMELTLING AND ASSEMBLY OF SYNCHROMESH GEAR BOX

Aim of the experiment: To study the working principle of synchromesh gear box with their advantages and disadvantages.

Apparatus required:

Model of synchromesh gear box

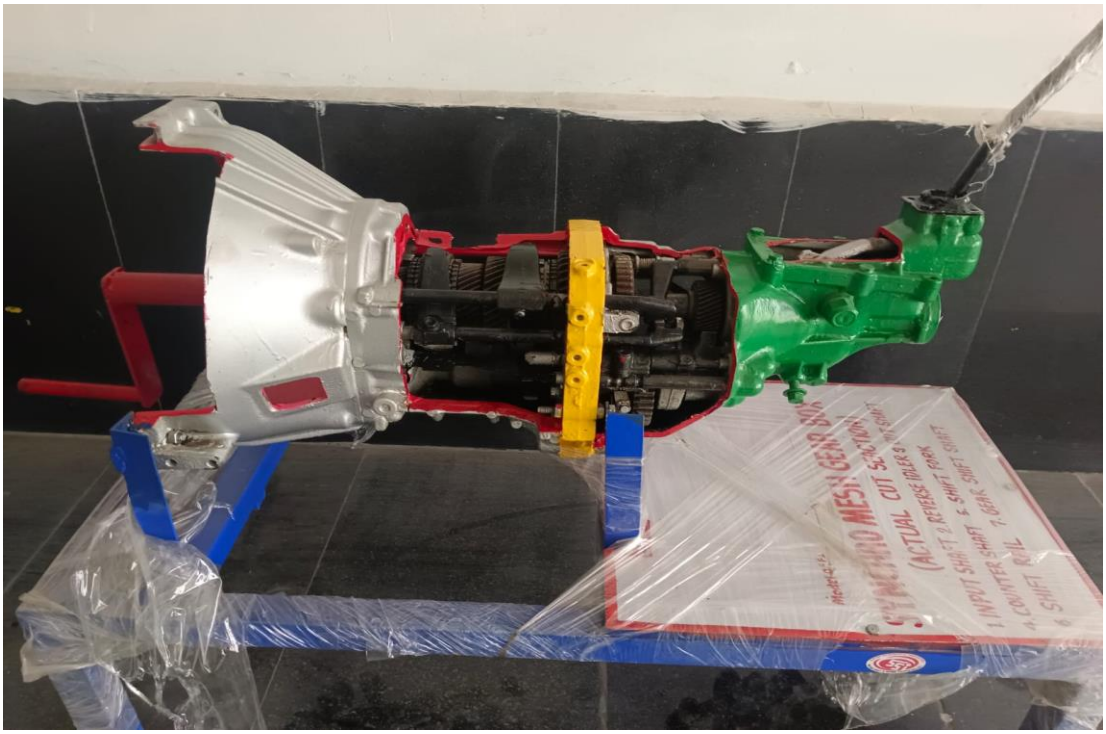
Theory:



In the Synchromesh gearbox, provision of synchromesh device avoids the necessity of double declutching. These synchromesh devices work on the principle that the two gears to be engaged are first brought into frictional contact, to equalizes their speed , and then they are Positively engaged . By using this even unskilled drivers can engage the gears without clash or damage to the gears. Synchromesh gearbox is similar to constant mesh gearbox except a synchronizing mechanism is additionally provided for smooth engagement of the gears.

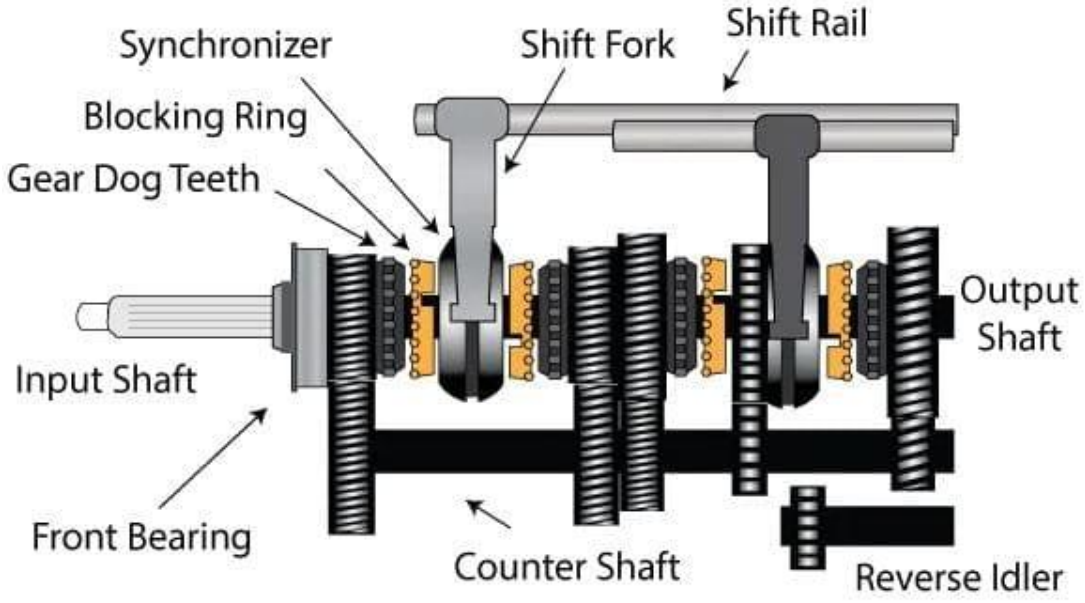
Construction and Working of synchromesh gear box:

The engine shaft carries a pinion which meshes with a wheel fixed to the lay shaft, while the gear on the main shaft is free to rotate and is permanently meshed with another wheel fixed to the lay shaft. Both the pinion and the wheel on the main shaft have integral dog tooth portions and conical portions. The synchronizing drum is free to slide on spines on the main shaft.



This drum has conical portions to correspond with the conical portions on the gearbox shaft pinion and on the wheel that rotates freely on the main shaft. The synchronizing drum carries a sliding sleeve. In the neutral position, the sliding sleeve is held in place by the spring loaded balls which rest in the dents in the sliding sleeve (or ring gear). In changing gear, the gear lever is brought to the neutral position in the ordinary way, but is immediately pressed in the direction it has to go to engage the required gear. When a shift starts, the spring loaded balls cause the synchronizing drum and sliding sleeve, as an assembly to move toward the selected gear.

The first contact is between the synchronizing cones on the selected gear and the drum. This contact brings the two into synchronization. Both rotate at the same speed. When the speeds of the two have become equal, a slightly greater pressure on the gear lever overcomes the resistance of the balls. Further movement of the shift fork forces the sliding sleeve on toward the selected gear. The internal splines on the sliding sleeve i.e. the dog portion, match the external splines on the selected gear the dog teeth are locked up, or engaged, and thus positive connection is established. The gear shift is completed.



Precautions to be followed

• Refer the appropriate service manual

• Use Specified tools, special tools and other equipments

Procedure :

• Dismantling

1. mount the gear box in work stand and remove the selector assembly
2. lock the main gear by engaging any two gear by shifting by respective sliding sleeve.
3. Remove the driving flange. Remove the gear box rear end cover.
4. Remove the speedometer drive gear. Remove the clutch shaft. Pull out the main shaft along with the bearing
5. Remove the main shaft gears, dog clutch, sliding sleeve, synchromesh unit, bearings and arrange these in the order of their fitment on the main shaft. 6. Remove the reverse idler gear shaft and the idler gear. Remove the lay shaft gear set with washers. Remove the lay shaft bearings.

• Inspection:

1. Inspect the transmission case for cracks and worn or damaged bearing bores and threads.

2. Check each synchronizer sleeve for free movement on its hub.

3. Check the amount of synchronizer ring wear by placing the ring on its gear cone.

4. Inspect the shift fork and groove in the synchronizer sleeve for wear or damage.

5. Check all bushings and bearings

6. Inspect all gears for crack or worn out excessively.

• Assembling:

1. Place all seats in the cover. Fit the counter shaft bearing.

2. Clamp the counter shaft in its position. Fix the reverse idler along with its shaft and lock it.

3. Assemble the gears, bushes, dog clutches, synchromesh units on the main shaft.

4. Place the plot bearing on the main shaft.

5. Lift the main shaft & place it in the gearbox casing. Fit the main shaft rear end bearing inside the casing.

6. Fix the bearing on clutch shaft & fit a circlip. Place the clutch shaft in the casing. Place the bearing housing along with the gasket on gear casing.

7. Place the speedometer drive gear on the main shaft. Fit all the bearing covers along with the gasket.

8. Place the drive flange on main shaft. Keep the main shaft in neutral position. Keep all the forks in neutral position.

9. Mount the selector assembly on gearbox.

10. Engage each gear and check the rotation by hand

THE ADVANTAGES OF SYNCHROMESH GEARBOX ARE AS FOLLOWS:

- The biggest disadvantage of the Constant Mesh Gearbox has been solved by the Synchromesh Gearbox i.e. Double-Declutching.
- The noise problem during the engagement of Gears has been minimized in the Synchromesh Gearbox.
- Due to the presence of Synchronizers, the quick-shifting of gears is possible.
- During transmission, there is no loss of Torque due to the presence of synchronizers

Conclusion:

Experiment- 7

STUDY OF DIFFERENT PARTS OF TORQUE CONVERTER

Aim of the experiment:

To study the working principle of different components used for torque converter with its advantages and limitation.

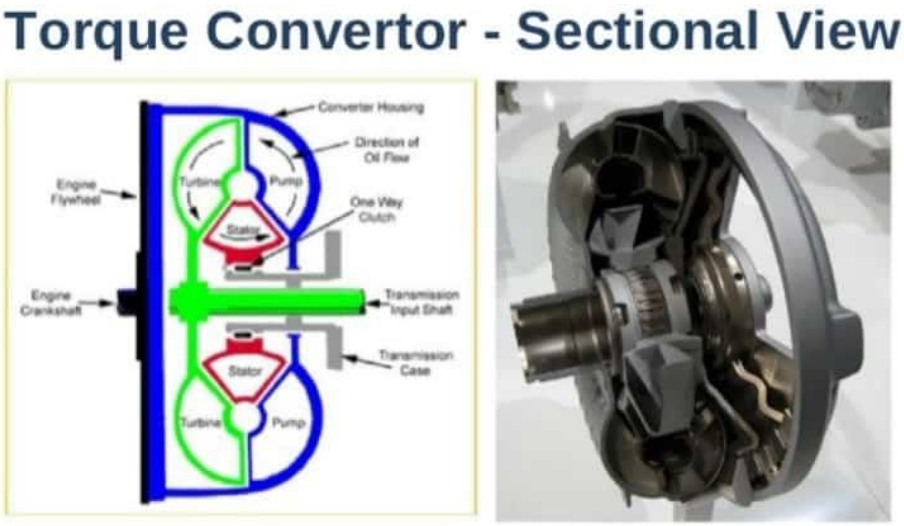
Apparatus required :

Model of Torque converter

Theory:

Torque converter placed in between engine and transmission. If you're familiar with manual transmission, you know that anis connected to a transmission by way of clutch. Without this connection, a car would not be able to come to a complete stop without killing the engine. Cars with automatic transmissions have no clutch that disconnects the transmission from the engine is called as torque converter.

Turning a car's engine crankshaft produces torque (which is the energy you create by twisting something). Torque is what allows you to accelerate your car. The more torque an engine produces, the faster a car goes. A torque converter allows the engine in a car with an automatic transmission to keep running even as the wheels come to a stop.



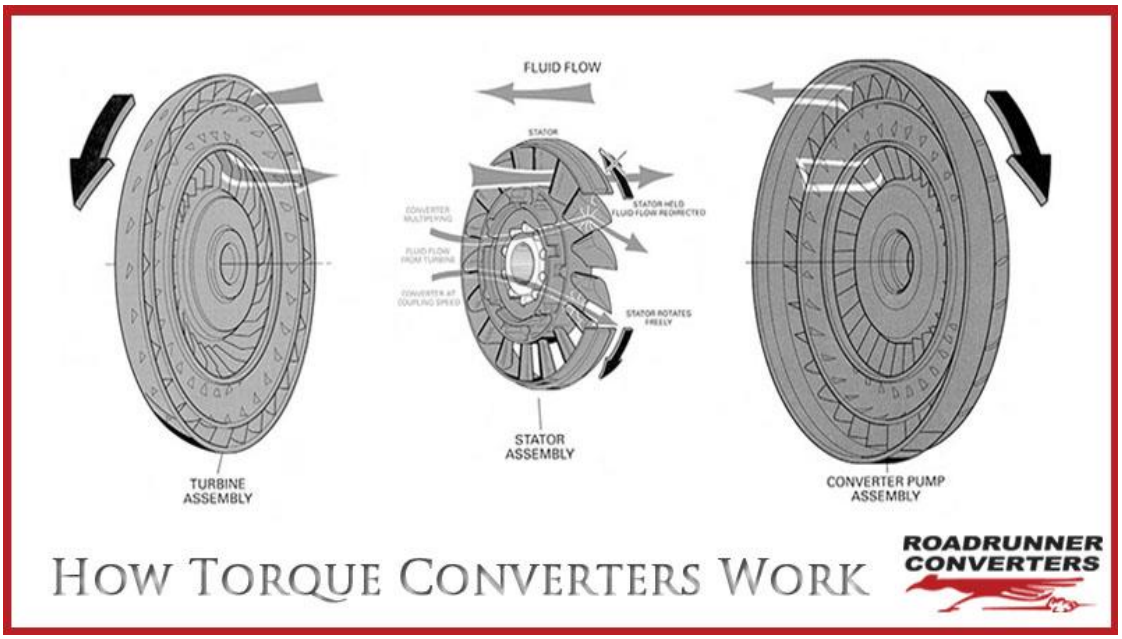
Components of torque converter :

There are 3 main components present inside the torque converter

They are

1. Impeller
2. Turbine
3. Stator

The housing of the torque converter is bolted to the flywheel of the engine, so it turns at whatever speed the engine is running at. The fins that make up the pump of the torque converter are attached to the housing, so they also turn at the same speed as the engine. The cutaway below shows how everything is connected inside the torque converter.



<u>Working function</u>:

The casing of the torque converter is connected to the engine's flywheel, causing the entire casing to rotate at the same RPM as the engine. The pump is also linked to the casing,

resulting in the pump rotating at the same speed and direction. Inside the casing, there is fluid that is propelled by the pump using centrifugal force.

The fluid then flows towards the turbine, which contains small grates that allow the fluid to enter and move the turbine. As the turbine absorbs the torque, it begins to rotate. The turbine is directly connected to the output shaft, which transmits the rotational power to move the vehicle.

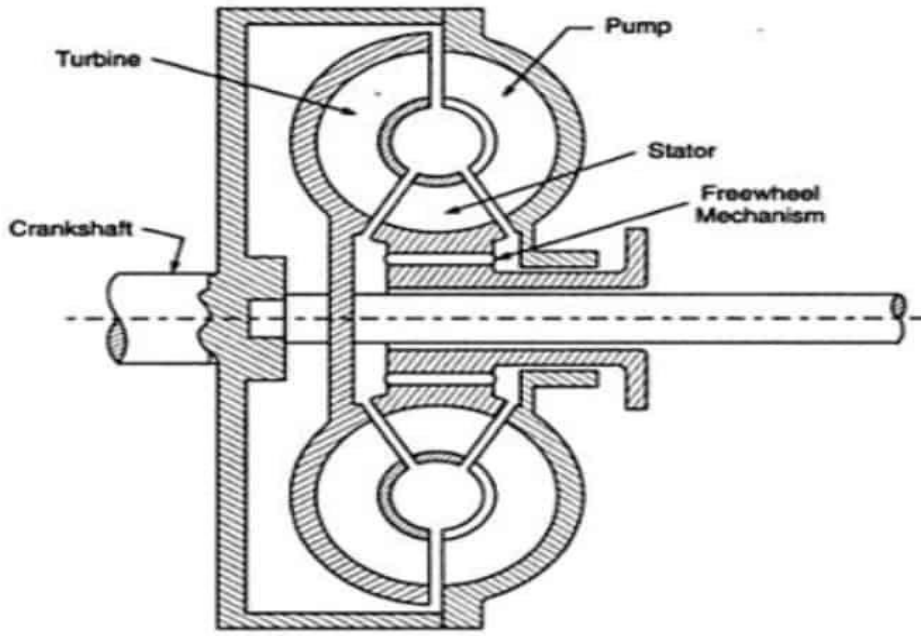


Fig: Torque converter

Once the fluid exits the turbine, it has lost much of its momentum and is flowing in the wrong direction for the pump. To rectify this, the stator comes into play. The stator rotates the fluid, aligning it with the direction required by the pump. This completes the cycle, which continues to rotate to propel the vehicle.

(model of torque converter available in **PMEC Transmission Lab**)

Advantages of torque converter

- Smooth and seamless power transfer:

  Torque converters provide a smooth and seamless transfer of power from the engine to the transmission, resulting in a comfortable driving experience.

- Torque multiplication:

  Torque converters have the ability to multiply torque, allowing for increased low-end torque and improved acceleration.

- Flexibility in driving conditions:

  Torque converters are designed to adapt to various driving conditions, such as starting from a standstill, climbing inclines, or towing heavy loads, providing the necessary torque for optimal performance.

- Increased stall torque:

  Torque converters can generate higher stall torque, which is the maximum torque output at idle or low speeds, enabling better control and manoeuvrability.

Limitation of torque converter

- Efficiency loss:

  Torque converters introduce a degree of energy loss due to fluid coupling, resulting in reduced overall efficiency compared to direct mechanical connections.

- Heat generation:

  The operation of torque converters generates heat energy due to fluid friction, which requires additional cooling mechanisms to maintain optimal operating temperatures.

- Increased weight and size:

  Torque converters add weight and size to the drive train, which can impact vehicle weight distribution and overall packaging constraints.

- Limited control over power transfer:

  Unlike manual transmissions, torque converters provide limited control over power transfer, as the fluid coupling design does not allow for direct engagement or disengagement of the engine and transmission.

Conclusion:

From the above experiment, we studied about the working function of torque converter with its advantages and disadvantages of torque converter.

Experiment-8

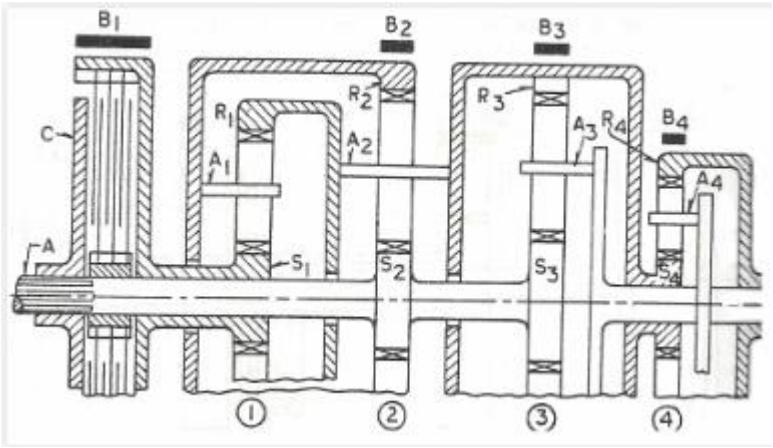
Study, dismantling and assembling of Wilson gear box

Aim of the experiment: To study the working function of Wilson gear box along with its advantages and disadvantages.

Theory:

The gearbox comprises of three sub-assemblies, the running gear, the brake harness and the control mechanism housed in an oil tight container. This consists of a four epicyclic trains of gear inter connected, so that different ratios and a reverse can be obtained. The direct drive is achieved by engaging the clutch.

One train of epicyclic gearing is used for all the various ratios, its sunS1 being secured to a shaft D coupled permanently to the engine and its armR1 to the shaft E which is coupled permanently to the driving road wheels and the various ratios are obtained by driving the annulus A1 at different speeds in relation to the engine speed.



(Line diagram of Wilson gear box)

Working function of wilson gear box

First gear is obtained by applying a brake to the first gear trainannulus A1. So that it is held stationary. The engine will then, be turning thesun gear S1. So that the planet gears will be rolling round inside the annulusA1 carrying their arm R1 round with them. As this arm R1 fixed to theoutput shaft its motion is imported to it.

First Gear ratio:
Engine speed = 1000 rpm = sun S1 speed
Arm R1 speed = wheel speed = 1000 x s/ (a +s)
= 1000 x 25 / (100 + 25)= 200
Where
s = 25 = sun wheel teeth
a = 100 = annulus teeth
Gear ratio = 1000: 200 =>5: 1

SECOND GEAR

Second gear is obtained by holding the second gear train annulus A2 cause the planet gear to revolve and their arm R2. But this arm R2 is connected to the first gear train annulus A1 which therefore turns, speeding up the rotation of the planet gear and arm R1 and it turning the output shaft faster than was the case in first gear, i.e. less reduction.

Second Gear ratio:
Engine speed = 1000 rpm = sun gear S1
Annulus speed = 100 rpm
Gear ratio = 1000 : 280 = 3.57 : 1

THIRD GEAR

Third gear is obtained by holding the third gear sun wheel S3 by brake drum holding. Which is interconnected further the annulus A3 is an integral part of the second gear planet arm R2 which is in turn connected to the first gear annulus A1. The third gear arm R3 is connected to the second gear annulus A2 so driving it in same direction as the engine. i.e. increasing its speed so the drive is taken back through the second gear planets and arm R2 and the first gear train annulus A1 both of which are speeded up. The result is to speed up the first gear train arm R1 which are connected to output shaft.

In other words by interconnecting the second and third arms, an increase of speed is obtained at the first gear train annulus, which increases the speed of the arm R1.

Third Gear ratio:
Sun wheel S1 speed = 1000 rpm
Arm R1 speed = 360 rpm
Gear ratio: 1000 : 360
2.78 : 1

TOP GEAR

In the top gear all the gear trains are locked together and revolve as a solid block driving the output shaft at engine speed. This is brought about by the engagement of this driving member to the clutch which is the drum and sun gear S3 gear train. So that locking the third gear sun to the driving shaft. Those are all the sun gear will be revolving at the same speed.

Since the first and second gear train sun wheel are fixed to the shaft (output) and their will not be any individual action of the various gear train. All the brake bands eing loose their annulus.

Gear ratio = 1000 : 1000 = 1 : 1

REVERSE GEAR

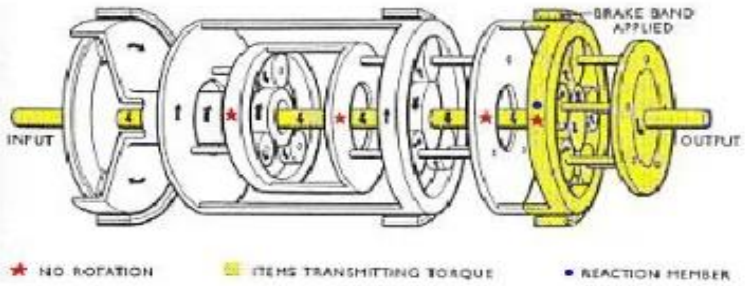
The first gear annulus A1 is connected to the sun gear S4 of the reverse gear trainand hence drive output shaft opposite to engine rotation. When the brake is applied to reverse gear annulus A4 the reverse gear planet wheels turned by the reverse sun gear connected to the first gear annulus and therefore turning opposite to the engine speed output shaft. As the arm A4 connected to the output shaft the direction of rotation of the propeller shaft reversed.

Reverse Gear ratio:
Sun wheel S1 = 25
Annulus A1 = 100
Sun wheel S4 = 40
Annulus A4 = 80
Gear ratio: 7 :1

The Gears

First Gear

With the annulus locked by the brake band and no. 1 sunwheel rotating, the planet wheels attempt to spin but are prevented by the locked annulus. By using the internal teeth of the annulus they can spin only by rolling and thus the planet spindles cause rotation of the planet carrier, which forms part of the output shaft, this now rotates in the same direction as the input shaft.



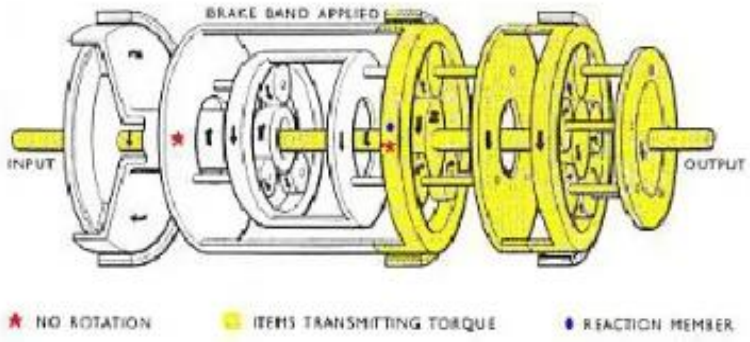
The speed of the output shaft in relation to the input is governed by the designed ratio e.g. 4.28:1. which means that the input shaft revolves 4.28 times for each revolution of the input shaft.

The figure also shows what is taking place in the other gear train when the no. 1 brake band is applied.

Second Gear

In this case the second gear is applied after the brake band for the first gear has been released as shown below. When the second brake band is applied for the following happens:-

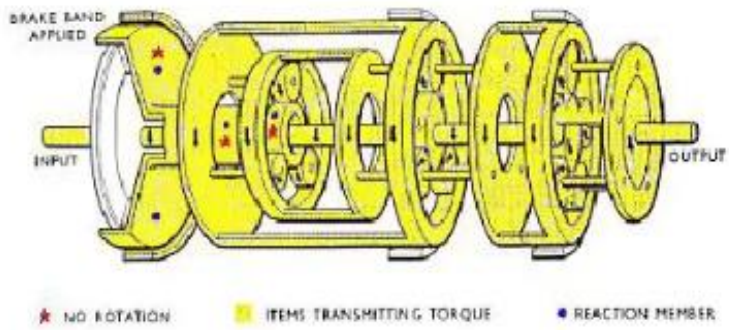
1. the first gear annulus is released
2. the second gear annulus is stopped
3. the sunwheel for no.2 gear is rotating
4. the three planet wheels of no.2 gear are rotating in the opposite direction to that of the input shaft
5. as the annulus is stopped, but with the sunwheel revolving, the planet wheel carrier revolves
6. as the planet wheel carries, which is directly connected to the annulus of the first gear, revolves, it causes the no.1 gear annulus to revolve
7. as the first gear annulus and first gear sunwheel are already revolving in the same direction, this added rotation causes no. 1 gear planet wheels to rotate more quickly, this in turn causes the output shaft to rotate at a greater speed than in first gear.



Third Gear

Third gear is obtained from the added motion which the third gear train passes to second gear and on to first gear. Summarising: second gear is used to speed up first gear for second gear range. Third gear is used to speed up second gear which in turn will further speed up first gear for third gear range.

When third gear is selected a brake band stops the third gear drum to which is attached the third gear sunwheel.



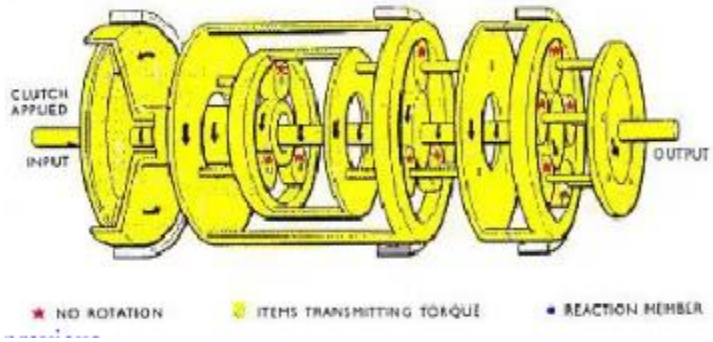
The planet wheels of third gear are connected to the annulus of second gear and the second gear planet wheels are connected to the third gear annulus as well as to first gear annulus.

Rotation of sunwheel no. 2 will cause second gear planet wheels to rotate about their own axis. They in their turn will cause the second gear annulus to rotate, which in its turn will cause third gear planet wheels to roll round the stationary third gear sunwheel. This will cause the third gear annulus to rotate, causing second gear planet wheels to roll round second gear annulus.

The combined movements of the third and second gear annulus will cause the second gear planet wheels to move faster, thus the first gear annulus will revolve faster which in its turn increases the speed of the output shaft.

Fourth Gear

The fourth gear is not engaged by applying a brake band but by means of a clutch which connects the sunwheel of the third gear train to the input shaft and thus locks all the running gears together, which then revolve with the main shaft. It should be noted that there is no rotation of any of the planet wheels around their pins. This arrangement gives a 'straight through' drive in top gear.



Conclusion: from the above experiment we get to learn about the working function of Wilson gear box.

Experiment-9

Study, dismantling & assembling of Chevrolet “turbo-glide” transmission system

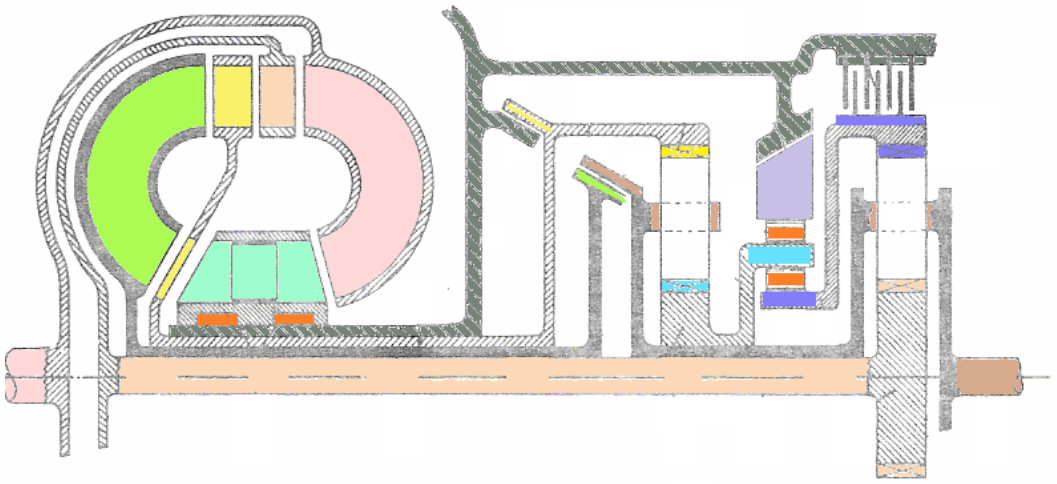
Aim of the experiment: To study about the Chevrolet turbo-glide transmission system along with its working principle.

Introduction to Chevrolet turbo-glide transmission system:

The Turbo-glide transmission had the following design features:

The transmission has a torque converter with an impeller, three turbines, and a stator. This combined with two planetary gearsets, four fluid controlled clutches, and three way sprag clutches. each two of the turbines drives one of the planetary gearsets. the third drives shaft directly. it does not shift gears as most transmission shift gears. It phases between gears. there is no active logic for gear selection in the valve body. Teh pull on the drive wheels and sprag cluthes select the gear ratio. Sprag clutches are one way clutches. They couple the shafts one direction and freewheel in the other direction. The only time the valve body changes the clutches is when the gears shifts is moves. Itbehaves very similarly to the new continuously variable transmission but it works in a totally different way. Is a shiftless transmission.

Working function:



The connections

- The engine turns the impeller.
- The 1st turbine drives the back sun gear for a starting gear ratio of 3:1
- 2nd turbine drives the front ring gear for a starting gear ratio of 1.60:1
- 3rd turbine drives the drive shaft through the neutral clutch for a cruising ratio 1:1

Neutral and park

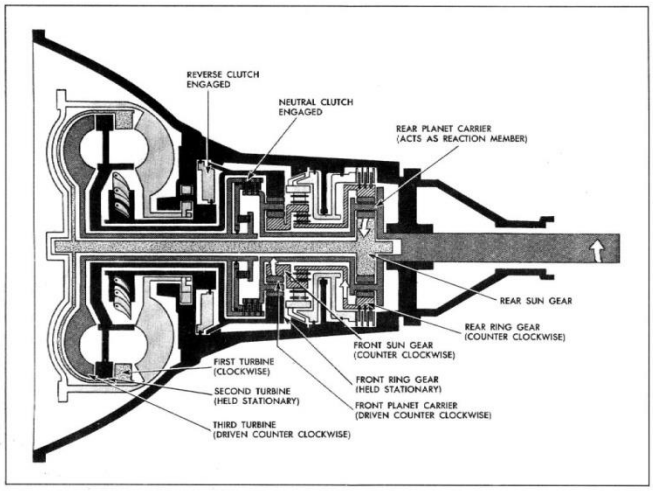
- When all the clutches are disconnected, non of the rotation in the torque converter can reach the wheels. This happens in park and neutral.
- In park, the park latch keeps the drive shaft from turning.

Drive

- When forward clutch is engaged, a spang clutch prevent rotation of parts in the direction opposite to the engine rotation.
- The neutral clutch connects the 3rd turbine to the drive shaft, with no sprag clutch.
- The inner spag stops the reverse rotation of the back ring gear, acting the rear gear set.
- The outer spang stops reverse rotation of the front sun gear, acting the front gear set.
- The stater spang stops the reverse rotation of the stater, acting torque multi application.
- When the vehicle drive is in drive and is just starting to move forward, all three turbines are driving the drive shaft but the 1st turbine is proving the most torque.
- When the car allowed to slow down, the process reverse. But the direct drive condition lasts as long as no power was needed by the driver.

Grade retard

- When grade retard is selected, the forward, neutral and retard clutches are all engaged. This locks the 1st turbine to the drive shaft at a low grade ratio. This uses the velocity of the car to drive engine proving engine braking.
- The disk clutch is used to gradually engage grade retard so the car does't jerk.
- With both the forward clutch and the retard clutch to the drive shaft with different gear ratio.
- With the neutral clutch engaged the 3rd turbine is directly coupled to the drive shaft.



Reverse

- Each of the turbine is trying to drive the engine at different speed. The turbulence in the torque converter slows the car while trying to drive the engine.
- This transmission is one of the few that can actually change gear ratios in revwerse.
- The reverse clutch stops the front ring gear. This cascades the two planetary gear sets.
- When the vehicle is revesre and just starting, both the 1st and 3ed turbine supply power in reverse to the drive shaft.
- If the vehicle ever gets to the point where the motion in reverse is faster then the 1st turbine drives it, the sprag clutch flywheel and turbine drives the car in reverse.
- Because the 3rd turbine is rotating backwards, the stator sprag clutch will never freewheel.

Conclusion: