

USN



Internal Assessment Test 3 – May 2019

|                                       |   |           |          |            |    |            |         |         |     |     |
|---------------------------------------|---|-----------|----------|------------|----|------------|---------|---------|-----|-----|
| Sub:                                  | Automobile Engineering  |           |          |            |    | Sub Code:  | 15ME655 | Branch: | ME  |     |
| Date:                                 | 14/05/19  | Duration: | 90 min's | Max Marks: | 50 | Sem / Sec: | VI/A&B  |         | OBE |     |
| <u>Answer any FIVE FULL Questions</u> |   |           |          |            |    |            |         | MARKS   | CO  | RBT |
| 1.                                    | Explain single plate clutch with a neat sketch.                           |           |          |            |    |            | [10]    |         | CO2 | L2  |
| 2.                                    | Define Ignition advance? Explain Vacuum advance system with a neat sketch |           |          |            |    |            | [10]    |         | CO3 | L2  |
| 3.                                    | Explain Battery ignition system with a next sketch.                       |           |          |            |    |            | [10]    |         | CO3 | L2  |
| 4.                                    | Explain over drive mechanism used in Automobiles with a neat sketch.      |           |          |            |    |            | [10]    |         | CO2 | L2  |
| 5.                                    | Explain rear axle drive systems with neat sketches.                       |           |          |            |    |            | [10]    |         | CO2 | L2  |
| 6.                                    | Explain the working 3 speed synchromesh gear box with a neat sketch.      |           |          |            |    |            | [10]    |         | CO2 | L2  |
| 7.                                    | Explain Electronic ignition system with a next sketch.                    |           |          |            |    |            | [10]    |         | CO3 | L2  |

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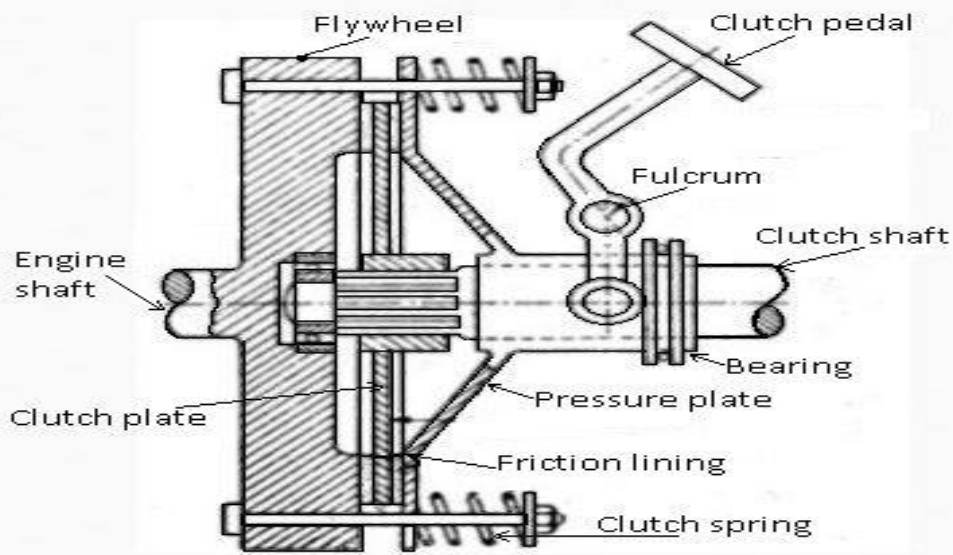
|                                       |   |           |          |            |    |            |         |         |     |     |
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**Scheme Of Evaluation**  
**Internal Assessment Test 1 – March 2019**

|              |                        |                  |        |                   |    |             |              |                |    |
|--------------|------------------------|------------------|--------|-------------------|----|-------------|--------------|----------------|----|
| <b>Sub:</b>  | Automobile Engineering |                  |        |                   |    |             | <b>Code:</b> | 15ME655        |    |
| <b>Date:</b> | 06/03/2019             | <b>Duration:</b> | 90mins | <b>Max Marks:</b> | 50 | <b>Sem:</b> | VI           | <b>Branch:</b> | ME |

**Note:** Answer Any Five Questions

| Question # |    | Description  | Marks Distribution |      | Max Marks |
|------------|----|--|--------------------|------|-----------|
|            |    |  |                    |      |           |
| 1          | a) | Explain single plate clutch with a neat sketch <ul style="list-style-type: none"> <li>• Diagram</li> <li>• Explanation</li> </ul>  | 5 M<br>5 M         | 10 M | 10 M      |
| 2          | a) | Define Ignition advance? Explain Vacuum advance system with a neat sketch <ul style="list-style-type: none"> <li>• Definition</li> <li>• Diagram</li> <li>• Explanation</li> </ul> | 2 M<br>4 M<br>4 M  | 10 M | 10 M      |
| 3          | a) | Explain Battery ignition system with a next sketch. <ul style="list-style-type: none"> <li>• Diagram</li> <li>• Explanation</li> </ul>   | 6 M<br>4 M         | 10 M | 10 M      |
| 4          | a) | Explain over drive mechanism used in Automobiles with a neat sketch. <ul style="list-style-type: none"> <li>• Diagram</li> <li>• Explanation</li> </ul>                            | 5 M<br>5 M         | 10 M | 10 M      |
| 5          | a) | Explain rear axle drive systems with neat sketches <ul style="list-style-type: none"> <li>• Diagram</li> <li>• Explanation</li> </ul>  | 5 M<br>5 M         | 10 M | 10 M      |
| 6          | a) | Explain the working 3 speed synchromesh gear box with a neat sketch. <ul style="list-style-type: none"> <li>• Diagram</li> <li>• Explanation</li> </ul>                            | 5 M<br>5 M         | 10 M | 10 M      |
| 7          | a) | Explain Electronic ignition system with a next sketch. <ul style="list-style-type: none"> <li>• Diagram</li> <li>• Explanation</li> </ul>  | 5 M<br>5 M         | 10 M | 10 M      |



## SINGLE PLATE CLUTCH

### Clutch plate:

In single plate clutch only one clutch plate is used. Clutch plate is main component of clutches. It is thin disc type metallic plate having both side frictional surfaces. Frictional surfaces on plate must be of such material to provide friction for transmitting torque without slipping. The coefficient of friction of contact surfaces should be high for proper connection without slipping. Clutch plate is assembled in between flywheel and pressure plate.

### Pressure plate:

The pressure plate which is generally made up of cast iron. It helps in applying pressure on clutch plates to maintain the proper contact between the surfaces of flywheel and clutch plate by means of spring which are attached to it.

### Springs:

Springs are used to maintain the pressure on pressure plate for proper connection between clutch plate and flywheel and prevent the slipping of contact surfaces.

### Flywheel:

Flywheel is attached to engine output and its other side comes in contact with clutch plate when pressure is applied by the pressure plate.

### Operating mechanism:

This includes foot pedal, linkage, bearing and lever etc. All these components are connected in a sequence. Foot pedal is located inside the automobiles; a lever mechanism is attached with foot pedal which transmit the motion from pedal to spring by means of thrust bearings.

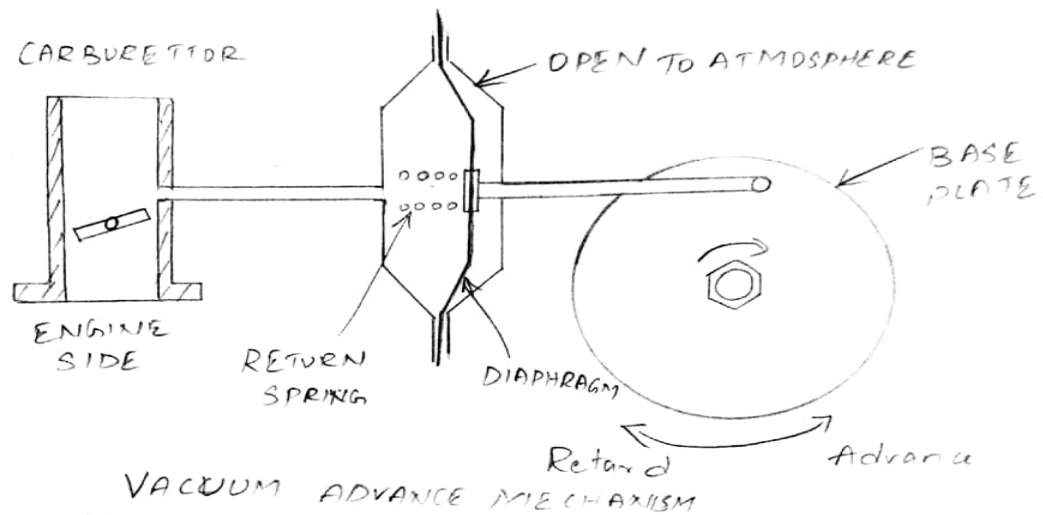
Working of single plate clutch is very simple. A mechanism is responsible for the engagement and disengagement of clutch. We easily engage and disengage the torque transmitting shafts just by apply some force on the paddle of automobile. A lever is attached to the paddle which is responsible for the force transmission from the paddle. When pedal is pressed spring is compressed and engine is free to move without any load. Lever is attached in such a manner when we press the clutch paddle thrust bearing moves forward and pressure plate moves backward or it moves away from the flywheel; due to this the connection between the clutch plate and flywheel released and shafts are disengaged. This time we can easily change gears in case of automobiles. Again if we want to engage the shafts just release the clutch paddle; then springs attached to the pressure plate push the pressure plate forward. Clutch plate is mounted between the pressure plate and flywheel on the hub. Clutch plate has both side friction lining that's why it mounted in between pressure plate and flywheel and helps in torque transmission.

## Ignition Advance

For efficient working of vehicle the ignition system should produce spark at the correct time. If the ignition occurs early in compression stroke the spark is said to be advanced. If it occurs near to the end of compression stroke the spark is said to be retarded.

For better performance the spark should occur at correct moment in terms of crankshaft position where the maximum pressure occurs at  $12^\circ$  after TDC. After the initiation of spark it takes some time to initiate combustion so the time must be given for that also. That time is known as ignition delay.

b) Vacuum Advance :- In this type the ignition advance can be done according to engine load.



The system consists of a rubber diaphragm which is connected to the base plate of the distributor. Atmospheric pressure is acting on one side of diaphragm while on the other side vacuum from the carburetor acts. The spring helps in maintaining the zero advance. As the load increases the vacuum in the carburetor increases which acts at the port provided just above throttle then the diaphragm moves against the spring force & causes ignition advance.

# Battery Ignition System

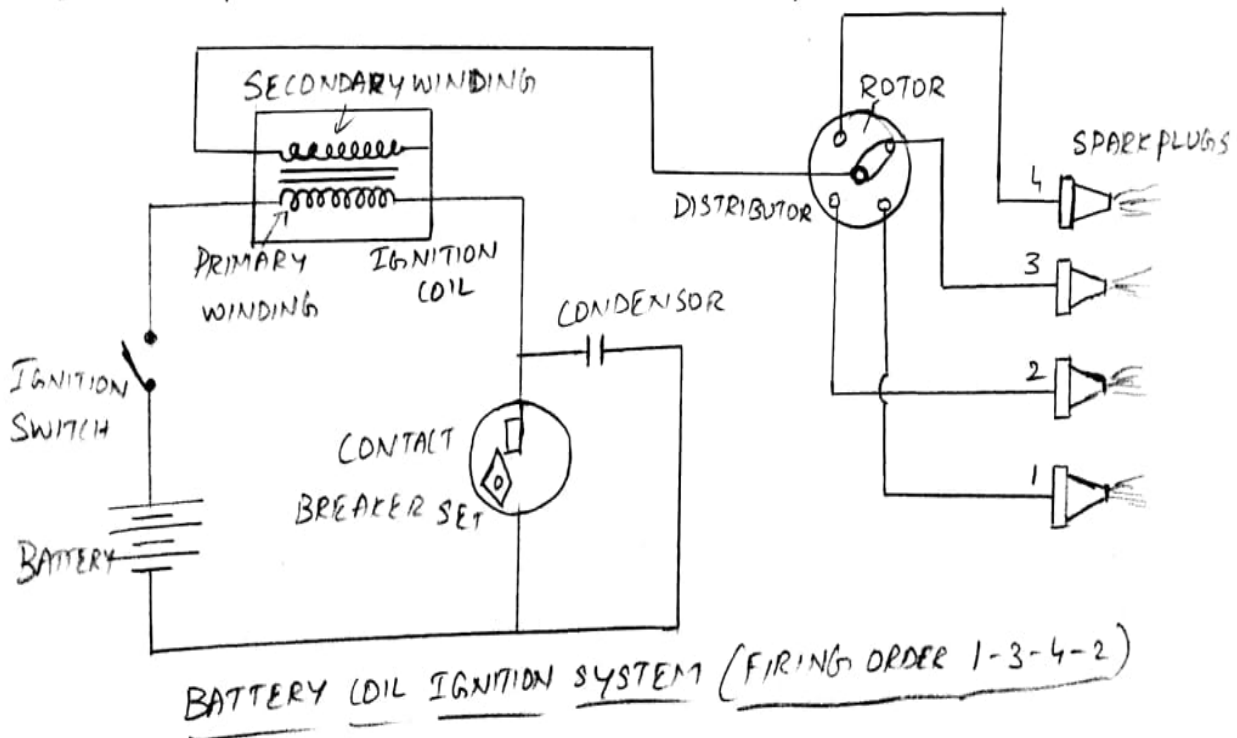
Majority of S.I engines utilize <sup>battery</sup> ignition system.

The components of such system are  
1) Battery (12 volts) 2) Ignition switch 3) Ignition coil 4) Contact breaker set 5) Condenser, ~~and~~ 6) distributor & spark plugs.

The system contains primary circuit & a secondary circuit.

Primary circuit :- The battery, primary coil of the ignition coil condenser & contact breaker.

Secondary circuit :- Distributor, secondary coil & spark plugs.



The primary coil & winding has 100 to 200 turns & secondary winding 10,000 to 20,000 turns. This helps in stepping the low voltage to high voltage.

## Working

- ① When the contact points are closed the primary circuit is completed & the primary current from battery flows to primary winding
- ② This induces the EMF in the secondary coil & is proportional to the rate at which magnetic flux increases.
- ③ The secondary voltage developed is not sufficient to produce spark.
- ④ When the contact breaker point & condenser comes into picture
- ⑤ When the breaker points are opened by the action of cam on the distributor shaft, the primary circuit is broken & magnetic field begins to collapse.
- ⑥ This induces an EMF in the secondary which is directly proportional to the rate at which magnetic field collapses which in turn depends on the rate of decrease of the primary current.
- ⑦ The condenser acts as a reservoir & stores the part of energy of the magnetic field.
- ⑧ Due to this rapid collapsing magnetic field high voltage is induced in the primary (250 volts) & even higher in the secondary (10,000 to 20,000 volts)
- ⑨ The high voltage in the secondary passes to the distributor rotor or arm through high tension lead.
- ⑩ The distributor arm connects high voltage to different spark plugs depending on the firing order of the engine.
- ⑪ To avoid burning of contact points condenser used & burning of contact points is called pitting

Over drive consists of –

### Gears

It consists of 3 types of gears that are meshed together in an order to make it functional that are-

**1. Ring gear-** It is a type of gear which is in a shape of ring having internal teeth and is responsible for transmitting the final output through the connected output shaft, Annulus or ring gear is an outer cage of an overdrive whose internal teeth are made to be in meshed with the planetary gears.

**2. Sun gear-** Same as our solar system, a sun gear is the centermost gear of an overdrive around which the number of planetary gears revolves in a direction guided by the ring gear or annulus.

The outer teeth of sun gear are made to be in mesh with the planetary gear and the power output from the splined input shaft meshed with the inner splines of the sun gear is transferred to the planetary gear later to the ring gear through the sun gear.

**3. Planetary gears-** Same as the solar system planets, planetary gears are the number of gears which revolve in between the sun gear and ring gear through the teeth which are made to be in meshed with both sun and ring gear.

### Shafts

**1. Input shaft-** In an overdrive solid cylindrical having splines cut over its surface is used as a input shaft which carries input from the transmission box into the overdrive for further direct drive or higher rpm drive. The splines of the input shaft are made to be in constant mesh with the sun gear's inner splines or in other words, sun gear is mounted over the splined input shaft.

**2. Output shaft-** It is a solid cylinder shaft which is used in an overdrive and is responsible for the transfer of final output from the overdrive to the differential through a propeller shaft.

**3. Carrier –** A carrier is a device used in overdrive, over which the planetary gears are mounted, in other words a carrier as the name suggest is a support provided to the planetary gear through there axis so that they can rotate about their axis as well as can also revolve around the sun gear.

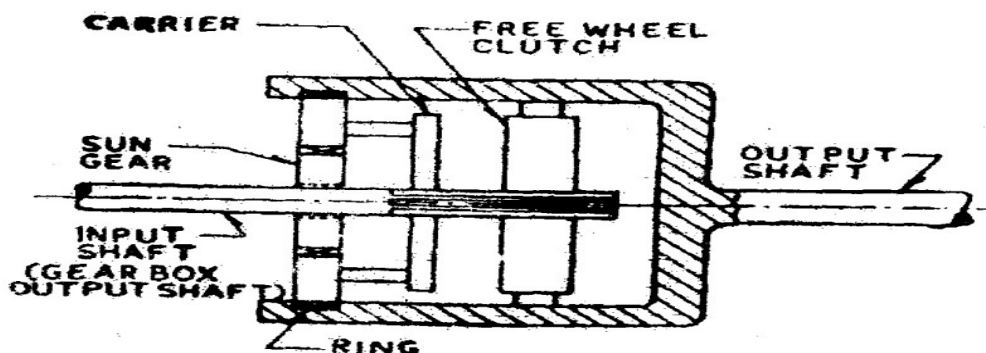
The carrier is itself mounted over the splined input shaft same as the sun gear.

The working of an overdrive depends on the same principle as any of the other sun and planetary or epi-cyclic gear arrangement like automatic gearbox i.e the fixing of any of the sun or planetary or annulus changes the power output of the drive.

Overdrive in cars can be enabled or disabled using any of the electrical, magnetic, pneumatic actuation method through button or knob, in first case let's just consider both the enable and disabled cases to understand its working-

Overdrive Disabled – When overdrive is disabled the input shaft passing through the sun gear rotates the sun gear which in turn rotates the constantly meshed planetary gears and then these planetary gears rotates the annulus and direct drive (same as input shaft rpm) is obtained.

Overdrive enabled- When driver enabled the overdrive, the sun gear becomes fixed which mean the annulus is now rotated by the planetary gears or in other words now the input from the input shaft is now transferred through the planetary gear to the annulus due to which overdrive is obtained, which means now the output shaft rotates with the higher rpm than input shaft due to the higher reduction ratio of planetary gears and annulus.

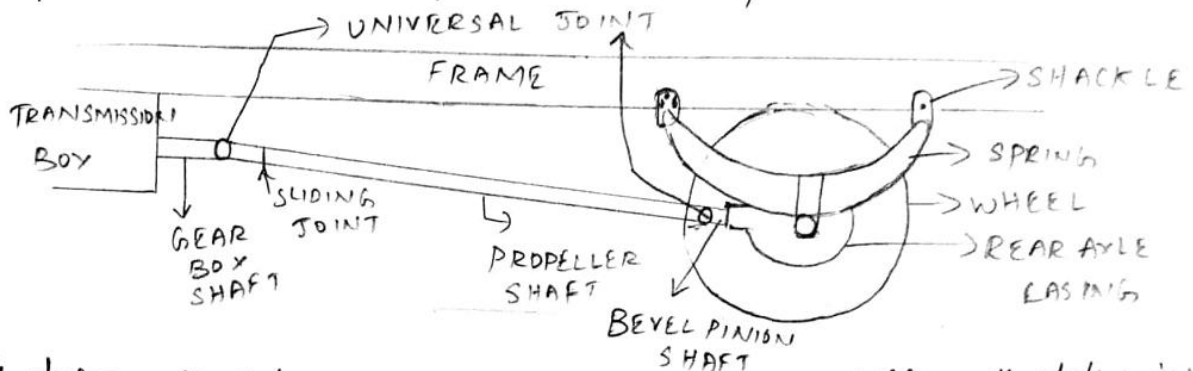


cut-away view of the overdrive.

The two important types of rear axle drives are

(i) Hotch kiss drive.

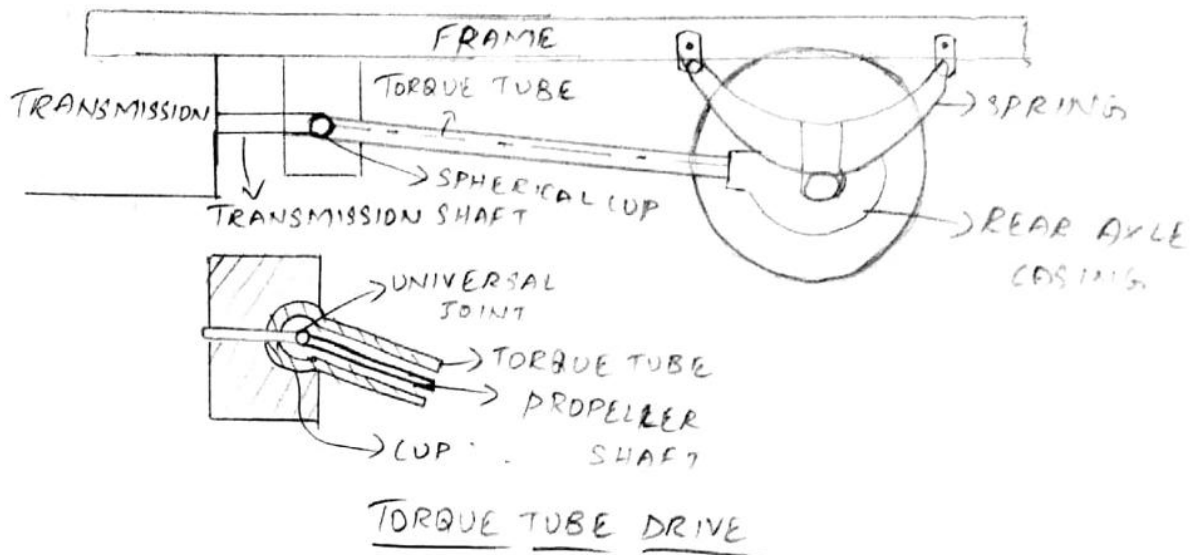
It is the most simple & widely used system. In this the Springs besides taking weight of the body, also take the torque reaction, driving thrust & side force.



The drive consists of open propeller shaft ~~shaft~~ with sliding joint & two universal joints one pinion shaft. The spring is bolted axle casing. The front end of the spring is rigidly fixed to the frame while the rear end is connected to the frame by swinging links or shackles. The front half of the spring will transmit the driving thrust to the frame. The springs offer considerable resistance to this deformation, thus torque reaction is overcome by the spring resistance to turn the axle casing. If universal joint is not provided in the rear end it will bend the propeller shaft because of axle casing movement the bevel pinion shaft tends to move up. The length of propeller shaft increases due to the movement of axle casing. So the sliding type propeller shaft is provided.

Torque tube drive :- In this case the springs take body weight & side thrust only. The torque reaction & the driving thrust is taken by the another member called Torque tube. Here the universal joints are replaced torque tube.





These torque tubes are made tubular & usually surround the propeller shaft. One <sup>end</sup> of the torque tube is attached to the axle case while the other end which is spherical in shape fits in the cup fixed to the frame. As torque tube take torque reaction, the axis of bevel pinion shaft will not change & always pass through the centre of spherical cup if the universal joint is located exactly in the centre of spherical cup. And both pinion shaft & propeller shaft will move about the same centre i.e. about centre of spherical cup. Hence no sliding is required.

### 6.3 Speed Synchromesh Gear Box

#### Principle:

In a gearbox, there is always a difficulty in engaging the stationary gear with the gears already rotating at a high speed. The principle states that "Before engaging the gears they are brought in frictional contact with each other and after equalizing the speed the engagement is done."

#### Construction:

The synchronizer is placed between two gears. So, we can use one unit for two gears. G1 and G2 are the ring-shaped members which are having the internal tooth that fits onto the external teeth. F1 and F2 are the sliding members of the main shaft. H1, H2, N1, N2, P1, P2, R1, R2 are the friction surface.

#### 1. Main shaft Gears:

A spline shaft is used as the output shaft over which the synchronizers and gears are mounted. According to the Fig. B, C, D, E are the gears that can freely rotate on the main shaft in mesh with corresponding gears in the layshaft. As long as shaft A is rotating all the gears in the main shaft and layshaft rotates continuously.

#### 2. Layshaft Gears:

It is the intermediate shaft over which gears with suitable size are mounted and is used to transmit the rotational motion from clutch shaft to the final output shaft. According to the Fig. U1, U2, U3, U4 are the fixed gears on the countershaft(layshaft).

### 3. Clutch Shaft:

It is the shaft used as an input shaft in the gearbox as it carries the engine output to the gearbox.

### 4. Cone Synchronesh:

The side of the gear to be engaged has two features. One is hollow-cone, and the other is cone surrounded by the ring of dog teeth. The gear is made the cone and teeth that the synchronesh mechanism contacts.

### 5. Synchronizers :

They are the special shifting devices used in the synchronesh gearbox which has conical grooves cut over its surface that provide frictional contact with the gears which is to mesh in order to equalize the speed of the main shaft, layshaft and clutch shaft which in turn provides smoother shifting of gears.

### 6. Gear lever:

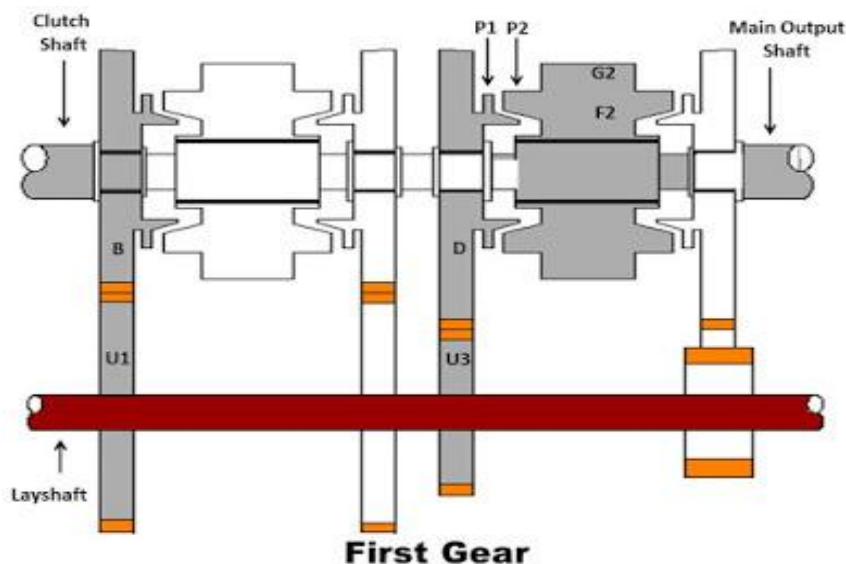
It is the shifting lever operated by the driver and is used to select the appropriate gear i.e. 1, 2, 3, 4, 5 or reverse gear.

Working:

In synchronesh gearbox Layshaft is connected to the engine directly, but it rotates freely when the clutch is disengaged. Because the gears have meshed all the time, the synchro brings the layshaft to the right speed for the dog teeth to mesh to achieve desire speed of output shaft.

#### 1. Working of First Gear:

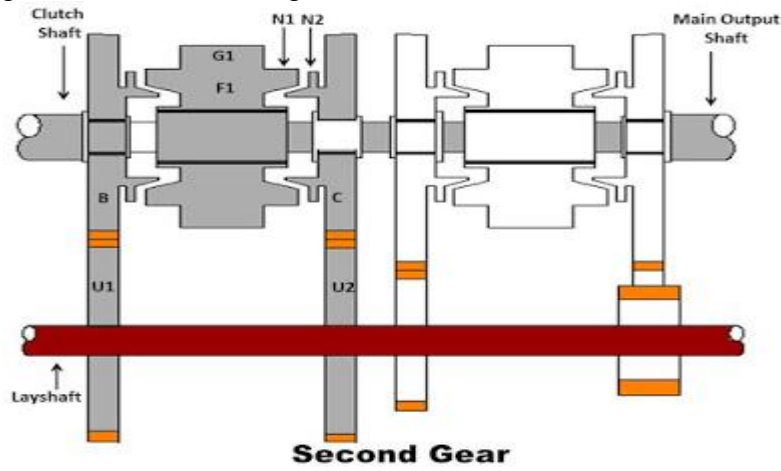
For first gear, the ring shaft member and the sliding members i.e., G2 and F2 moves towards left till the cones P1 and P2 rub each other. Then friction makes their speed equal. Once their speeds are equal G2 is further pushed towards left and it engages with the teeth L2. A motion is carried from clutch gear B to the layshaft gear U1. Then it goes to layshaft U3, and the motion is moved to the main shaft gear D. From there the motion is transferred to F2 which is the sliding member and then to the main shaft for the final drive.



#### 2. Working of Second Gear:

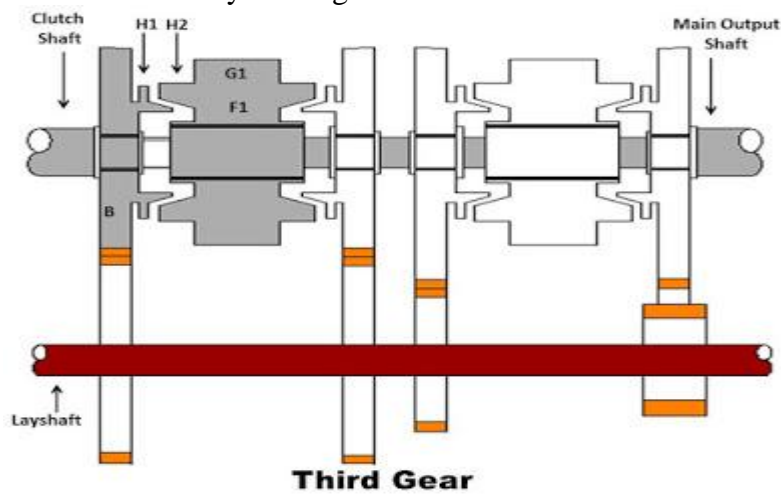
For second gear the ring shaft and the sliding members i.e., G1 and F1 moves towards the right till the cones N1 and N2 rub each other. Then the friction makes their speed equal. G1 is further pushed towards the right so that it meshes with the gear. The motion is transferred from clutch gear B to the layshaft gear U1. From

U1 the motion is transferred to U2. From U2 it is shifted to the main shaft gear C. Then the motion is transferred to the sliding member F1. Then it goes to the main shaft for the final drive.



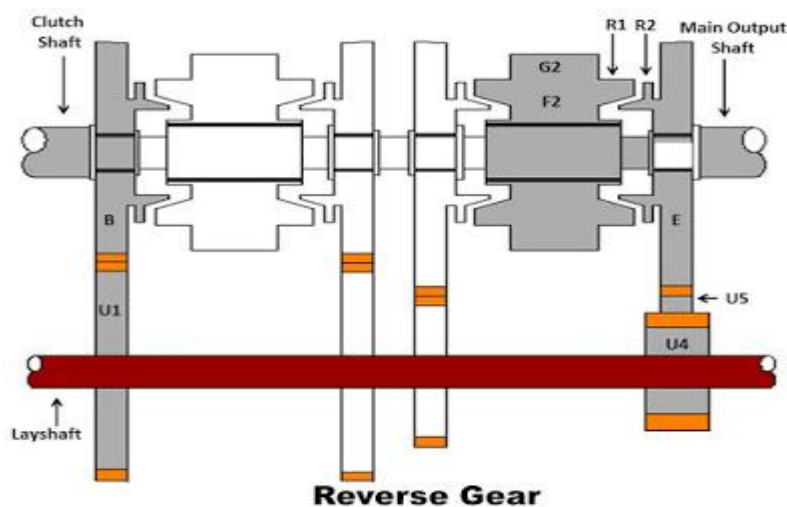
### 3. Working of Top Gear:

For top gear or direct gear, the motion is shifted directly from clutch gear B to the sliding member F1. Then from F1 to the main shaft. This is done by moving G1 and F1 to the left.



### 4. Working of Reverse Gear:

For reverse gear, the motion is transferred from clutch gear A to the layshaft gear U1. From there it is transferred to layshaft gear U4 and then to the intermediate gear U5. From there to the main shaft gear E and then to the sliding member F2 and then to the main shaft for the final drive. This is done by moving G2 towards the right. Intermediate gear helps to achieve the reverse gear.



**Advantages:**

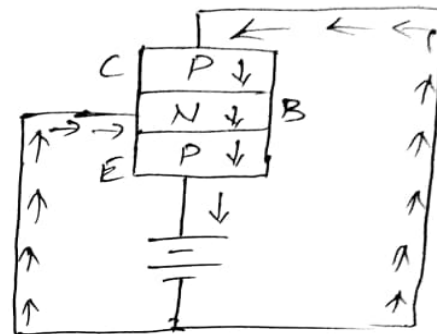
- Smooth and Noise free shifting of gears which is most suitable for cars.
- No loss of torque transmission from the engine to the driving wheels during gear shifts.
- Double clutching is not required.
- Less vibration.
- Quick shifting of gears without the risk of damaging the gears.

**Disadvantages:**

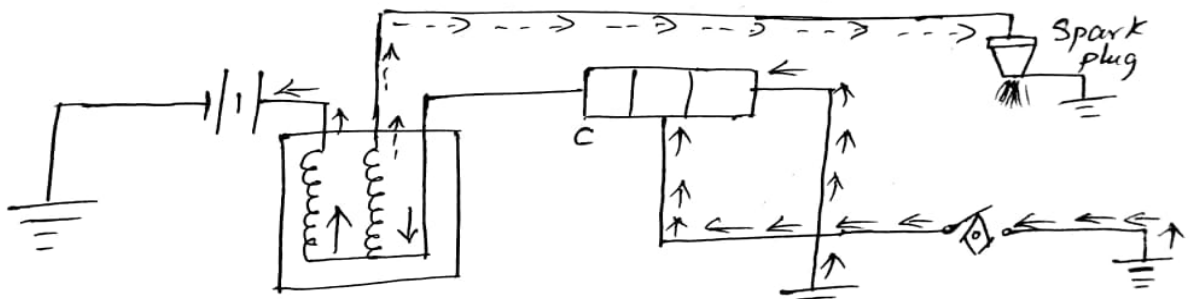
- It is extortionate due to its high manufacturing cost and the number of moving parts.
- When teeth make contact with the gear, the teeth will fail to engage as they are spinning at different speeds which causes a loud grinding sound as they clatter together.
- Improper handling of gear may easily prone to damage.
- Cannot handle higher loads.

Transistorised Ignition System

A single electric source supplies current to E-B circuit & E-C circuit as in fig. The base current is only a fraction of collector current, but the collector current cannot exist without base current. If the current flow to base ~~current~~ is interrupted causes interruption of large current flow in the collector circuit. This can be used as alternative to condenser & breaker points of a conventional ignition system.



Current flow in E-B & E-C circuit



Transistor Ignition System (TAC)

The base is connected to contact points. The collector is connected to the primary winding in the ignition coil & the emitter is grounded. When the cam operates, contact breaker points opens & base current is -- primary is interrupted there by induces high voltage.