AUTOMOBILE TRANSMISSION SYSTEM

Automobile transmission systems have the following functions

- Enable the engine to be disconnected from the road wheels.
- Enable the engine, when running, to be connected smoothly and without shock to the driving wheels.
- Enable the leverage between the engine and the driving wheels to be varied
- Reduced the speed of the engine.
- Turn the drive round through 90°.

ELEMENTS OF TRANSMISSION

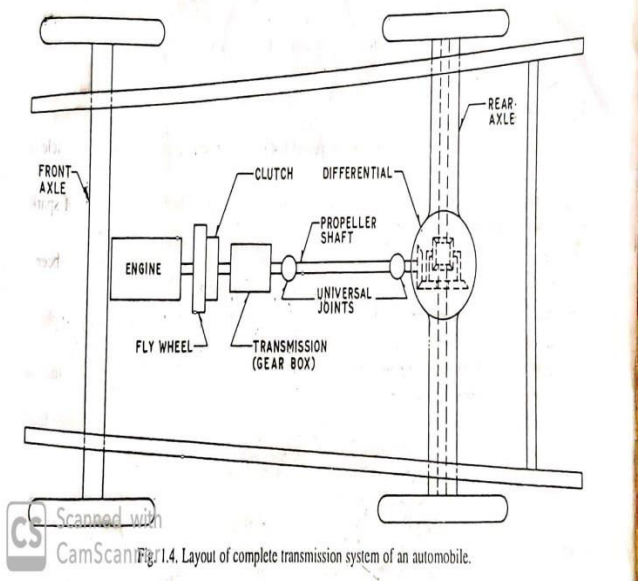

Fig. 1.4. Layout of complete transmission system of an automobile.

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1. Clutch

- To connect the fast running engine to the stationary transmission in a progressive manner to effect smooth take off from rest.
- To engage or disengage the engine from transmission.
- To facilitate smooth change of gears in varying the speed of transmission.

2. Gear Box

- To change the speed of the vehicle.
- To reverse the vehicle.
- To overcome the low torque at low speed.

3. Propeller Shaft

- To transmit power (torque) from the gear box to the differential and at last to the final drive.
- To transmit power to the rod wheels at varied lengths and varied angles.

4. Universal Joint

- To enable the drive shaft (propeller shaft) to transmit power at different angles.

5. Differential

- To bring down the speed of propeller shaft to that of the road wheels.
- To provide different rotational speeds to the road wheels when the vehicle negotiates curved paths.

6. Rear Axle

- To rotate the two rear wheels.

CLUTCH

- A mechanism which enables the rotary motion of one shaft to be transmitted to the other when desired.

Functions of clutch

- Connect and disconnect engine torque to gear box when required.
- Transmit power gradually from the engine to the drive wheels in order to start the vehicle smoothly from stop.
- Smoothly change the transmission gears when shifting gears.

Types of clutch

1. ***Friction clutches*** – It work on friction, when two rotating discs come in contact with each other. It may be dry or the wet type.

2. ***Fluid fly wheel*** – It works on the transfer of energy form one rotor to the other by means of a fluid.

Types of Friction Clutch

1. Single plate clutch
2. Multiplate clutch
3. Cone clutch
4. Centrifugal clutch.
5. Semi centrifugal clutch.

Requirements of Clutch

1. Gradual engagement.

2. Torque transmission.

3. Heat dissipation.

4. Vibration damping.

5. Dynamic balancing,

6. Free pedal play.

7. Ease of operation.

Principle of friction clutch

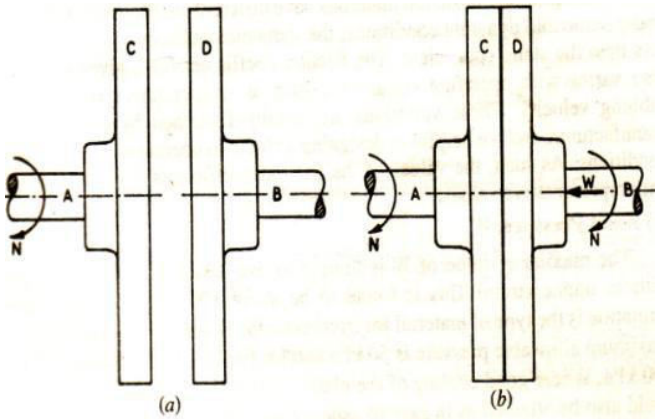
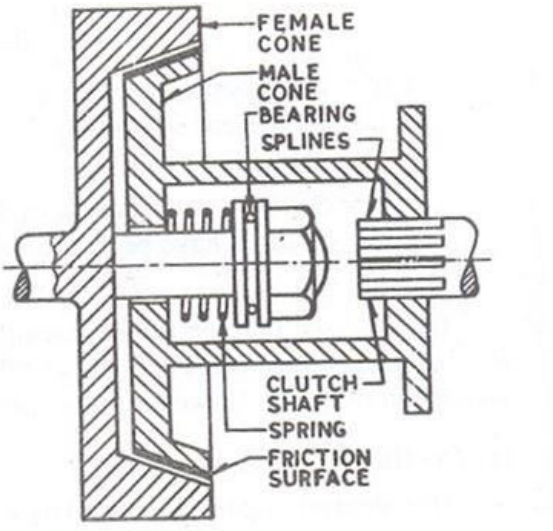


Fig. 3.1. Principle of friction clutch.

CONE CLUTCH

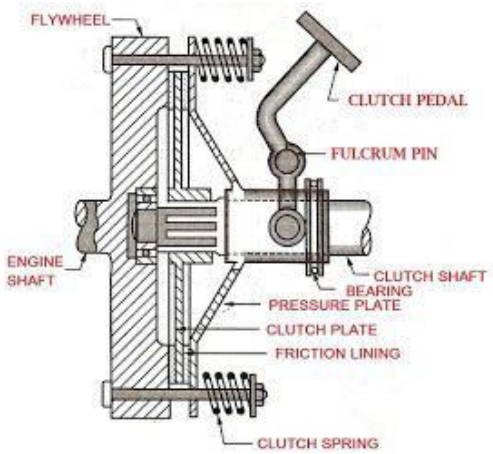
- In this type contact surfaces are in the form of cones.
- In the engaged position, the male cone is fully inside the female cone so that the frictional surfaces are in complete contact.
- This is done by means of springs which keep the male cone pressed all the time.
- The torque is transmitted from the engine via the flywheel and the male cone to the splined gear box shaft.
- For disengaging the clutch the male cone is pulled out by means of lever system operated through the clutch pedal there by separating the contact surfaces.



SINGLE PLATE CLUTCH

- Friction plate is held between the flywheel and the pressure plate.

- There are springs (the number may vary, depending upon design) arranged circumferentially, which provide axial force to keep the clutch in engaged position.
- The friction plate is mounted on a hub which is splined from inside and is thus free to slide over the gear box shaft.
- Friction facing is attached to the friction plate on both sides to provide two annular friction surfaces for the transmission of power.
- A pedal is provided to pull the pressure plate against the spring force whenever it is required to be disengaged.
- When the clutch pedal is pressed, the pressure plate is moved to the right against the force of the springs. With this movement of the pressure plate, the friction plate is released and the clutch is disengaged.



Advantages

1. With the single plate clutch, gear changing is easier than with the cone clutch, because the pedal movement is less.

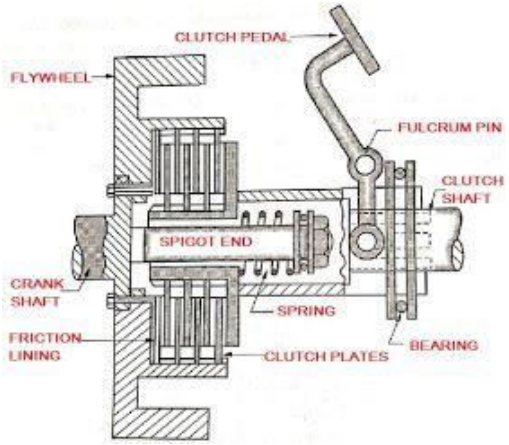
2. It does not suffer from disadvantages of cone clutch i.e., binding of cones etc. and hence it is more reliable.

Disadvantage

1. As compared to cone clutch, the springs have to be stiffer and this means greater force required to be applied by the driver while disengaging.

MULTIPLATE CLUTCH

- The multiplate clutch is an extension of single plate type where the number of frictional and the metal plates are increased.
- The increase in the number of friction surfaces obviously increases capacity of the clutch to transmit torque, the size remaining fixed.
- The overall diameter of the clutch is reduced for the same torque transmission as a single plate clutch.
- This type of clutch is, therefore, used in some heavy transport vehicles and racing cars where high torque is to be transmitted.
- Besides, this finds application in case of scooters and motor cycles, where space available is limited.



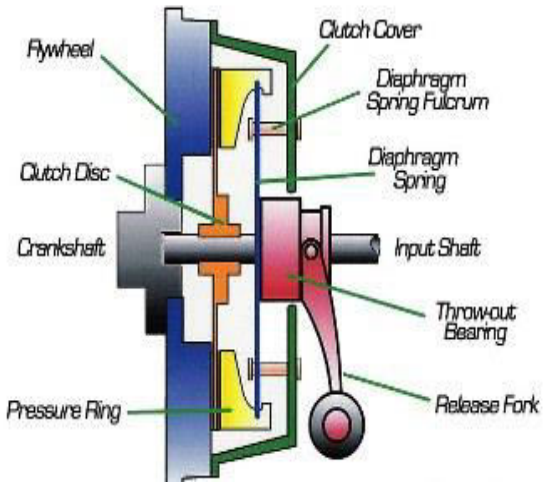
DIAPHRAGM TYPE CLUTCH

- Principle and operation of diaphragm clutch are almost similar to that of the single plate type.
- Here diaphragm springs (Belleville springs) are used instead of the ordinary coil springs.
- In free condition, it is of conical form, but when assembled it is in flat condition because of which it exerts load upon the pressure plate.

Working

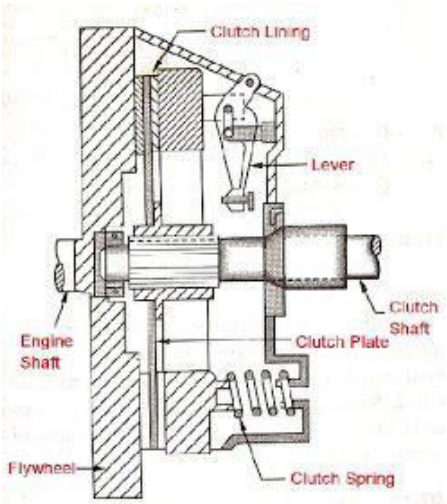
- When the clutch pedal is pressed, the pressure plate is moved to the right against the force of spring.

- This movement, release the friction plate and the clutch is disengaged.
- Ordinarily the pressure plate is presses the clutch plate against the flywheel by spring force, that the clutch is in engaged position.



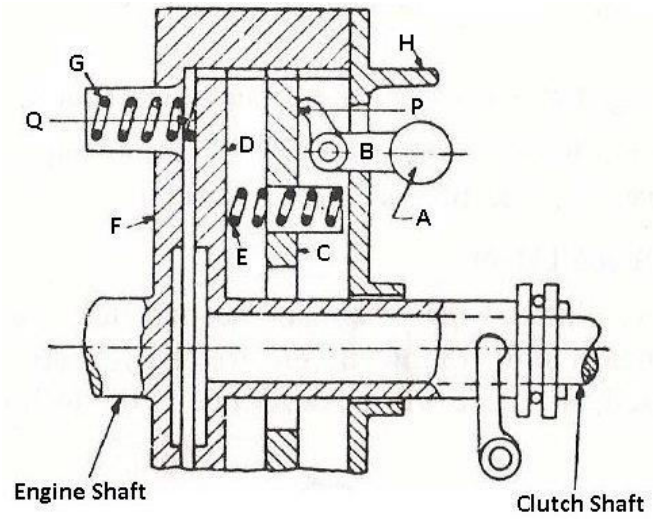
SEMI CENTRIFUGAL CLUTCH

- The clutch springs are designed to transmit the torque at normal speeds, while for higher speeds, centrifugal force assists in torque transmission. Such types of clutches are called semi-centrifugal clutches.
- Three hinged and weighted levers are arranged at equal intervals.
- This lever is having fulcrum at A and is hinged to pressure plate at B. The upper end of the lever is weighted at C. D is the adjusting screw, by means of which the maximum centrifugal force on the pressure plate can be adjusted.
- At moderate speeds the pressure of the springs is sufficient to transmit the required torque.
- However at higher speeds, the weight C, due to the centrifugal force moves about A as fulcrum thereby pressing the pressure plate.



CENTRIFUGAL CLUTCH

- In the fully centrifugal type of clutches, the springs are eliminated altogether and only the centrifugal force is used to apply the required pressure for keeping the clutch in engaged position.
- The advantage of the centrifugal clutch is that no separate clutch pedal is required.
- As the speed increases, the weight A flies, there by operating the bell crank lever B which presses the plate C.
- This force is transmitted to the plate D by means of springs E.
- The plate D containing friction lining is thus pressed against the flywheel F thereby engaging the clutch.
- Spring G serves to keep the clutch disengaged at low speed, say, 500 rpm. The stop H limits the amount of centrifugal force.



CENTRIFUGAL CLUTCH

FLUID FLYWHEEL

- This is a liquid coupling used to transmit the engine turning force to a clutch .This assembly consists mainly of two members :

1. Driving member and

2. Driven member

- The driving member or the pump impeller is connected to the flywheel casing.
- The driven member or the turbine runner is connected to the transmission shaft.

- Both members are positioned on the respective shafts with a small clearance between them. These two members do not have any direct contact with each other.
- The casing is filled with oil.
- When the engine runs, it rotates the impeller and due to centrifugal force the oil inside the torque converter directed towards the turbine.
- As it strikes turbine blades, the turbine starts rotating and transfer power to transmission shaft.

Advantages

1. Requires less maintenance and attention.

2. No wear of moving parts.

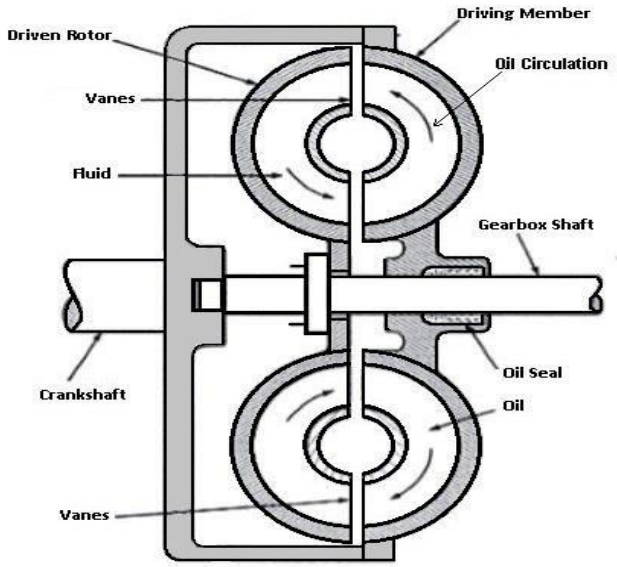
3. Simple, compact in design.

4. Specific operating skill is not needed.

Disadvantages

1. Drag on the gear box.

2. Gear changing is slightly difficult.



FLUID FLYWHEEL

TORQUE CONVERTOR

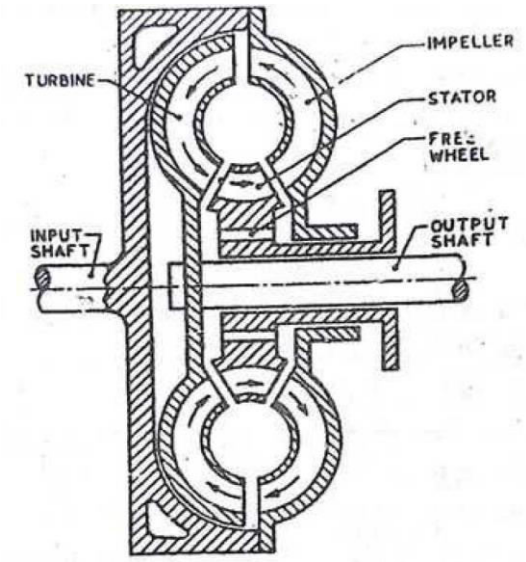
- Torque convertor in automotive transmission gives a maximum gear ratio during starting from rest.
- The construction of the torque convertor is almost similar to the construction of the fluid fly wheel.
- But an additional member called the reaction member is provided in between the turbine and the impeller.
- This consists of

(1) An impeller which is the driving member connected to the engine.

(2) The turbine which is the driven member connected to the propeller shaft. The stator is fixed to the frame.

WORKING

- When the engine runs, it rotates the impeller and due to centrifugal force the oil inside the torque converter directed towards the turbine.
- As it strikes turbine blades, the turbine starts rotating.
- Suppose there was no stator, the fluid from the turbine would enter into impeller directly. This throwing of fluid will push the turbine blade in the opposite direction, causing a power loss.
- In this operation the presence of the stator changes the direction of the fluid suitably to strike the impeller in the most favourable direction.
- Later, the impeller pushes the fluid back into the turbine.
- This process is repeated continuously causing the torque on the turbine to increase.



GEARBOX

- Gear box is a device placed in between the clutch and the rest of the transmission.

Functions of the gear box:

1. To exchange engine power for greater torque and provide mechanical advantage to drive the vehicle under different operating conditions.

2. To provide reverse motion.

3. To provide neutral position and disallow power flow to the rest of the transmission.

Types of Gear Boxes

Gear Boxes are generally classified as

1. Selective type.

2. Progressive type.

3. Epicyclic or Planetary type.

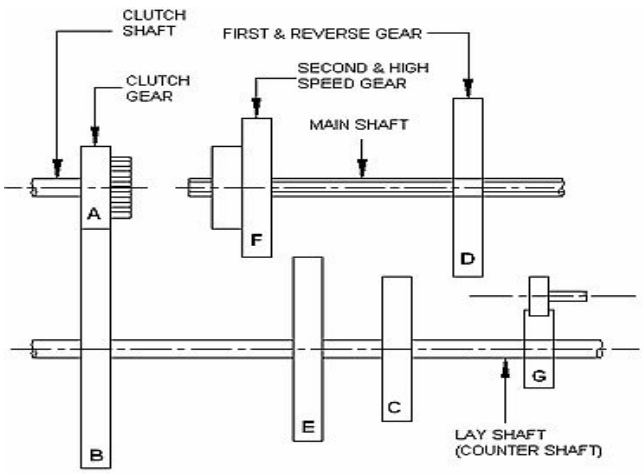
Selective type is further classified as

(a) Sliding mesh.

(b) Synchro mesh.

(c) Constant mesh.

SLIDINGMESH GEAR BOX



- All the gears on lay shaft are fixed and they rotate in all time when the engine is running.
- Three direct and a reverse speeds are attained by moving the gear on the main shaft.
- Gear movement is by means of selector mechanism.
- Selection / shifting of gears is done by gear selectors and are operated by gear lever.
- When gear F slide to left its teeth are engaged with clutch gear and give direct gear (top gear).
- When it slid to right makes contact with the second gear and second gear is obtained.
- Similarly we can select different gear ratios by sliding remaining dog clutches to the right or left.
- Reverse direction is obtained by engagaging gear D to gear G. The

intermediate gear between D&G is called idler gear.

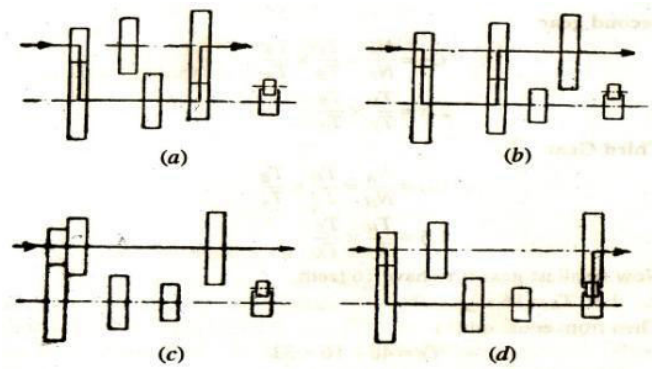


Fig. 4.7. Various Gear Positions in a Sliding Mesh Gear Box.
(a) First Gear (b) Second Gear
(c) Top Gear (c) Reverse Gear

CONSTANT MESH GEAR BOX

- This is almost similar to the sliding mesh gearbox, but in this arrangement, the gears are inconstant mesh 'with the corresponding gears on the counter shaft.
- When the left dog clutch is slide to the left by means of the selector mechanism, its teeth are engaged with those on the clutch gear and we get the direct gear.
- The same dog clutch, however, when slide to right makes contact with the second gear and second gear is obtained.
- Similarly movement of the right dog clutch to the left results in low gear and towards right in reverse gear.

Double Declutching

- In the constant mesh gear box for the smooth engagement of dog clutches it is necessary that the speed of main shaft gear and sliding dog must be equal
- There for to obtain lower gear speed of the clutch shaft, lay shaft and main shaft gears to be increased.
- This is done by double de clutching

Procedure

- The clutch is disengaged and the gear is brought to neutral. Then the clutch is engaged and accelerator pedal pressed to increase the speed of the main shaft gears.

- After this the clutch is again disengaged and the gear is moved to the required lower gear and the clutch is again engaged.
- As the release and re-engage the clutch of a vehicle twice when changing gear from higher to lower gear, it is called double de clutching
- For changing to higher gear reverse effect is done , the driver has to wait with gear in neutral till the main shaft gear is decreased for the smooth engagement of gear

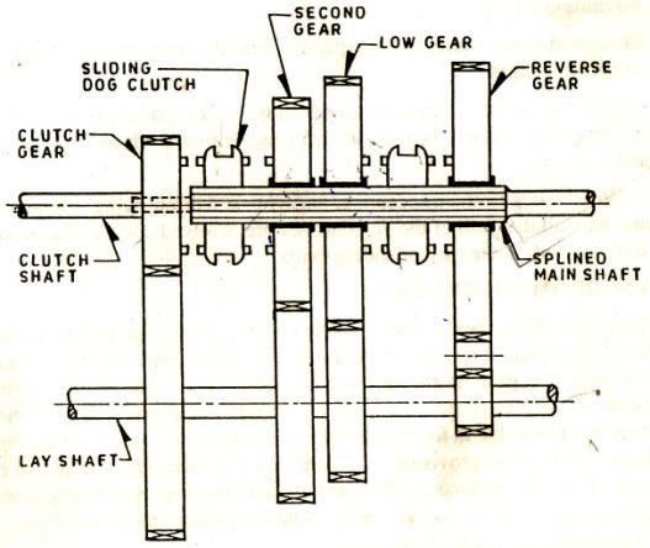


Fig. 4.9. Constant mesh gear box.

SYNCHROMESH GEAR BOX

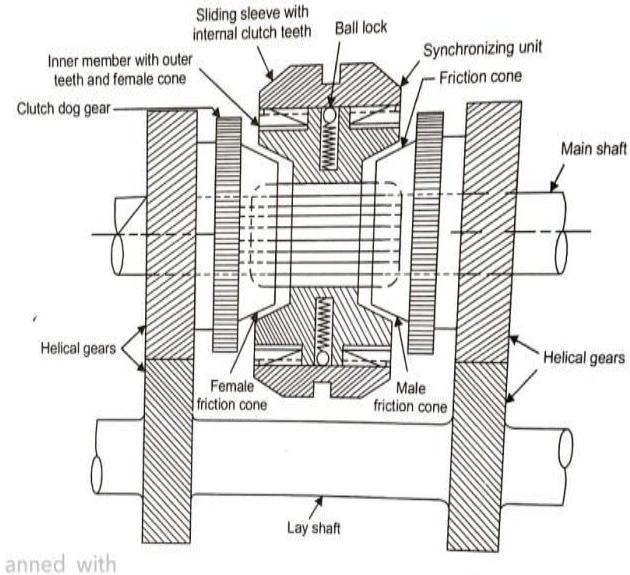


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Fig 4.17 Synchronising Unit

- This type of gearbox is similar to the constant mesh type gearbox.
- Instead of using dog clutches here synchronizers are used.
- The modern cars use helical gears and synchromesh devices in gearboxes, that synchronize (equalize) the rotation of gears that are about to be meshed.
- As in the constant mesh type in that all the gears on the main shaft are in constant mesh with the corresponding gears on the lay shaft.

- The gears on the lay shaft are fixed to it while those on the main shaft are free to rotate on the same.
- Its working is also similar to the constant mesh type, but in the former there is one definite improvement over the latter.
- This is the provision of synchromesh device which avoids the necessity of double-declutching.
- The parts that ultimately are to be engaged are first brought into frictional contact, which equalizes their speed, after which these may be engaged smoothly.
- In most of the cars, however, the synchromesh devices are not fitted to all the gears.
- They are fitted only on the high gears and on the low and reverse gears ordinary dog clutches are only provided.
- This is done to reduce the cost.

PROPELLER SHAFT

- The shaft transmits the drive from transmission to differential unit.
- Drive (propeller) shaft—a hollow metal tube that transfers turning power from the front universal joint to the rear universal joint.
- Slip joint —this serves to adjust the length of the propeller shaft according to the rear axle movement and it is depends on the type of drive.

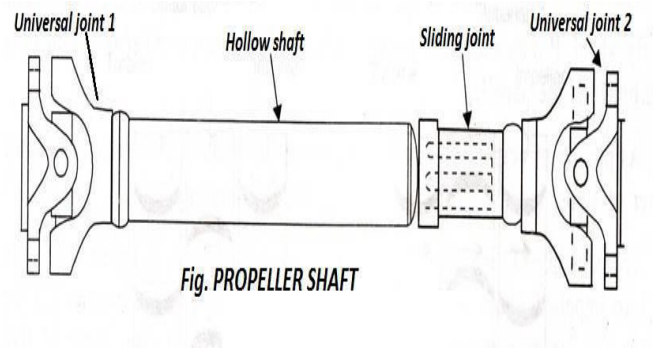


Fig. PROPELLER SHAFT

UNIVERSAL JOINT

- Universal joint is used to connect two shafts at an angle for transmitting torque.

Types of universal joint

1. Variable velocity joint.

    (a) Tracta

    (b)Bendix Weiss.

    (c) Rzeppa.

2. Constant velocity joint

    a. Crossed or spider type.

    b. Ring type.

    c. Ball and trunnion type

Constant Velocity Universal Joint

- This type of joint permits movement of both driving and driven shafts at constant velocity.
- These joints are generally used when the automobile in a front wheel (axle) drive

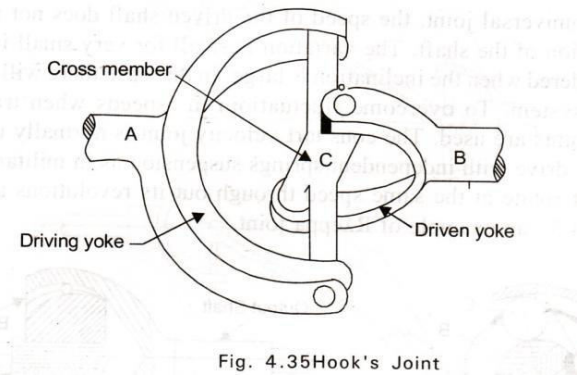


Fig. 4.35Hook's Joint

DIFFERENTIAL UNIT

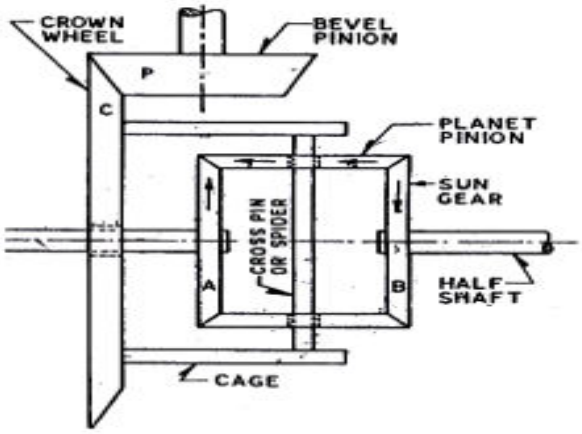
- In this there is a crown wheel of the final drive to which attached a cage which carries a cross pin (in case two planet pinion) or spider (in case four planet pinions are used).
- Two sun gears mesh with the planet pinions.
- Axle half shafts are splined to each of these sun gears.
- The crown wheel is free to rotate on half shafts.

Working

- When the vehicle is going straight the cage and inner gears rotate as a single unit and the two half shafts rotate at same speed.
- While taking a turn to left, that is If the left side gear encounters resistance, the planet gear spins as well as revolving, allowing the left side sun

gear to slow down, with an equal speeding up of the right side sun gear.

- This will be same but vice versa when turning to right also.



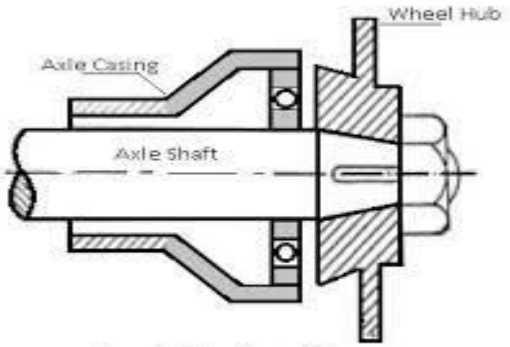
Open Differential

REAR AXLE

- Rear axles are used to connect differential and wheel assembly.
- The power from the differential is transferred to the wheel through the axle shaft.
- Rear axle shafts are of three types according to the manner in which they are supported.
  1. Semi floating axle
  2. Three-quarter floating axle
  3. Full floating axle

Semi floating axle

- The wheel hub is directly connected to the axle shaft or is an extension of the same.
- In this all the loads (Shearing force due to vehicle weight, Driving torque, End thrust due to cornering etc.) are taken by the axle shaft.
- The vehicle load is transmitted to each of the half shafts through the casing and the bearing.
- It is widely used in cars

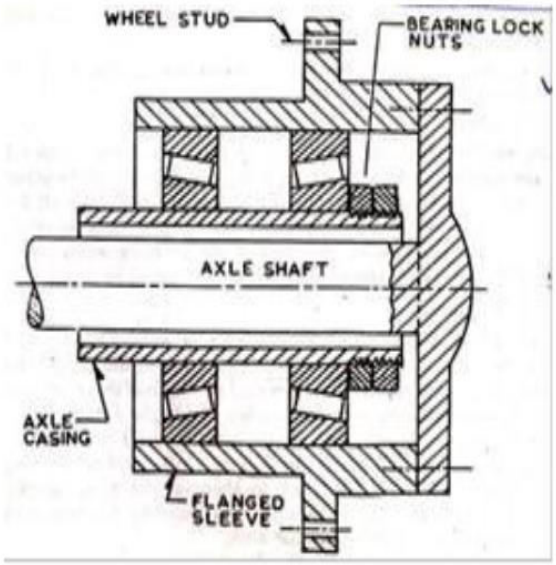


Semi-Floating Axle

Full floating axle

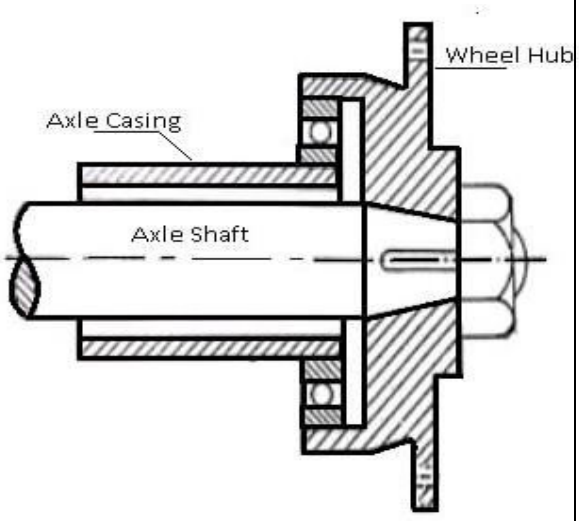
- The axle shafts have flanges at the outer ends, which are connected to the flanged sleeve by means of bolts.

- There are two taper roller bearings supporting axle casing in the hub, which take up any side load.
- The axle shaft only carries driving torque.
- It is used for heavy vehicles.



Three-quarter floating axle

- In this bearing is located between axle casing and the hub.
- In this type axle shaft only carries driving torque, shearing or bending actions due to vehicle weight are taken by the axle casing through the hub and bearing.



Three Quarter Floating Axle