UNIT-I

TRANSMISSION SYSTEM

CLUTCHES

TYPES OF FRICTION CLUTCHES:

The clutches used in motor vehicles are almost very similar in construction and operation. There are some differences in the details of the linkage as well as in the pressure plate assembly. In addition, some clutches for heavy duty application have two friction plates and an intermediate pressure plate.

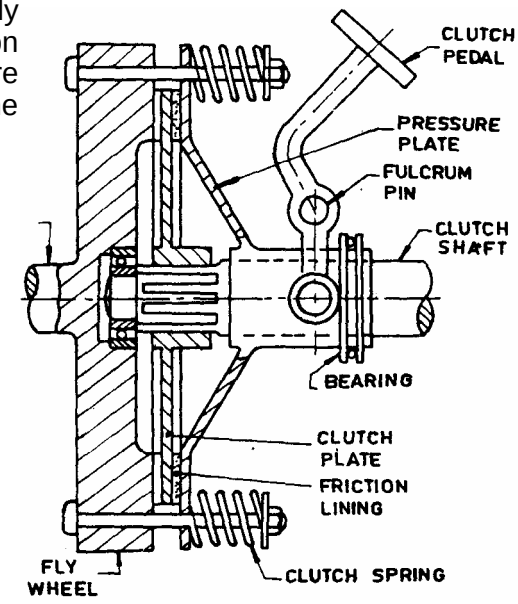
Different types of clutches are as follows

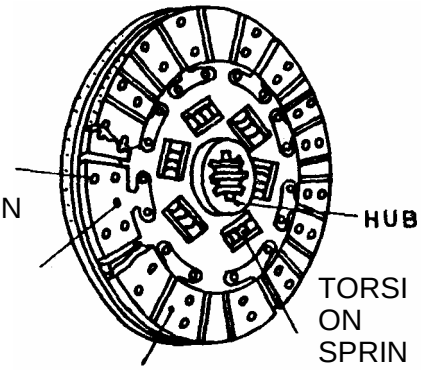
1. Friction clutches

   a) Single plate clutch.
   b) Multi plate clutch (i) wet (ii) dry
   c) Cone clutches (i) External (ii) Internal

SINGLE PLATE CLUTCH:

A simplified sketch of a single plate clutch is given In the Fig. 3. 3. It is most common ‘type of clutch used in motor vehicles. Basically, it consists of only one clutch plate (Fig. 3. 4) mounted on the splines of the clutch shaft. The clutch plate is held between the flywheel and the pressure plate is bolted to the fly wheel through the clutch spring and is free to slide on the clutch shaft when the clutch plate is operated. There are six springs (the number may vary depending on the design) arranged



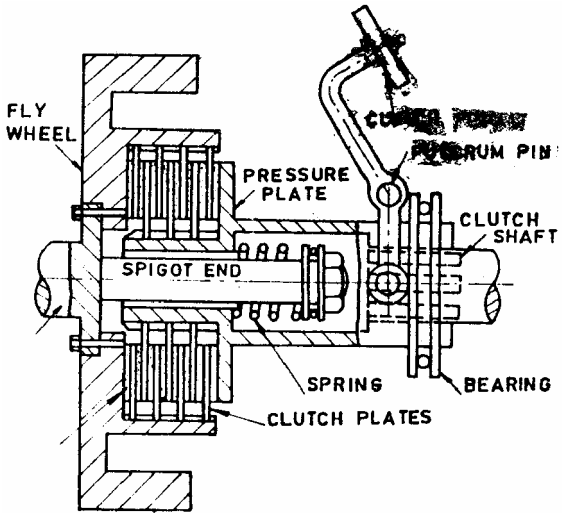


circumferentially which provide axial force to keep the clutch in engaged position. Friction linings are attached to the clutch plate on both sides to provide two annular friction surface for the transmission of power. Due to the friction between the flywheel, clutch plato and pressure plate, the clutch plate revolves with the flywheel. As the clutch plate revolves, the clutch shaft also revolves. Clutch shaft is connected to the transmission. Thus the engine power is transmitted to the crank shaft to the clutch shaft. A pedal is prov,ded to pull the pressure plate against the spring force wherever it is required to be disengaged. Ordinarily it remains in engaged position as shown in the Fig. 3.3

When the clutch pedal is pressed, the pressure plate is moved to the right against to the force of s'ring, and the clutch plate becomes free between flywheel and the pressure plate, This is achieved by means of a suitable linkage and through bearing. With this movement of the pressure plate, the friction plate is released and .the clutch is disengaged.

MULTIPLATE CLUTCH

Multi plate clutch consists of a number of clutch plates, instead of only one clutch plate as in the case of single plate clutch. As the number of clutch plates are increased, the friction surface also increase. The increased number of friction surface obviously increases the capacity of the clutch to transmit torque Ihe plates are alternately fitted to the engine shaft and the gear box shaft.



In this cluth there are four pressure plates and four friction plates as shown in Fig. 3.5 These pressure plates are linked to the clutch cover by means of studs. The clutch cover is fitted to the fly wheel. The first friction plate is between the first and second pressure plate. The second friction plate is between the second pressure plate and third pressure plate and so on. The link mechanism is the same as the one used in the single plate clutch. The friction plates are connected to the clutch shaft by means of splines arrangements.

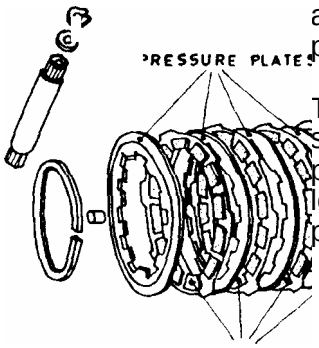
While the flywheel is rotating the pressure plates rotate and press against the friction plates. This cause to rotate the friction plate also. The clutch shaft is then rotated. When the pedal is pressed the flywheel continues

to rotate. The friction plates are then released. This happens because they are not fully pressed by the pressure plates. The friction plates are thus free of rotation. The clutch shaft also stops rotating.

The multi plate clutches are used in heavy commercial vehicles, racing cars and motor cycles for transmitting high torque. the multi plate clutches may be dry or wet. When the clutch is operated in an oil path, it is called wet clutch, The wet clutch are generally used in connection with, or as a part or the automatic transmission.

MOTOR CYCLE CLUTCH:

In a motor cycle, a single plate clutch is not able to transmit the power from the engine~ to the gear box, Therefore, a multi plate clutch is used. Multi plate clutch ‘consists of a number of clutch plates, instead of only one clutch plate as in the case of single plate clutch. As this number of clutch plates are increased, the friction surface is also increased. The clutch is always kept immersed in oil. Due this the surface of the plate do not get too heated,



The various parts of the motor cycle multi plate clutch are shown in Fig.~.6. There are four clutch disks, four pressure plates, a hub and springs. When the control lever 1~2~perated the clutch gets disengage Then that. presser

Fig.3.6 Motor Cycle Clutch

plates do not press on the clutch disks. Thus there is no transmission from the flywheel to the gear box. When the clutch lever is not ,n operation, the clutch gets
engaged. The clutch disks do not get pressed by the pressure plates. The power is not transmitted from engine to the gear box. The clutch disks carry a clutch lining on both its sides. This develops the adhesive friction required for the operation of the clutch.

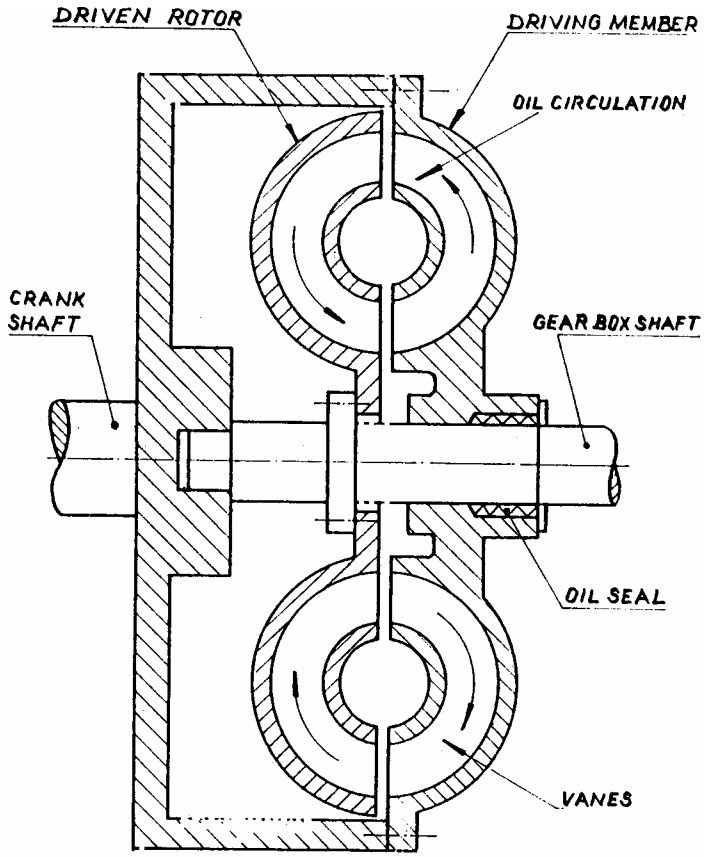
DIAPHRAGM CLUTCH:

The construction of this type of clutch is similar to ~that of the single plate type of clutch except that here diaphragm springs are used instead of the ordinary coil springs. In the free Condition the diaphragm spring is of conical form but when assembled, it is constrained to an approximately flat condition because of which it exerts a load upon the pressure plate. A diaphragm spring type

clutch is shown in the Fig. 3.7a shows the clutch in the engaged position and Fig. 3.7 in the disengaged position. When the clutch is engaged, the spring pivots on the. rear pivot rings as it is held in the clutch over, so that its. outer ring contacts pressure plate, In this conical position of spring the clutch plates remains gripped, between the fly wheel and the pressure plate.

When the clutch pedal is pressed. the throughout bearing moves towards the flywheel, pressing the centre portions of the spring, which causes the rim to move backward. This removes the pressure on the pressure plate and the clutch is disengaged.

This type of clutch has some advantages over coil spring type clutches. It needs no release levers. The spring itself as series of levers. The pressure of the spring



increases the flat position is reached and decreases as this caution is passed. The driver does not have to exert such heavy pressure to hold the clutch disengaged as with the coil spring type,

The fluid flywheel or fluid coupling is a hydraulic clutch. It is variably used in connection with epicyclic gear box in heavy vehicle application.
(e.g.) Ashok Leyland Tiger.

The fluid fly wheel (Fig.3. 8) consists of a split housing rotated with the engine. Inside this housing is a turbine(or driven motor) which is connected by a shaft to this gear box. The housing rotated by the engine is known a~ the pump. The pump is divided up into a number of cell~ correspond to similar openings in the turbine. The fluid fl~ wheel housing is filled with the oil. As the driving member rotates, the fluid flows outwards under the action of centrifugal force, and circulates from the pump cells to turbine cells. Because the fluid is also being carried round by the pump member, the fluid tends to rotate the turbine. In fluid flywheel the pump and the turbine should not rotate a the same speed because of they rotate at the same speed fluid circulation will seize. Hence the turbine speed will be less than that of the pump. This known as ' Slip' At maximum efficiency the amount of slip become 2% The slip being greater at lower speed. Complete disconnection of the drive is not possible with fluid coupling and it is no suitable for use with an ordinary gear box.

Fluid flywheels require less attention than friction clutches and need adjustment. The drive is taken up smoothly, torsional vibration of the crank shaft and the transmission are damped out, the fluid absorbs transmission shock when breaking (or) coasting down a hill the clutch pedal is eliminated.

GEAR BOX:

PURPOSE CF GEAR BOX:

When a vehicle is starting from rest, accelerating hil climbing and meeting other resistance a high tractate effort is required at the driving wheels. The tractate effort at the wheels is depended upon the torque developed by the engine which increases, with in limits as the engine speed. increases, reading a maximum at some predetermined number of revolution. If the engine was coupled directly to driven axle, the engine speed would necessarily below when
high driving torque is required. To deal with the problem the engine revolutions are maintained by reduction gears. The reduction gears are enclosed in a metal box called a gearbox. The road Wheel rotate at lower speed to suit the following operating conditions of the vehicle.
1)Thus by maintaining. the optimum engine speed the gear box can multiply the engine torque to meet the torque requirement at the road wheels.
2)In order to reverse the vehicle the gear box changes the direction of drive from engine to road wheels.
3)The gear box also provides a neutral position so that the clutch may be left in engagement while the engine running.

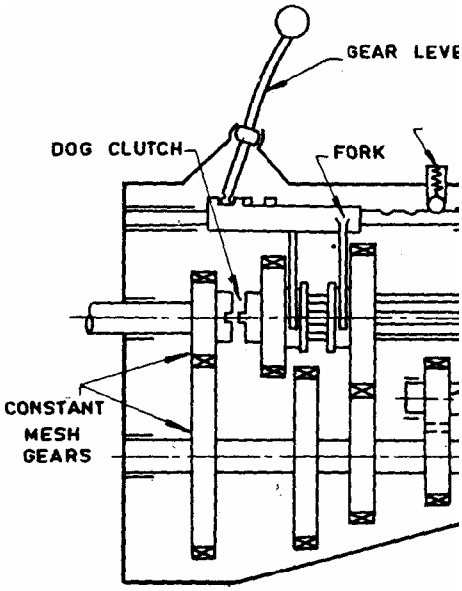
TYPES OF GEAR BOX:

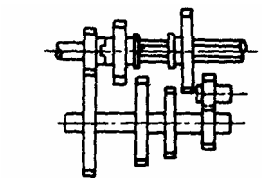
The gear boxes are classified according to the method of engaging the gears on the main shaft to the gear on the counter shaft. They are given under':

1. Sliding mesh type 2. Constant mesh type
3. Synchromesh type 4. Epicylic gear type

SLIDING MESH GEAR BOX:

It is the oldest and simplest form of a gear box. A three speed sliding gear





box is shown in (Fig. 3. 9.) in first gear position The clutch gear is rigidly fixed to the clutch shaft it remains always connected to the driven gear of the countershaft. Three other gears are also rigidly fixed to the counter shaft (lay shaft). They are second speed gear, first speed gear and reverse speed gear. Two gears are mounted on the splined main shaft which can be shafted by the shifter yoke when the shift lever is operated. These gears are the second speed gear and first and reverse speed gear. They can be connected to the corresponding gear of counter shaft. A reverse idle gear is mounted on another shaft and always remains connected to reverse gears of the counter shaft.

GEAR IN NEUTRAL

When the engine is running and clutch is engaged, the clutch shaft gear drives the counter shaft gear. The counter shaft rotates opposite in direction to the clutch shaft. In neutral position. only the clutch shaft gear is connected to the first gear on the counter shaft. The main shaft turns in the same direction as the clutch shaft. A gear reduction of approximately 3 :1 is obtained.

By operating the gear shift lever, the larger gear o~ the main shaft is moved along the shaft to mesh.

SECOND GEAR:

By operating the gear shift lever, the larger *SPRING* **LOAOEO BALL**
gear of the main shaft is demeshed from the
first gear of the counter shaft and then the smaller gear of the main shaft is meshed with the second gear of the counter shatt. A gear reduction of approximatly 2:1 obtained. (Fig. 3 .9a)

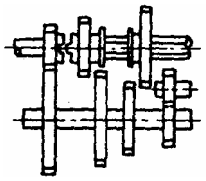
THIRD OR TOP OF HIGH SPEED GEAR:

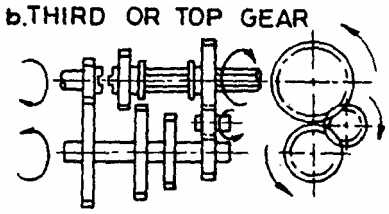
By operating the gear shift lever, the second gear of the main shaft and counter shaft are demised, and then the second and top gear of the main shaft is forced axially against the clutch shaft gear. External teeth on the clutch shaft gear mesh with the internal teeth in the second and top gear. The main shaft turns with the clutch shaft and gear ratio of 1:1 is obtained (Fig. 3. 9b).

REVERSE GEAR:

By operating the gear shift lever, the larger gear of the main shaft is meshed with the reverse idler gear. The reverse idler gear is always in mesh with the counter shaft reverse gear. Interposing the idler gear between the counter shaft reverse gear and main shaft bigger gear, the main shaft turns in the direction opposite to that of the clutch shaft. This reverses the rotation of wheels so that, the vehicle backs (Fig. 3.Sd).

CONSTANT MESH GEAR BOX





The construction of the constant mesh gear A is similar to the sliding mesh gear box but the difference is only that all the gears of the main shaft are in constant mesh with the corresponding gears of the counter shaft (lay shaft). And all the gears are helical gears.

Fig3. 10 shows a constant mesh gear box. It consists of a clutch shaft, a counter shaft and a main shaft'

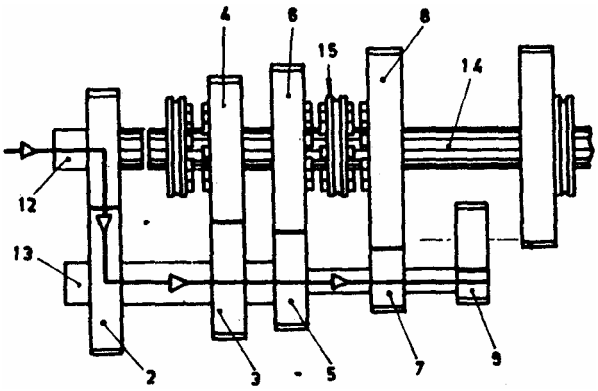
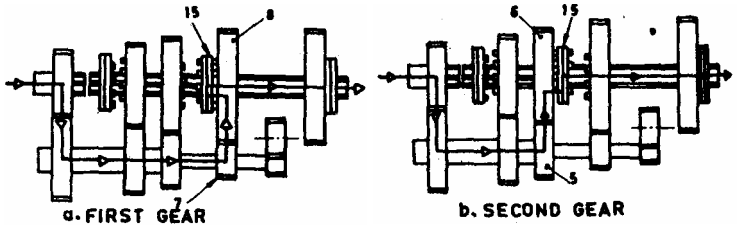
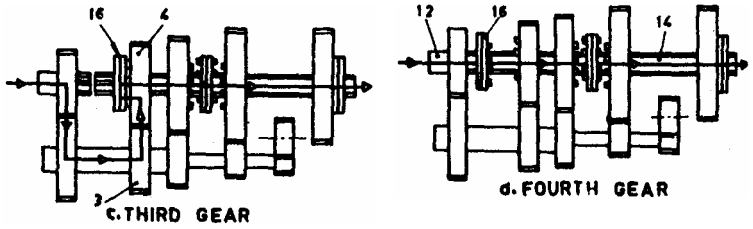
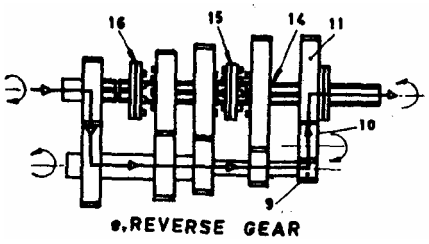


Fig. 3. 10 Constantmesh Gear Box







Gears (2), (3), (5), (7) and (9) are fixed to the counter shaft. They do not slide along it. Gear wheels (4), (6) and (8) are not fixed to the main shaft. Therefore, these gears can revolve fteely around it. Gear (4) of the main shaft. is in constant mesh with gear (3) of the counter shaft. Similarly, gear (6) is in constant mesh with gear (5) and gear (8) with gear (7). All the gears are shown in the neutral position.

Power transmission in the four gear positions is given below:

FIRST GEAR :

Collar (15) is spline to the main shaft. It ~an slide along the shaft. The collar revolves with the shaft. It is locked to gear (8) by means of a dog clutch. Power is transmitted from gear (7) to gear (8j and then to collar (15). The collar rotates the main shaft.

SECOND GEAR:

Collar (1 5) slides in the opposite direction along the main shaft. This collar is locked to gear (6) by means of a dog clutch. Power is transmitted from gar (5) to gear (6) and then to collar (15). The collar rotates the main shaft.

THIRD GEAR

Collar (16) is splined to the main shaft. It can slide along the main shaft. This collar revolves with the shaft. This collar ‘is locked to gear (4) by means of a dog clutch. Power is transmitted from gear (3) to gear (4j and then to collar (16). The collar rotates the main shaft.

FOURTH OR TOP GEAR :

Collar (16) is locked directly to the clutch shaft (12) by a dog clutch. Power is transmitted from the clutch shaft to main shaft.

Here, collars (15) and (16) are not engaged. Gear (11) can slide along main shaft (14). Gear (10) is the reverse gear. Power is transmitted from gear wheel (9) to gear wheel (11), through reverse gear (10). Due to this the main shaft rotates in the opposite direction Thus, the vehicle moves in the reverse direction.

SYNCHRO MESH MECHANISM:

The modern cars use helical gears and synchromesh devices in the gear boxes, that synchronize the rotation of gears that are about to be meshed This eliminates clashing of the gears and make gear shifting easier. The synchromesh gear box is similar to the constant mesh gear but the synchromesh gear box is provided with a synchromesh device by which the two gears to be engaged are first brought into frictional contact which equalizes their speed after

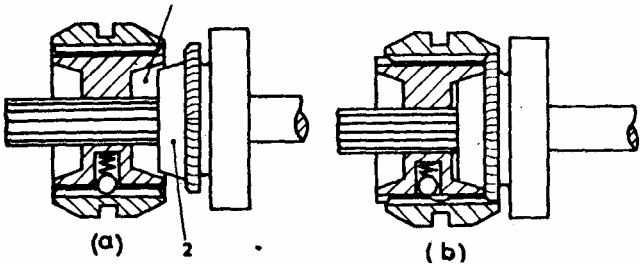
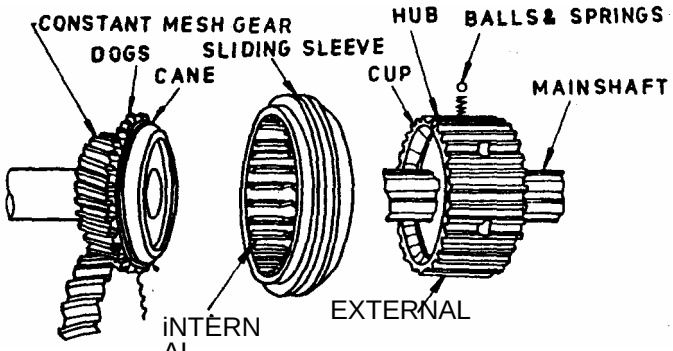


Fig. 3. 11 Synchromesh Unit r



of Sychromesh

GEAR BOX

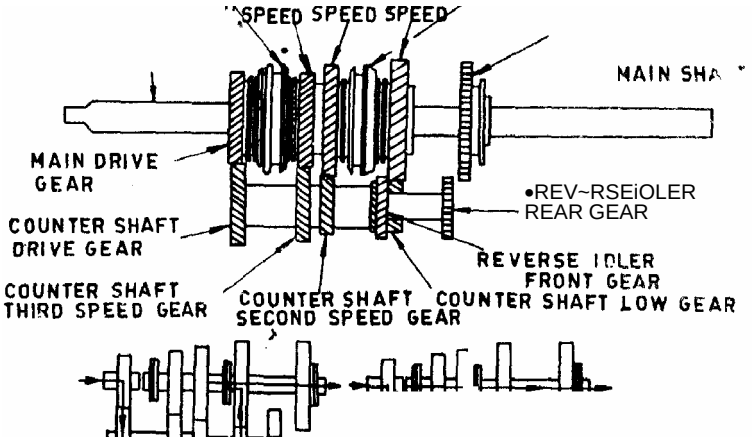
which they are engaged smoothly. In most of the cars, the synchromesh devices are not fitted to all the gears. They are fitted only on top gears. Reverse gear and in some cases the first gear do not have synchromesh device since they are intended to be engaged when the vehicle is stationery.

To understand the working of the gear box Fig. *.3.* 11 shows in steps how the synchromes'i unit is engaged.

When the syachromesh is disengaged, gear are running free on the mainshaft and the two gears to be engaged are running at different speeds. When the selector lever is moved, the sliding sleeve and sliding gear slide together because of the pressure of the spring loaded balls untd the cones on the gears contact. Both gears bave now reached, the same speed. As the selector lever is moved further, the *sliding* gear cone is held against the high speed gear cone and the sliding sleeve press the spring loaded bails and slides over on to the high speed gear there by king the gear to It. Since both pinion and synchromesh units are moving at the same speed, this engagement is done without noise or damage to the dogs. A slight delay is necessary before engaging the dog teeth so that the cones have a chance to bring the synchronizer arid pinion to the same speed.

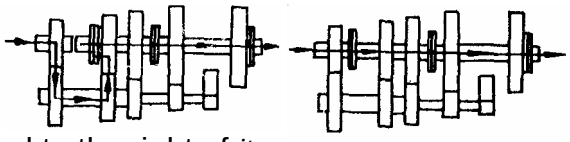
SYNCHROMESR

The Synchroinesh gear box is similar to the constant mesh eacept the synchromeeh Unit Fig.3.J 4.ashows a synchromesh type gear box having Five speeds. The gear positions shown in Fig1a Corresponds to situation when the Vehicle is in Neutral lear,

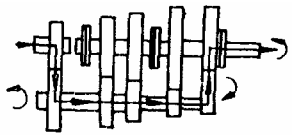


I.FIRST GEAR

Figure a shows the power flow through the transmission in first. The 1-2 synchronizer



has been moved to the right of *its*
internal teeth engage the external teeth of the first speed gear.



2.SECOND GEAR

Figure b shows the power flow through the transmission In used gear. The 1-2 synchronizer has been moved to the lift so its Internal teeth engage the external teeth of the upend speed gear.

a FIRST GEAR b SECOND GEAR

Figure c shows the power flow brought the transmission in has been moved to the right so its internal teeth engage the external teeth of the third-speed gear.

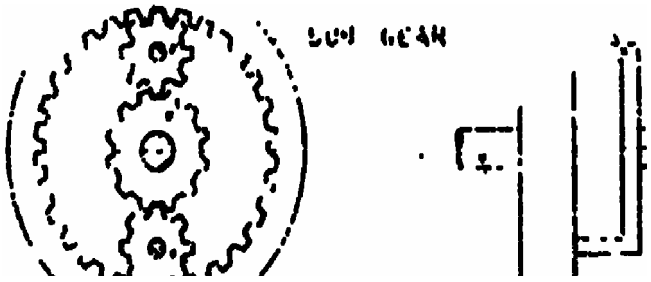
4.FOURTH GEAR

Figure d shows the power flow throw the transmission in fourth gear. The 3..4 synchronizer has been moved to the left, so its internal teeth engage the external teeth of the clutch gear.

In reveuse. both synehronimbers sre is the neutiat peeldom. The reverse gear has '~etn rnovei to the left, so it engage the reverse idler gear. Now, the elba gear in the train causes the maim shaft to trw its the reverse arecuon. so the car moves bacliward.

EVICYCLIC GEAR BOX:

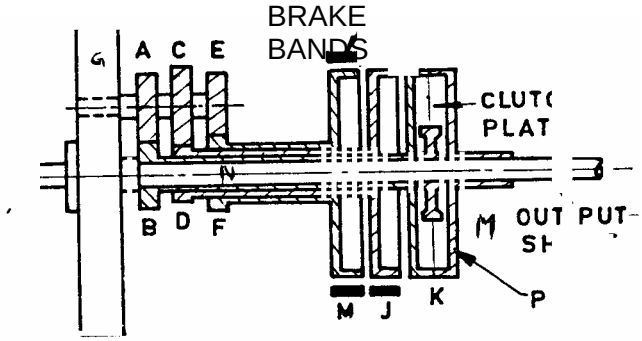
SIMPLE EPICYCLJC GEAR TRAIN



the ring gear cannot move, the planet gears are forced to climb over it. During this position, ~he ring gear acts as a track for the planet gears to move over. The driven shaft which is connected to the planet gear carrier is thus rota ted

When the ring gear is released it is free to ntove in consequence to the rotation of planet gears which rotate around their axis. During this position there is no movement of planet carries and hence the driven shah remains stationary.

A planetary gear box contains a number of such units in different sizes to obtain



various speed reductions. Fig.3.13 Epicyclic Gear Box
In a simple epicyclic gear
set, There may be six possible speeds, four of which are forward and two reverse.

i. Forward, fast output speed: This is obtained when planet carrier is driving, ring gear is driven and the sun gear is held stationary.
ii. Forward. very fast output speed This is obtained when planet carrier is driving, sun gear is driven and the ring gear is held stationary.
iii. Forward, slow output speed: With ring gear driving planet carrier driven and the sun gear stationary, this comas about
iv. Forward, is slow output speed This results when the sun is driving, planet carrier driven and the ring gear stationary.
v. Reverse, slow output speed: This is obtained when the sun gear is driving~ the ring gear is driven, and the planet carrier is stationary.
vi. Reverse, fast output speed This condition is obtained with the ring gear driving, sun gear driven and the planet carrier stationary.

CONSTRUCTION AND OPERATION OF EPICYCLIC GEAR BOX:

Fig 3.13'. shows an epicyclic gear box, The compound gear ACE is mounted on a pin fixed to a wheel G. The compound gear is free to rotate on the pin. Gears, A, C and E are meshed with the three different gears B,D and F respectively, which are connected in turn to the drums

H, J and K. The drums H and J have brakes in outer circumference and drum K is provided with a number of clutch plates. A hub is fitted to the flywheel spigot shaft N to which a number of clutch plates are attached. When the member M is pressed against the clutch plate, it engages the clutch, thereby connecting the shaft N to the output shaft ***P.*** directly. It is top speed gear.

To obtain low speed gear, disengage the clutch and apply on drum J, with the help of gear change lever. This action locks the gear D, thereby decreasing the speed of gear B and hence that of the output shaft.

To obtain reverse gear, disengage the clutch and apply brake on drum M. This locks the gear F. thereby reversing the direction of rotation of B, with respect to the input shaft. The speed of B is also reduced.

PROPELLER SHAFT:

This is the shaft which transmits the drive from the gear box to the bevel pinion or worm of final drive. It consists of three parts.

Shaft.

One or two universal joints, depending upon the type of the rear axle drive used. The universal joints act for the up and down movements of rear axle when the vehicle is running.

Slip joint . Depending upon the one slip joint he there in the shaft. This serves to adjust the length of the propeller shaft when deranged by the rear axle movement.

Fig shows **propeller** shaft, with two universal joint.~ at the ends and a slip or sliding joint. Slip joint is formed by the internal splines on the sleeve attached to he left universal joint and external splines on the propeller as shown.

'he rotary motion of the transmission main shaft is carried out the propeller shaft to the differential, causing

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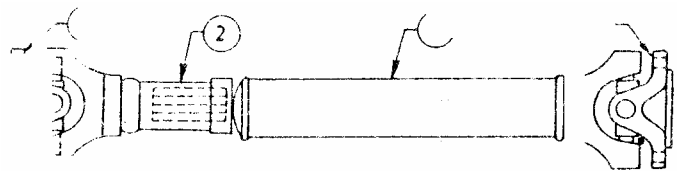


2. SLIP JOINT

I. UNIVERSAL JOINT

3. HOLUOW SHAFT

whoels to rotate. ~The propeller shaft has to with with the torsional stress of the transmitting torque, it must be light and well balance so that vibration and whip will not occur at high speed. i-or those reasons, it is made of strong steel tube.

In so vehicles, torque piece propeller shaft is used. It consist of twO' propeller shaft supported in the middle by o self- ball in a cross member of the chassis. In all there are, three universal joints two slip

UNIVERSAL JOINT

An universal joint is used where two shafts are connected at to transmit torque. In the transmission system c-f a motor vehicle, the transmission main shaft, propeller shaft and the pinion shaft are not in one lies hence the coincide between them are made by the universal one joint is used to.

TYPES OF UNIVERSAL JOINT

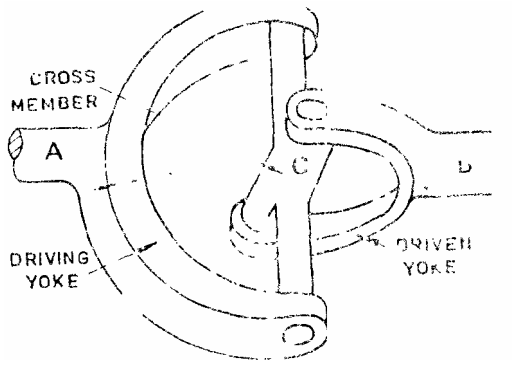
1. Cross type or spider and two yoke type
2' Pot type joi it
3 Ball and turnnion type
4.Constant velocity type
5.Flexible ring universal joint

1. CROSS TYPE OR SPIDER AND TWO YOKE TYPE:

axis **yy.** An Improved form of this joint uses needle roller bearing to support the cross in the yoke. This result in increase of joint efficiency. To allow for the telescopic movement an extnded hub of one yoke is internally splined as shown in figure 3. 15a.

SPLINES FOR SI$_4$DING JOINT

Cross'type universal joint



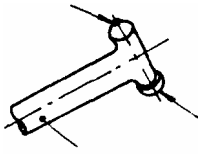
Cross Tube universal joint

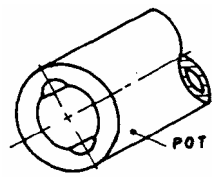
2. POT TYPE JOINT:

Pot type of joint is another kind of universal joint Fig:3~. 16 gives the general arrangement of this type of joint. The end of one shaft is specially shaped and carries two hemi-spherical shaped blocks atta ched to it by means of a pin. These blocks slide in the pot; the pot itself **is** carried by the second shaft. This arranand axial movements.

SPHERICAL BLOCK SHAFT

Fig. 3.16 Pot Type **Joint**





In most automobile vehicles the final drive is embodied in rear axle. But in various popular vehicles with front wheel drive and a few special purpose vehicles with four wheel drive, it becomes necessary to consider final drives as units dependent of their positions.

FUNCTIONS OF FINAL DRIVE:

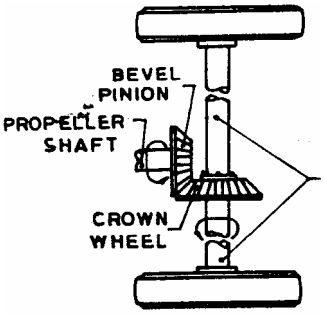
In a motor vehicle the final drive has two purposes.

1.To provide a permanent speed reduction. For motor cars the reduction is usually about 4:1 and 10 :1 in heavy vehicle.

2.To turn the drive through 90~ so that the torque may be transmitted from propeller shaft to the rear axle.

CONSTRUCTION OF FINAL DRIVE:

The final drive consists of a



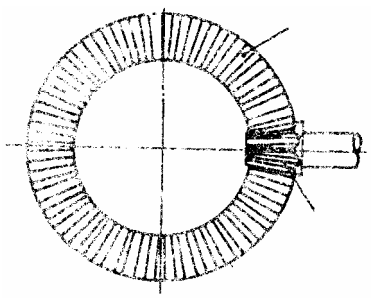
TYPES OF GEARS:

There are three types of the final drive gearing:

a) Straight bevel gears
b) Spiral bevel gears
c) Hypoid gears.

bevel pinion and crown wheel (ring gear). as shown in Fig 3.17. Thebevel pinion is mounted on the shaft which is conn movements.ectesi to the propeller shaft generally AXLE through a universal joint. From the crown wheel the drive goes to rear axIes through differential.

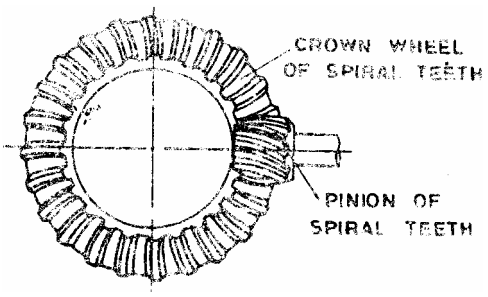
STRAIGHT BEVEL GEARS :(Flg.3 ISa)



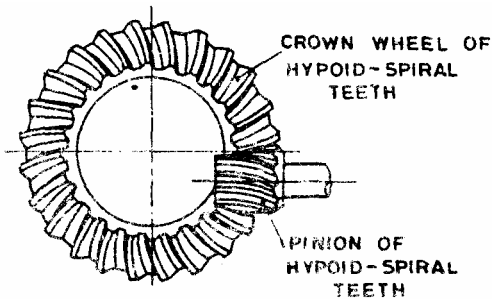
These contain the straight *teeth.* They are therefore simplest arid thus the. cheapest of all type.

BEVEL *GEAR* Of STRAIGHT TEETH

% EVEL PINION OE 5I¼iAIGHT YEETH



C Hypoid Sniriil Gear



ADVANTAGES OF HYPOID GEARS:

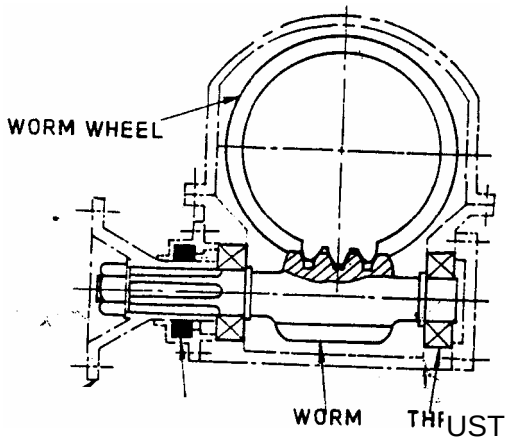
1.This permits a lower position of the propellei shall thus a~low~nc a low chassis height.

2.Wiping action ~ake~ place between the teeth as the teeth mesh and de~nesh, The result is smooth runni~ig.

3, the same size of spiral bev~I crown wheel the shape and size of pinion teeth in hypoid drive is greater Lhus can with stand high torque.

WORM AND WORM WHEEL DRIVE: Fig.3.18d

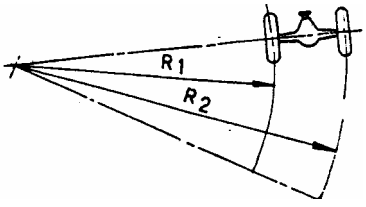
Instead of bevel pinion and the crown wheel, the worm and worm wheel ~irrangement is also used frequently. This gives a quite and efficient drive. Further. larger gear reduction as compared to the bevel pinion type where double reduction has to be employed The worm can be mounted either below the wheel axis level low chassis height or above the wheel axis level allow ground clearance.



WORM WHEEL

DIFFERENTIAL

If a vehicle tra~cofs in a straight line, the two rear wheels turn on the road exactly at same speed. There is no relative movement between the two rear wheels. But when the vehicle takes a turn, the outer wheel travels on a longer radius than the inner wheel. The outer wheel turns faster than the inner wheel, that is, there is a relative movement between the two rear wheels. If the two rear wheels are rigidly fixed to a rear axle the inner wheel will slip which will cause rapid tyre wear, .steering difficulties and poor road holding. Therefore there must be some devices to provide relative movement to the two rear wheels when the vehicle is taking a turn. The differential serve this purpose,



The outer wheel turns faster than the inner wheel when the cur is taking a turn. This requires a differential.

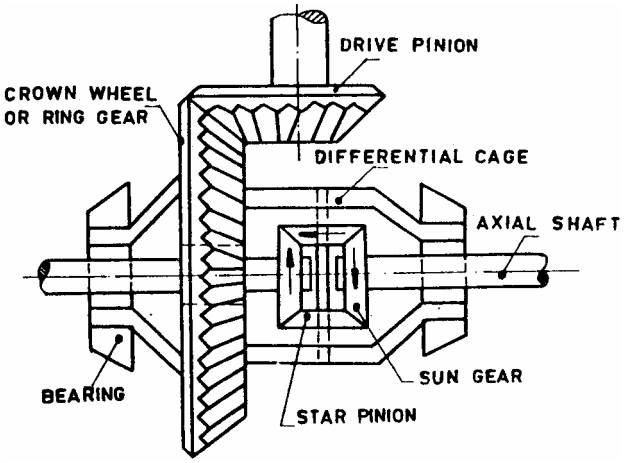
The function of the differential is to allow each rear wheel to rotate at different speeds during running but at the same time transmit equal torque to each wheel when both wheels have equal traction.

TYPES OF DIFFERENTIAL

(i)Conventional

(ii)Power lock or Non-slip

(iii) Double reduction type.



CONVENTIONAL TYPE (CONSTRUCTION)

It consists of a cage which contains differential gears. The differential gear (Fig..3.21) consists of two sun gears

Fig .3.21 Differential

and four star pinions all the bevel type. The star pinions are fitted on a pin if there are two in number and a spider, if four are in number. The pinions are free to move around their axes. The pin or spider is held in between the two parts of the cage which encloses the differential gears. The sun gear and star pinions are always In mesh with each other. The differential assembly is supported on taper roller bearing provided on both sides

of the cage. When installed in the drive axle, the whole assembly moves around the bearing.

The ring gears or crown wheel is attached to the differential cage which forms part of the final drive. Drive is given to the ring gear by means of drive pinion to which propeller shaft is attached.

Such gears are located parallel to ring gear inside the differential cage and face towards each other. Shaft of each wheel is splined into the sun gear of that side.

WORKING OF DIFFERENTIAL.

When the vehicle is moving on straight bevel road and the resistance effecting both the driving wheels is the same, there is no relative movement among the differential gears. The whole arrangemet meshed together moves as one unit and both the half shafts in the driving wheel rotate at the same speed.

When the front wheels are turned to any directions to take a turn, a binding force acts on the inner wheel being nearer to the point around which wheels move in a circle. The sun gear of the side is held slow in relation to the movement of the complete cage or crown wheel. When the vehicle is going straight on level road, the power is divided equally at the differential, one half flowing to one side wheel and the other half flowing of the other side wheel. While taking a turn when the bonding acts on the inner side sun gear and its speed is slowed down, the star pinion rotate the other side sun gear at a speed as a result of loss on the inner side and gain on the outer side plus the speed at which the complete differential assembly is rotating, This ra~ults in a faster movement of the outer wheel than the inner one. Thus the differential is functio ni ng

Rear Axles

TORQUE REACTION:

The forces experienced by the rear axle are given under

i)Weight of the body

ii) Torque reaction

iii)Driving thrust

iv) Bracking thrust

v) Side thrust Torque Reaction

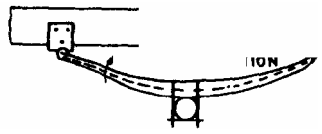
The propeller shaft drives a torque to the pinion and the pinion will have to roll round the crown wheel taking with it casing. This tendency is also present when the vehicle is running. This torque is equal and opposite to the driving torque applied to the road wheels. This phenomena.. non is called torque reaction. In the same way the braking torque on the axle casing is opposite in direction to the torque reaction. This opposition of the casing prevent, bending of the propeller shaft.

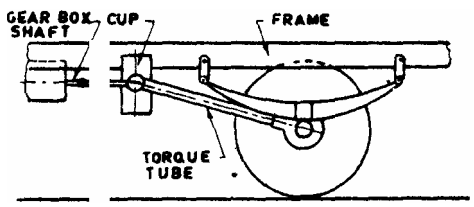
3.10 REAR AXLE DRIVES:

The load and weight of the body of the vehicle ii communicated to the rear axle through the springs which an rigid with the casing. To transmit the torque from th gear box to the rear axle, the common drives are use as given under:

3.10.1HOTCH KISS DRIVE:

This drive is very simple and generally used in th~ vehicles. The arrangement of the parts is shown in this





:igure3.22 In this case the springs beside taking weight of the body, also take
he torque reaction, driving thrust and the
SideUNIVERSAL SPRING
thrust.

Drive the frame with the bracket and rear end is supported in a shackle with the pins. The propeller shaft is provided with two universal joints and one sliding joint.

Due to torque reaction the front half spring deflects as shown in figure 3.22e1t means that the driving thrust is transmitted to the frame by this portion of the spring.

When the spring deflects . of spring in the manner shown to the torque reaction bevel pinion shaft will tend to tilt its axis. If there is one universal joint near the gear box then under the torque reaction the propeller shaft will bend. Therefore, to avoid the bending of the propeller shaft another universal joint is used at is rear end.

Again when axle moves up and down relatively to the frame it has to move in a circle whose centre lies at the front end of the spring. Then propeller shaft also has to move in circle keeping its centre at the front universal joint. As these two centres do not coincide, therefore, the length of propeller shaft always has to vary this condition which is accommodated by the sliding joifli in the propeller joint.

3.10.2TORQUE TUBE DRIVE:

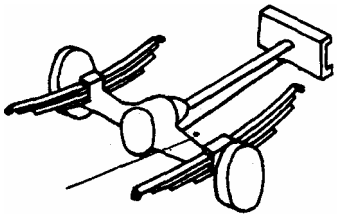
In this type of drive, the spring take only the side thrust besides supporting the body weight. The coil springs, however, cannot take any side thrust and hence a separate member is required for the same The torque reaction and

the driving thrust are taken by another member which is called the torque tube. One end of the torque tube is attached to the axle casing, while the other end which is spherical in shape fits in the cup fixed to the frame a

PROPELLER

Torque Tube As it is seen the Drive torque tub. Encloses the propeller shaft. In this case no universal joint is provided at the rear end of the propeller shaft. Also no sliding joint is need in The propeller shaft.

Clearly the torque reaction and the driving thurst are taken by the torque tube. In this case, the



bevel pinion shaft axis will always pass through the universal joint at the front end of the propeller shaft if this joint is situated exactly at the centre of the spherical end of the torque tube. Due to this reason no universal joint is at the rear end. Since both pinion shaft and propeller shaft will work about the same centre that of the spherical cup while moving up and down the axle then no sliding joint will be necessary.

RADIUS ARM DRIVE:

The radius arm drive method (Fig5.4) uses two torque rods or radius arm to transmit the driving thrust to the frame. The radius arm are connected between the rear axle and the frame by connections that allow relative motion between the two. The torque reactions is resisted by the suspension springs. The springs must, therefore, be stiff, enough
The torque arm drive (Fig.3.23aconsists of a tubular arm connected between the rear axle housing and the frame with a rigid connection at ~he a5cle housing and a ball and socket joint at the frame. The propeller shaft torque unlike torque tube drive membersre mains open; apart from This the working principle Torque Arm of exactly same as thetorque-tube drive.

REAR AXLE:

There are two types of rear axles; dead axle and live axle. A dead axle does not rotate with the wheels but the wheels rotate on it. They support the rear weight of the vehicle. A live axle takes the load and at the same time, also drives the wheel connected to it. The live axle is not a single piece, but it is in two halves connected by the differential known as half shaft. In a four wheel drive all the axles are live axles. In case of rear-wheel drive vehicle the front axles are dead whereas in front-wheel drive vehicle the rear axles are dead. Almost all rear axles on modern passenger cars are live axles.

TVPES OF REAR AXLES:

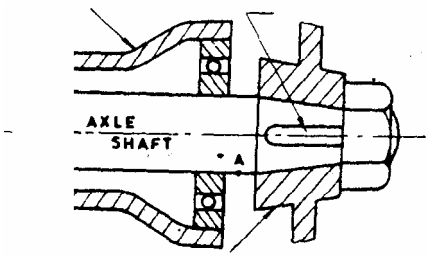
Depending upon the method of supporting the rear axles and mounting~ the rear wheels, the rear axles are of three types:

a) Semi floating axle
b) Full floating axle

ci Three quarter floating axle.

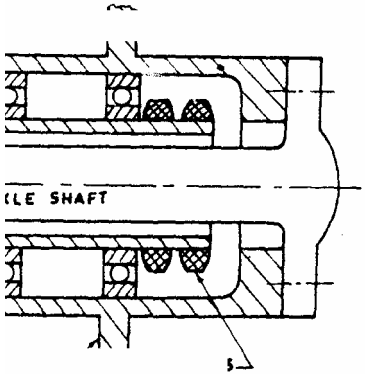
SEMI FLOATING AXLE:

-Fig. shows a semi floating type of rear axle. A bearing is located between the axle and inside the axle casing.
Therefore, it needs to be of a larger size, for the same torque out put, than any other type. The inner end of the axle is supported by the differential side gear. It is thus relieved of the job of supporting the weight of the car by the axle housing. The outer end has to support the weight of the car and take end thrust- rhe inner end Semi Floating Axleof the axle is splined to and the bearing, which causes the bending or shearing of the axle. The semi floating axle is the simplest and cheapest of all other types and widely ‘used.



FULL FLOATING AXLE

This type is very robust one. And is used for heavy, vehicles. In this the axle shatt carry only the driving torque A full floating axle (Fig.3.25jhas two deep-groove ball or taper roller bearings, located between the axle casing wheel hub. The outer of the axle is made



flanged to which the wheel hub is bolted. The axle is not supported by bearings at either end, and its position is maintained by the way that it is supported at both ends: Thus the axle ~s relieved of all strains caused by weight of the vehicle on end thrust~ It transmits only the driving torque. For this reason it is called full floating. The axle may be removed from the housing without disturbing the wheel by removing the nuts An additional advantage of the design is the ability to withstand the vehicle even if it has a broken axle. This type of axle is more expansive and heavier than the other axles.

THREE-QUARTER FLOATING AXLE:

In the three quarter floating axle the single bearing located between the hub and the axle casing. Thus, the weight of the vehicle is transferred to the axle casing. Thus, the weight of the vehicle is transferred to the axle casing, and only the side thrust and driving' torque are taken by the axle. The axle (Fig.3.26 is keyed rigidly to the hub, thus providing the driving connection and main taininr the alignment of the wheel: The inner end of this axle has the same construction as that of the semi-floating axle. As clear from the figur3.26 the axle shaft do not take any shearing AXLE or bending loads due to the weight of the vehicle. However it has to take the end loads and driving torque. Although the three quarter floating axle is more reliable but it is not d5 simple as the semi floating axle.