Layout of drive shafts

Drive line types:

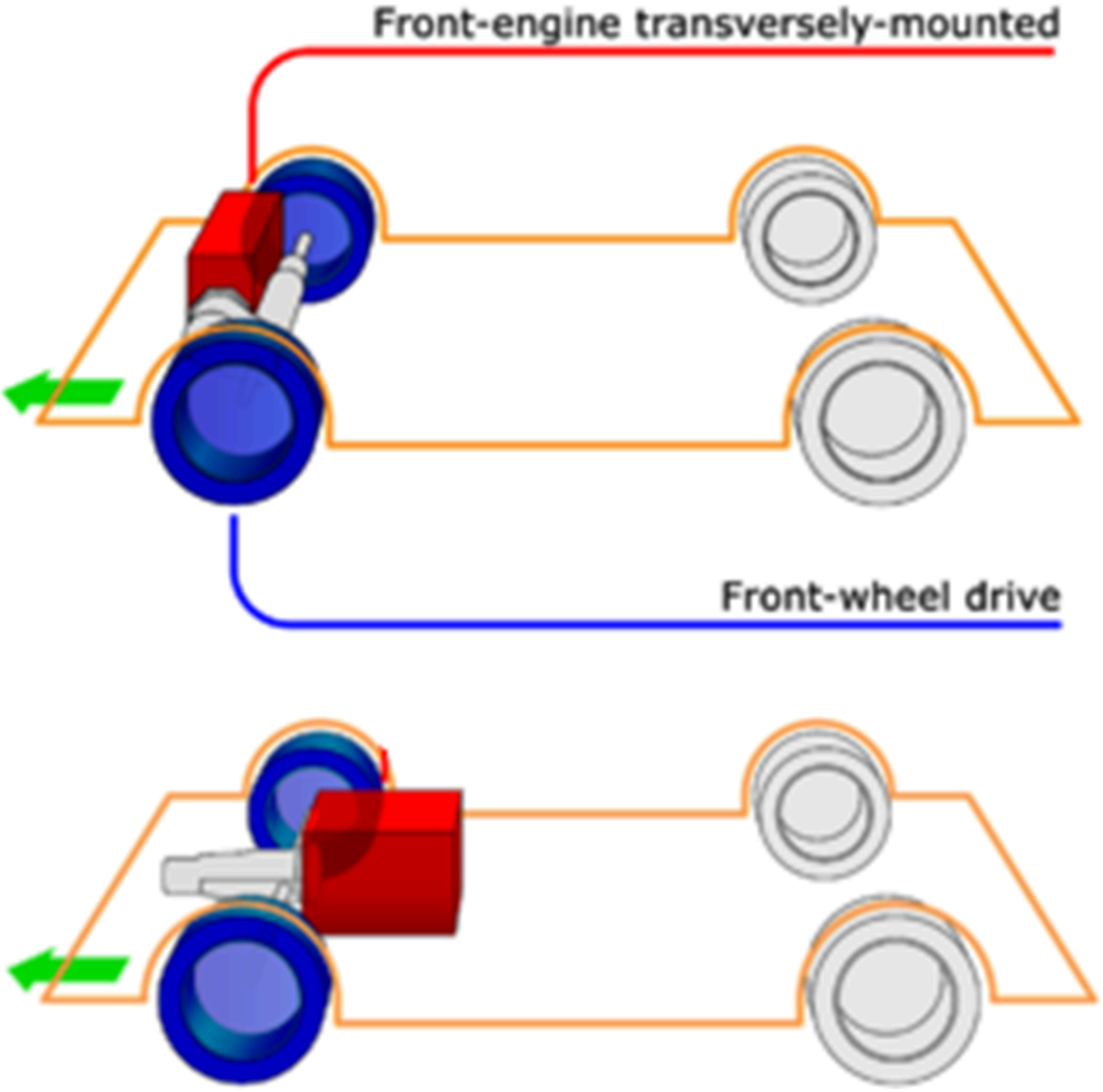
In the transmission system there are two types of drive lines. One is front wheel drive and the other one is rear wheel drive line to transmit the engine torque to the driving wheels.

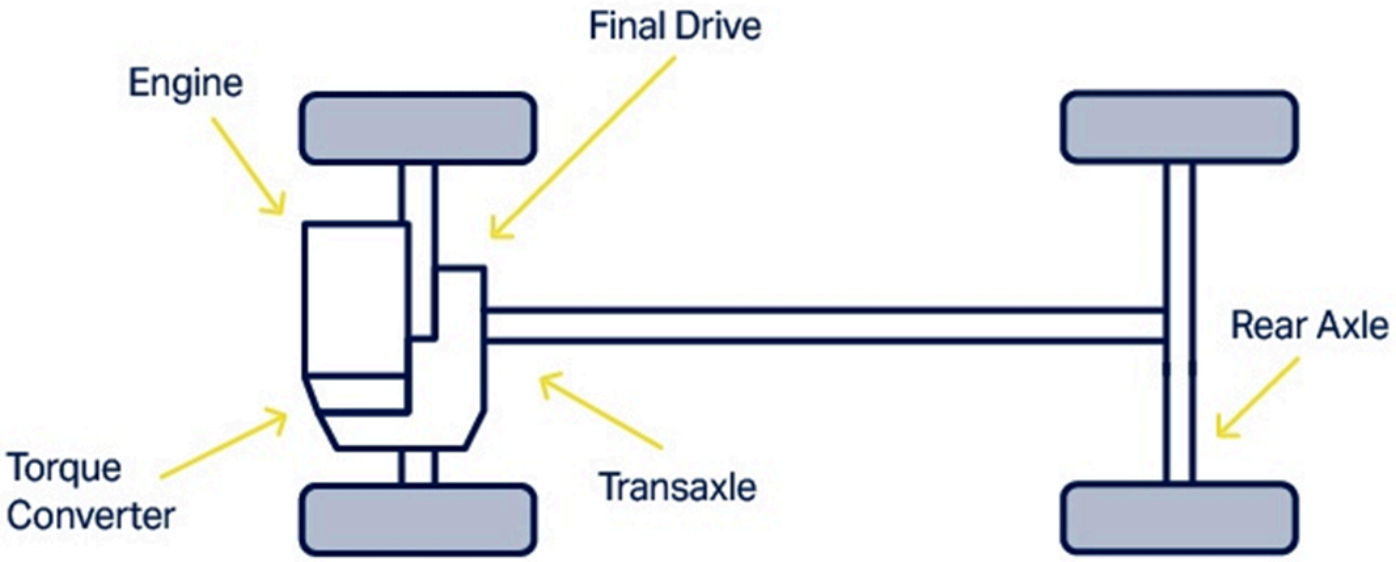
Drive line:

The drive line represents the universal joints, drive shaft and other parts transmitting engine torque to the driving wheels or rear driving axle. The purpose of the drive line is to transmit engine torque smoothly to the driven parts in the driving axle.

Front-wheel drive line:

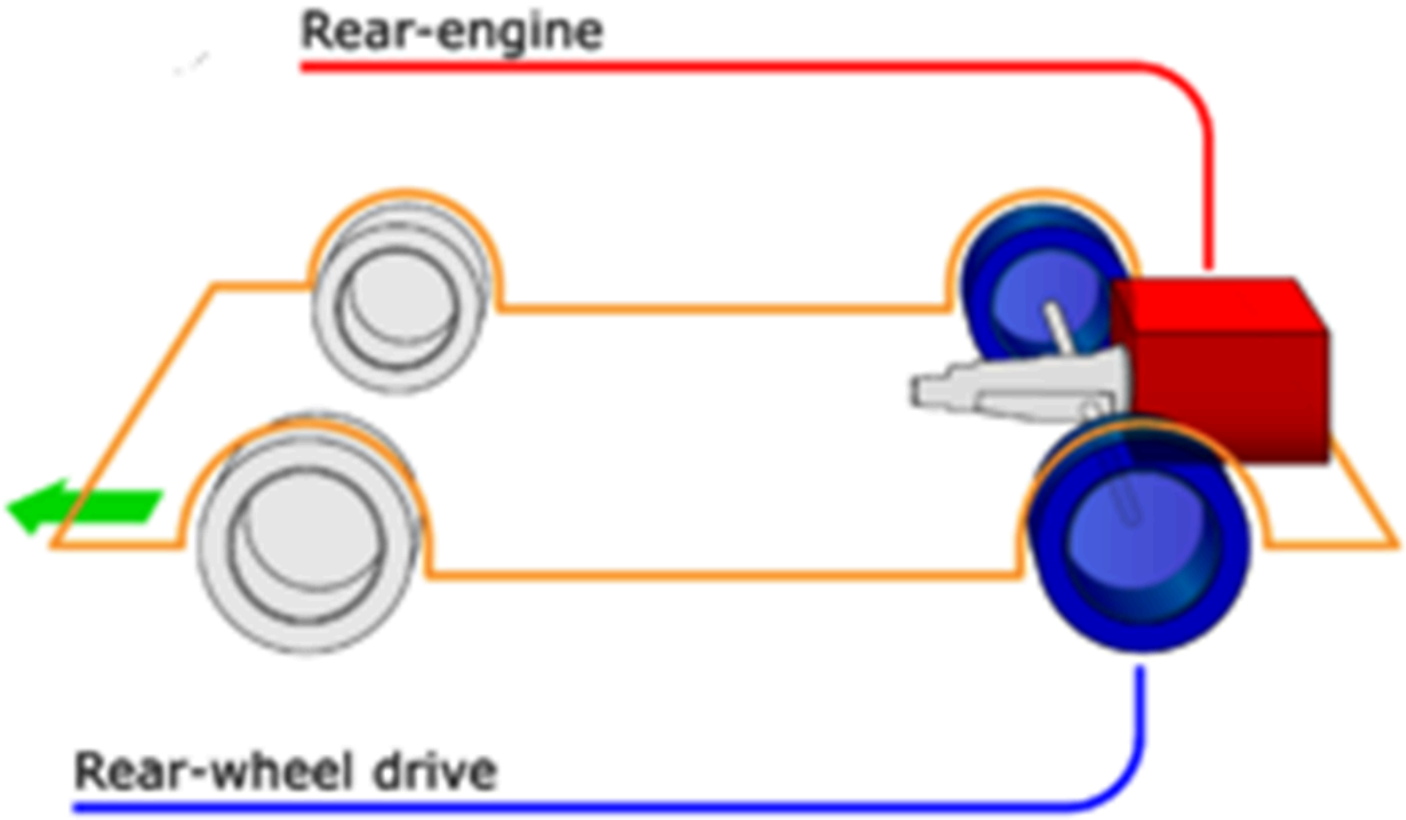
Front wheel drive has the engine and driveline located between the front driving wheels. A key point to observe with front wheel drive is that the power flow leaves the transaxle (transmission and axle) housing to enter the driveline to rotate the front driving wheels.



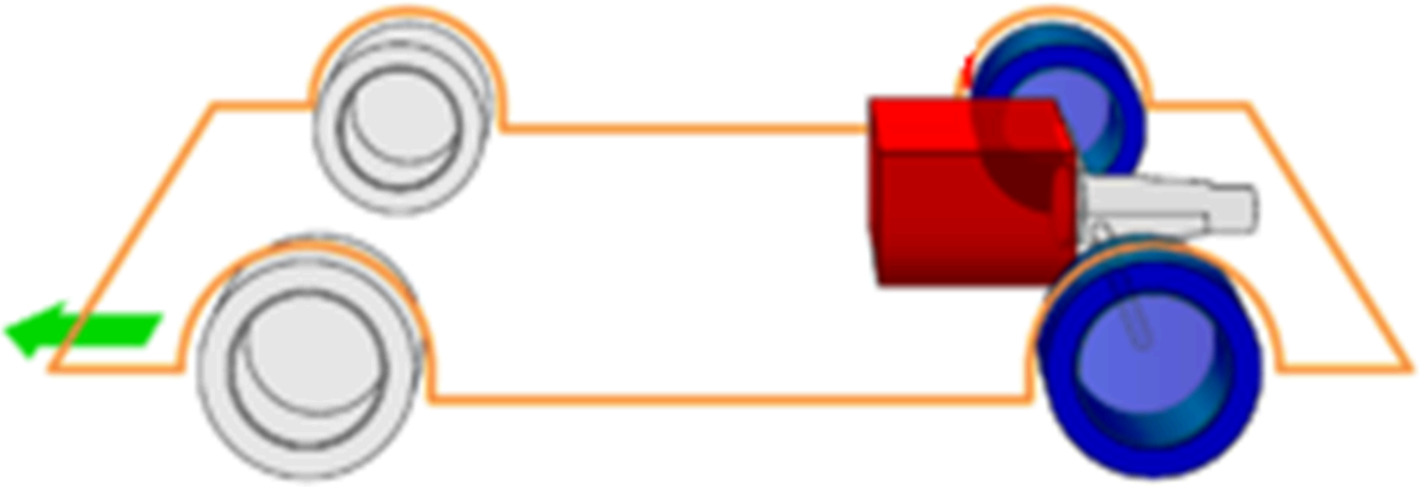

Final Drive
Engine
Rear Axle
Torque
Converter
Transaxle

Rear wheel drive line:

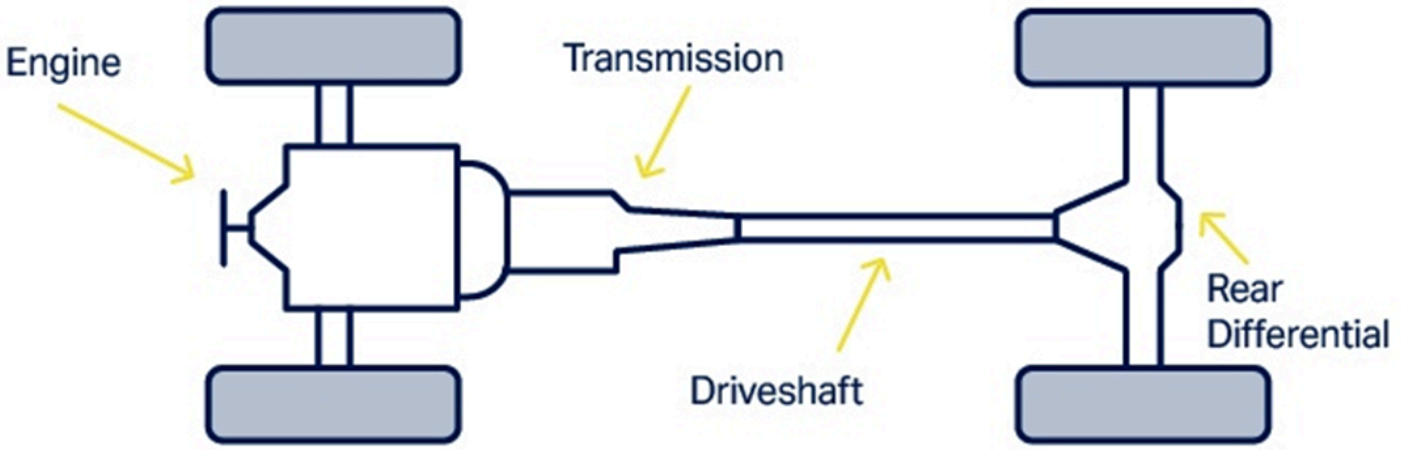
The purpose of the rear the wheel drive line is the same as the front wheel drive line the difference is location. The rear wheel driveline is located between the transmission and the rear axle housing.



The power flow will leave the transmission to enter the drive line.

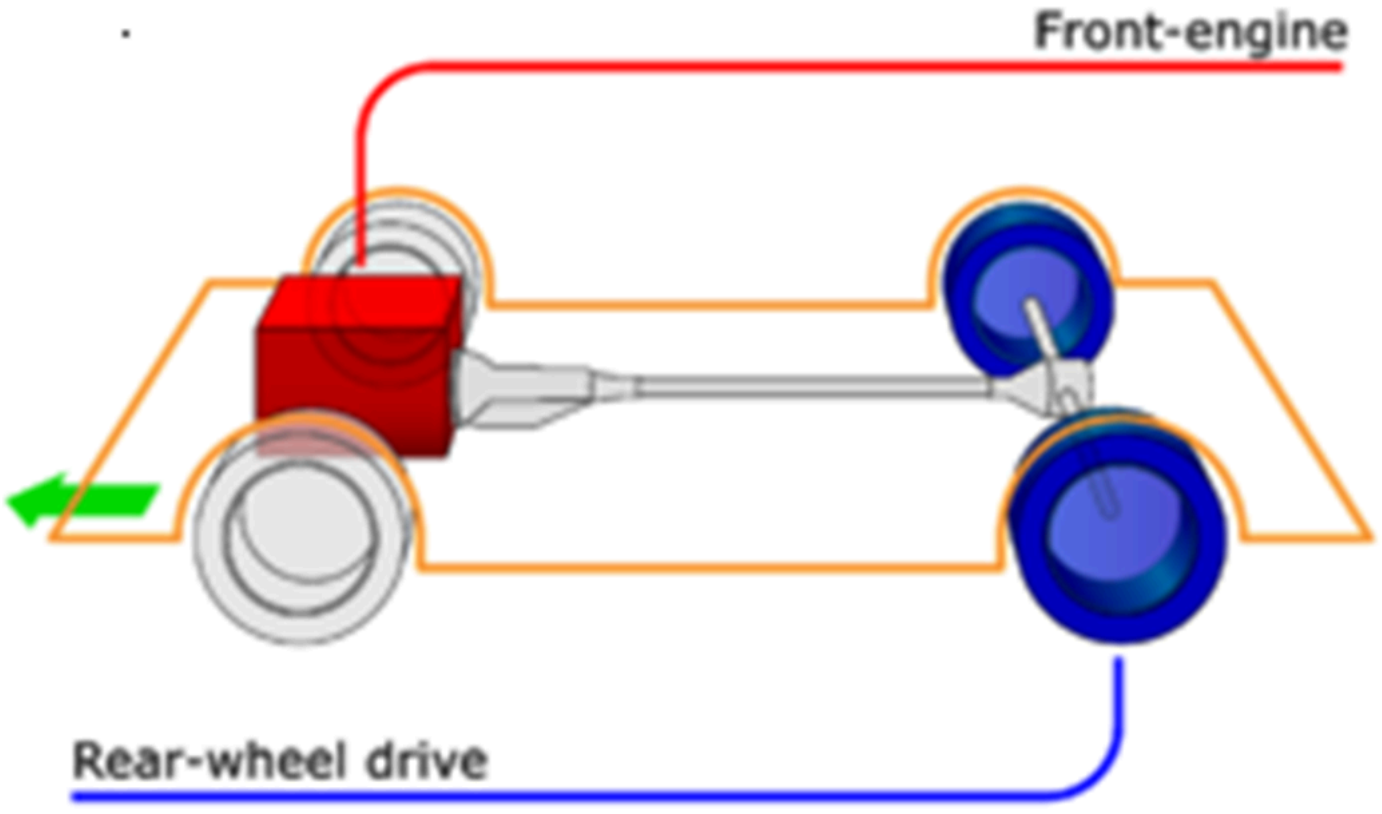


The drive line torque will then enter the rear driving axle to rotate the driving wheels.



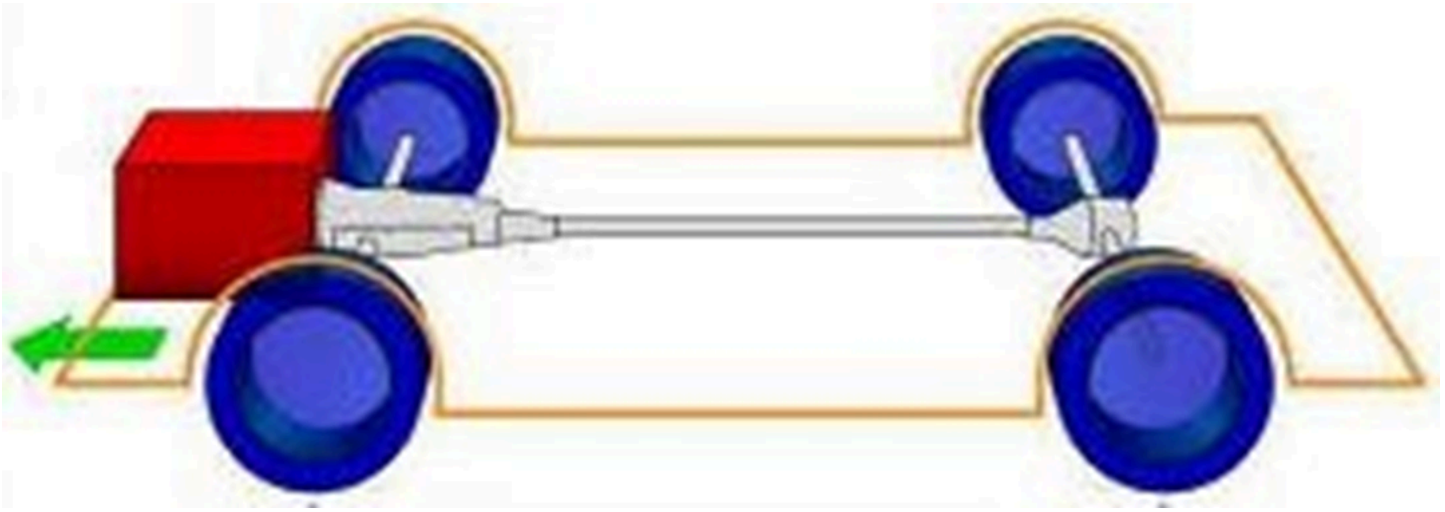
Power train of an automobile with rear-wheel drive:

In a manual transmission,the driver must shift by hand or manually. It is an assembly of gears and shaft that transmits power from the engine to the final drive or drive axle.

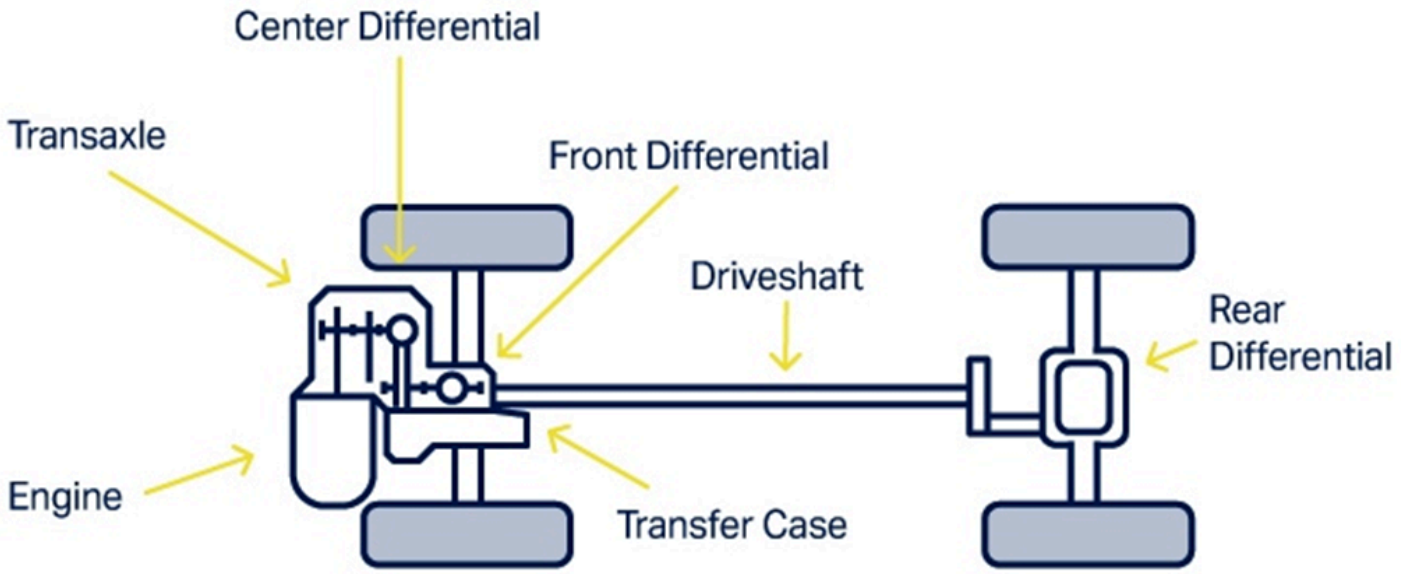


All wheel drive:

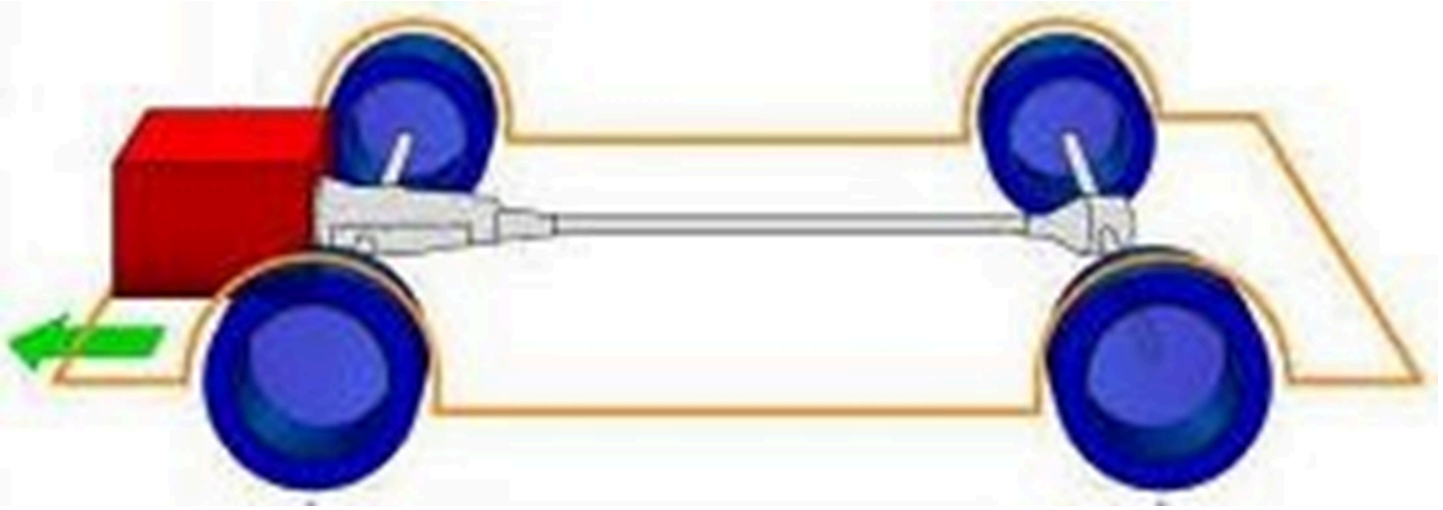
These systems are sometimes called full- time four wheel drive. All wheel drive systems are designed to function on all types of surface, both on and off-road, and most of them cannot be switched off.



All wheel drive is used in special applications like race and sports cars.

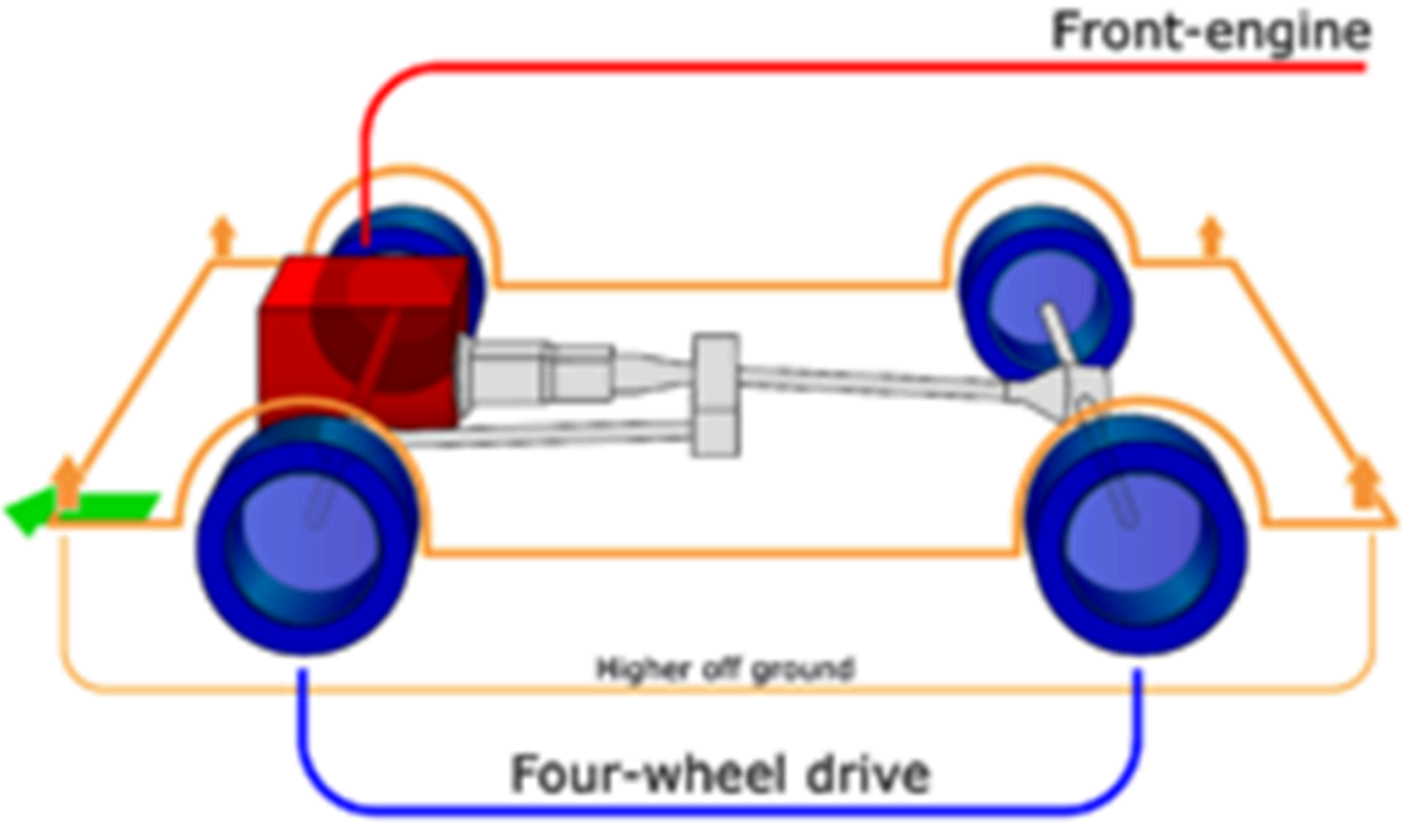


These systems can be used in high gears and high speed applications.

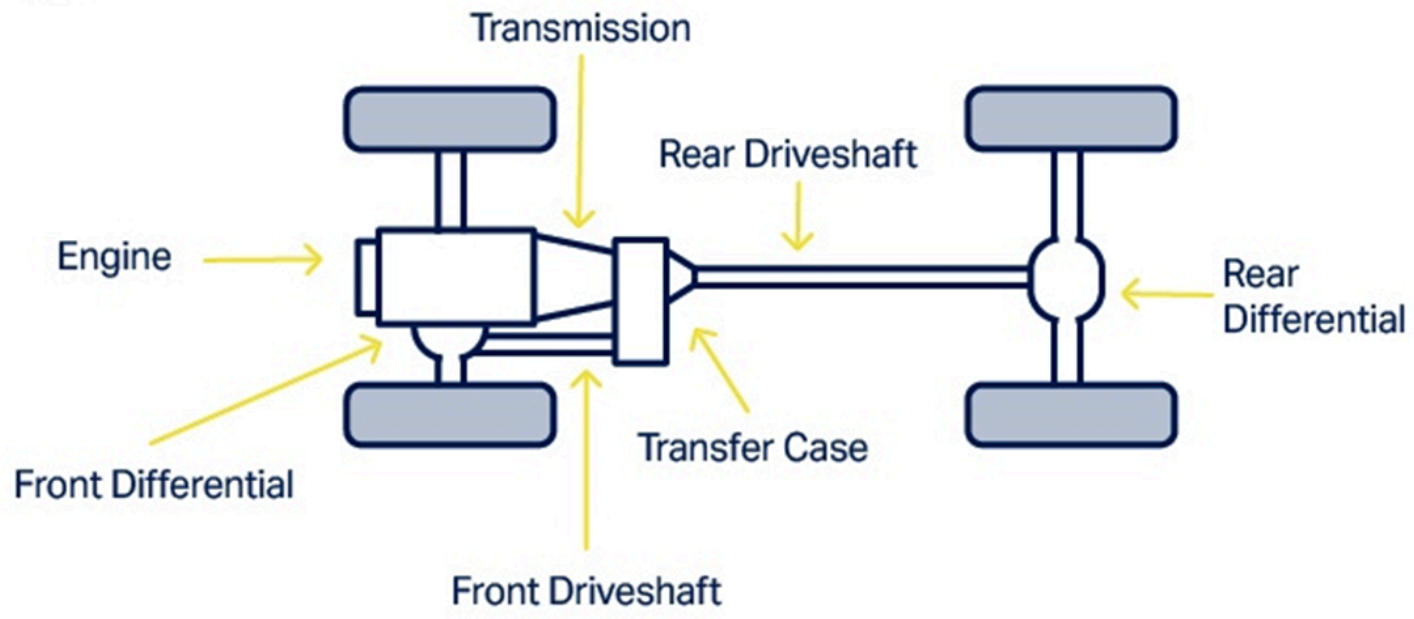


Four wheel drive

Usually, when car makers say that a car has four wheel drive, they are referring to a part time system.



These systems are meant only for use in low traction conditions, such as off-road or on snow or ice, beach clay and mountains.



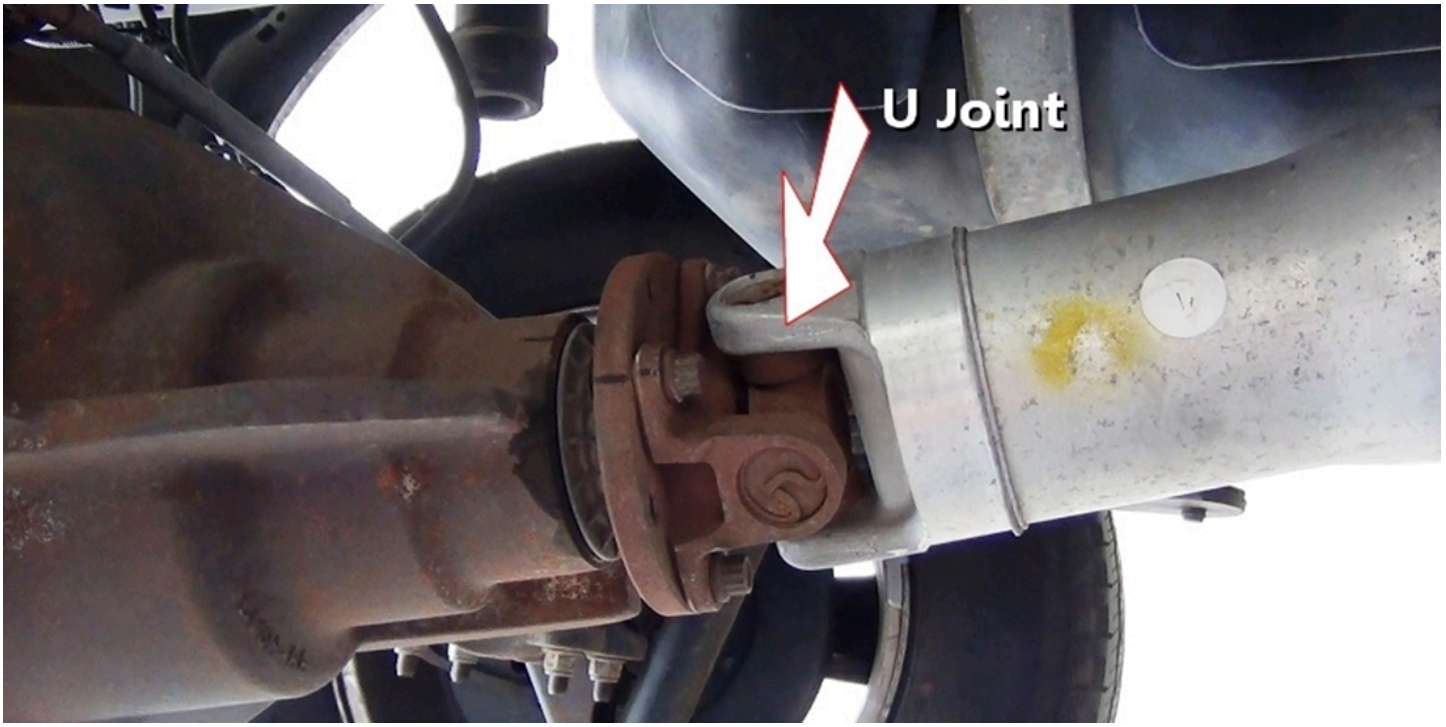
These systems can be incorporated in low gears only.

Universal and slip joints

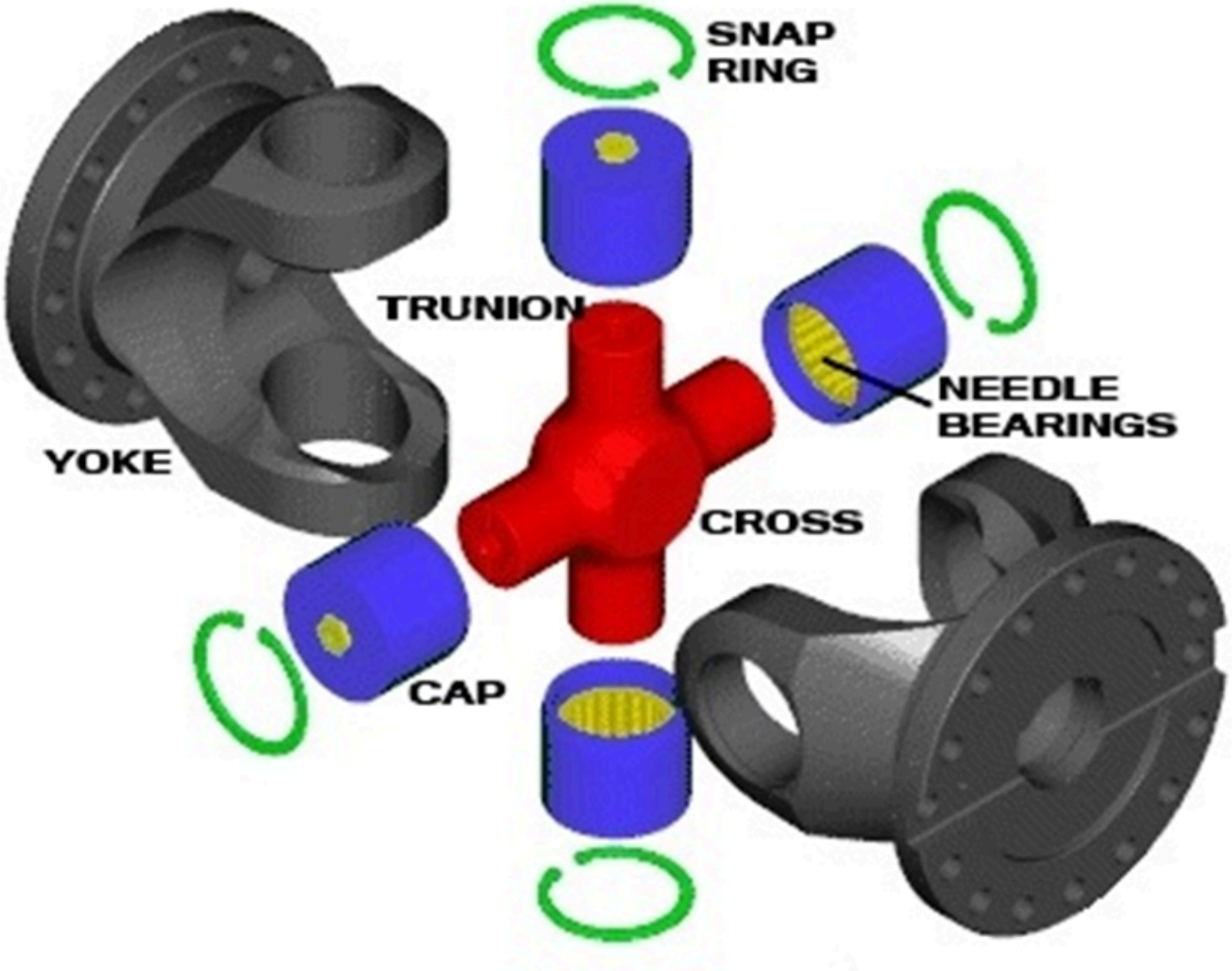
Fabric Type Universal Joint

Need and function of universal joint

In any vehicle the gearbox and the rear axle are at different levels. A universal joint provides a flexible connection. It allows the propeller shaft to transmit torque from the gearbox to the rear axle.



Similarly, due to the ups and downs on a road, the angle between the gearbox and the rear axle changes.

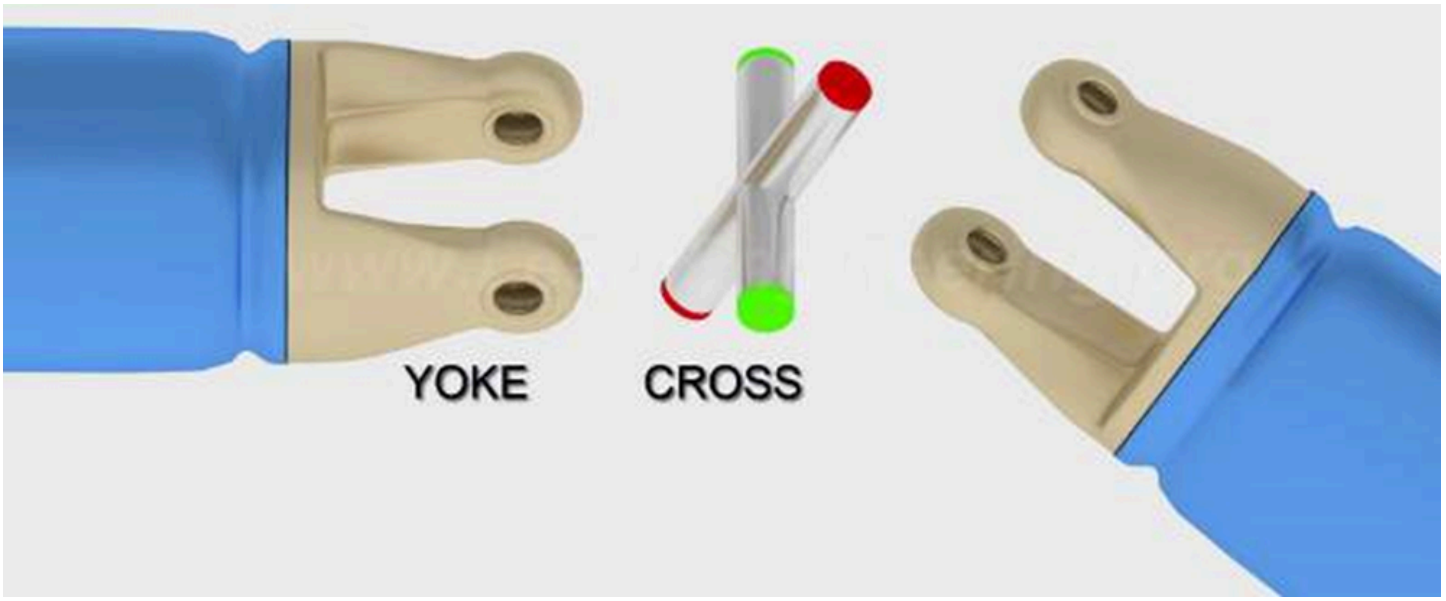


The universal joint accommodates this variation in angle and permits smooth transmission of torque from the gearbox to the rear axle.

Types of universal joints

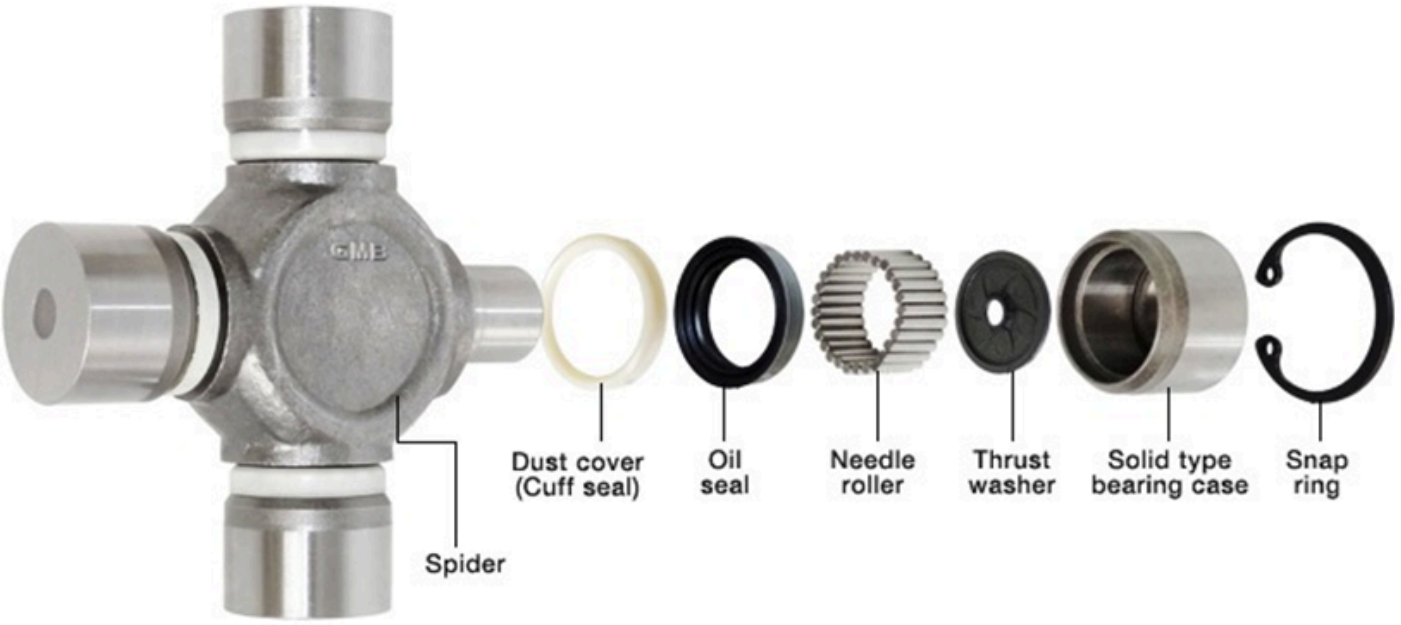
Cross-type or spider & two yoke type

A cross-type universal joint has a spider.



At the four ends of this, needle roller bearings are fixed with bearing caps .

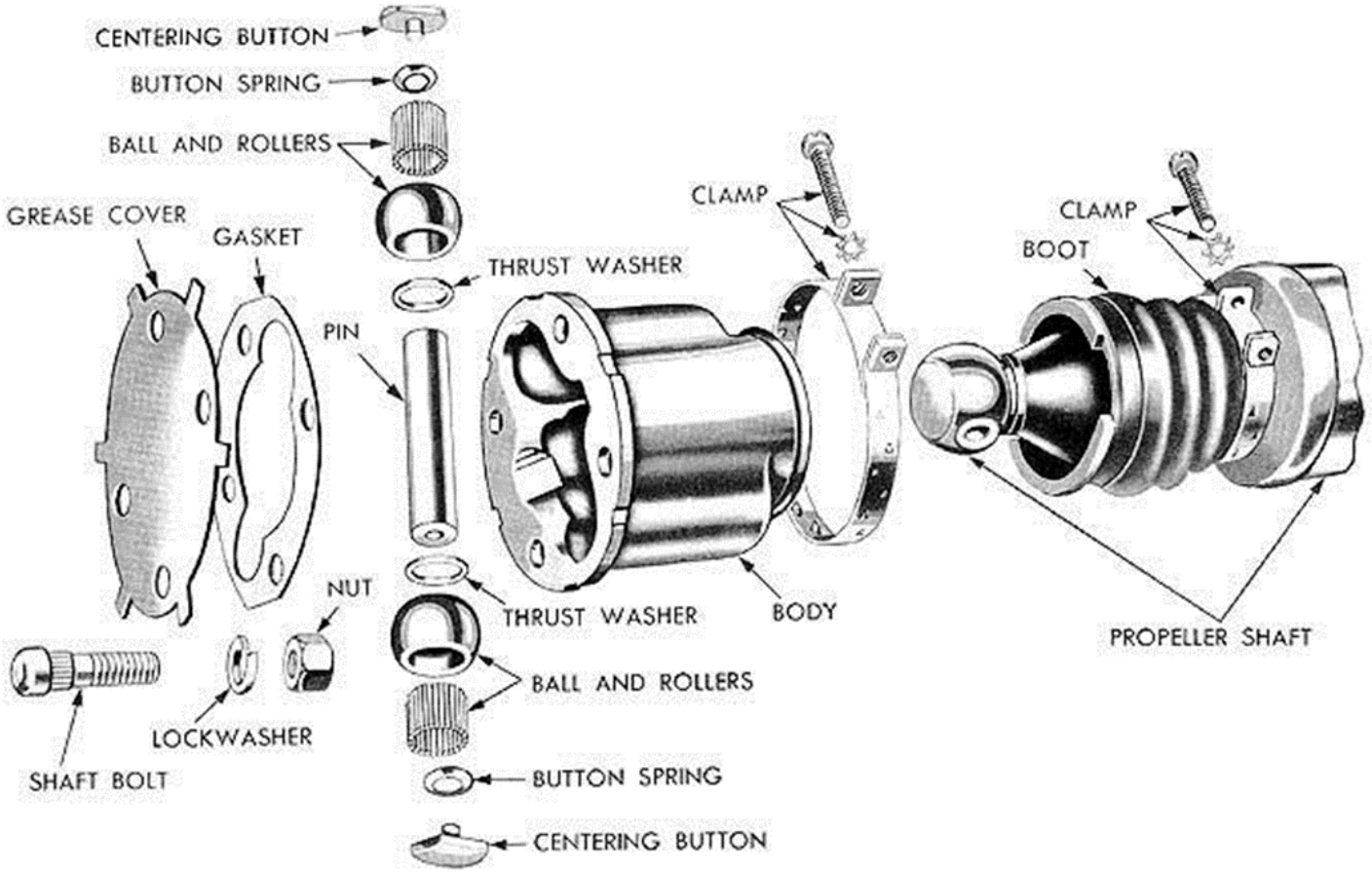
Two yokes are pivoted to the spider at 90°



Ball and trunnion type

In this type of joint, a ball head is fixed at the end of the propeller shaft by a pin.

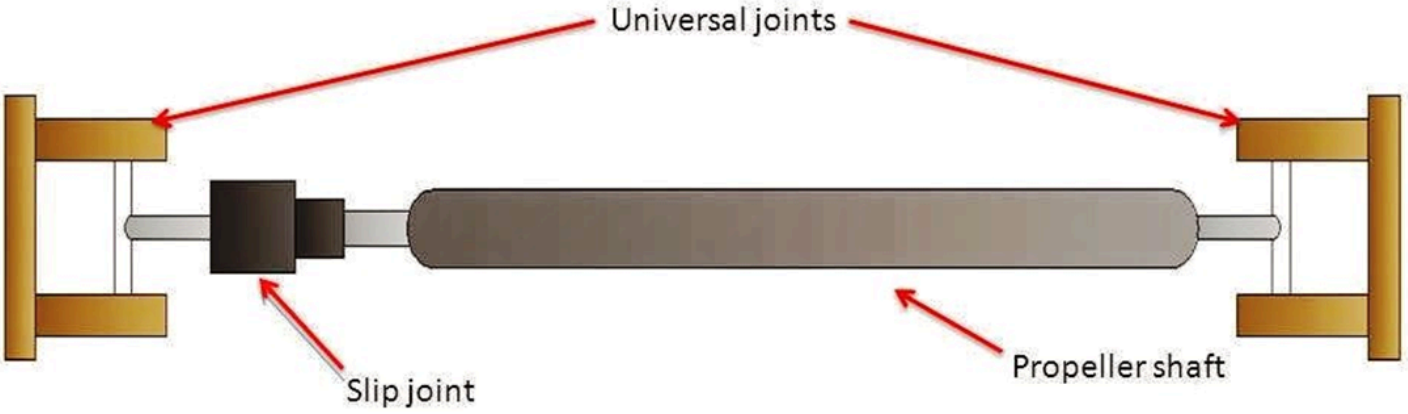
At both the ends of the pin two steel balls with roller bearings are fixed. The centering button and a button spring keep the pin in the center.


CENTERING BUTTON
BUTTON SPRING
BALL AND ROLLERS
GREASE COVER
GASKET
THRUST WASHER
PIN
CLAMP
CLAMP
BOOT
NUT
THRUST WASHER
BODY
PROPELLER SHAFT
BALL AND ROLLERS
LOCKWASHER
SHAFT BOLT
BUTTON SPRING
CENTERING BUTTON

The propeller shaft and universal joint assembly is fixed to the companion flange. Whenever the angle between the gearbox and the rear axle changes, the ball accommodates this variation by moving in the U' channel.

Slip joint

When the vehicle is moving, the rear suspension spring Compresses and expands because of the ups and downs on the road. As a result, the length and the angles between the gearbox and rear axle varies. To accommodate this change in length, slip joints are used.



The joint yoke has internal splines matched with external splines of the propeller shaft. Whenever there is any change in length the joint yoke moves on the shaft and adjusts the length.

Parts of rear axle assembly

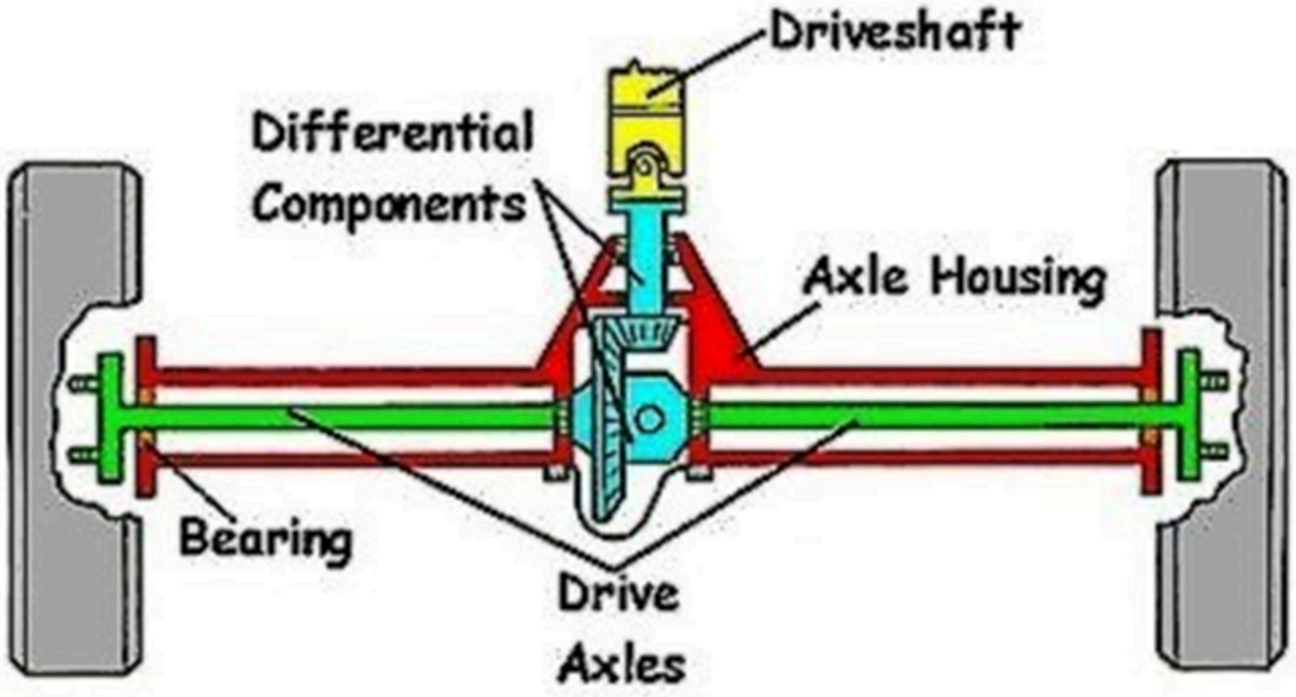
The rear axle assembly consists of the following units.

Axle housing

Axle shaft

Hub,brake and wheel.

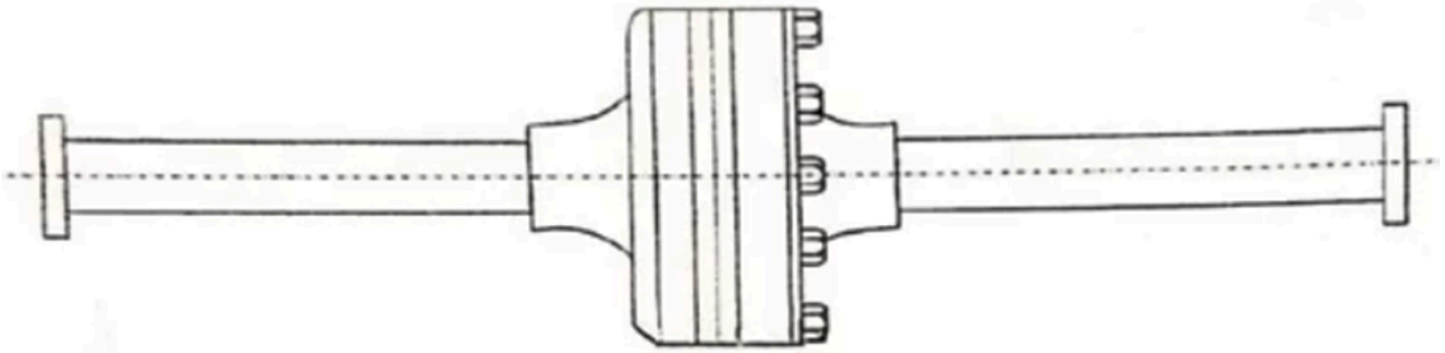
Differential and CWP



Types of axle housings

Split type-

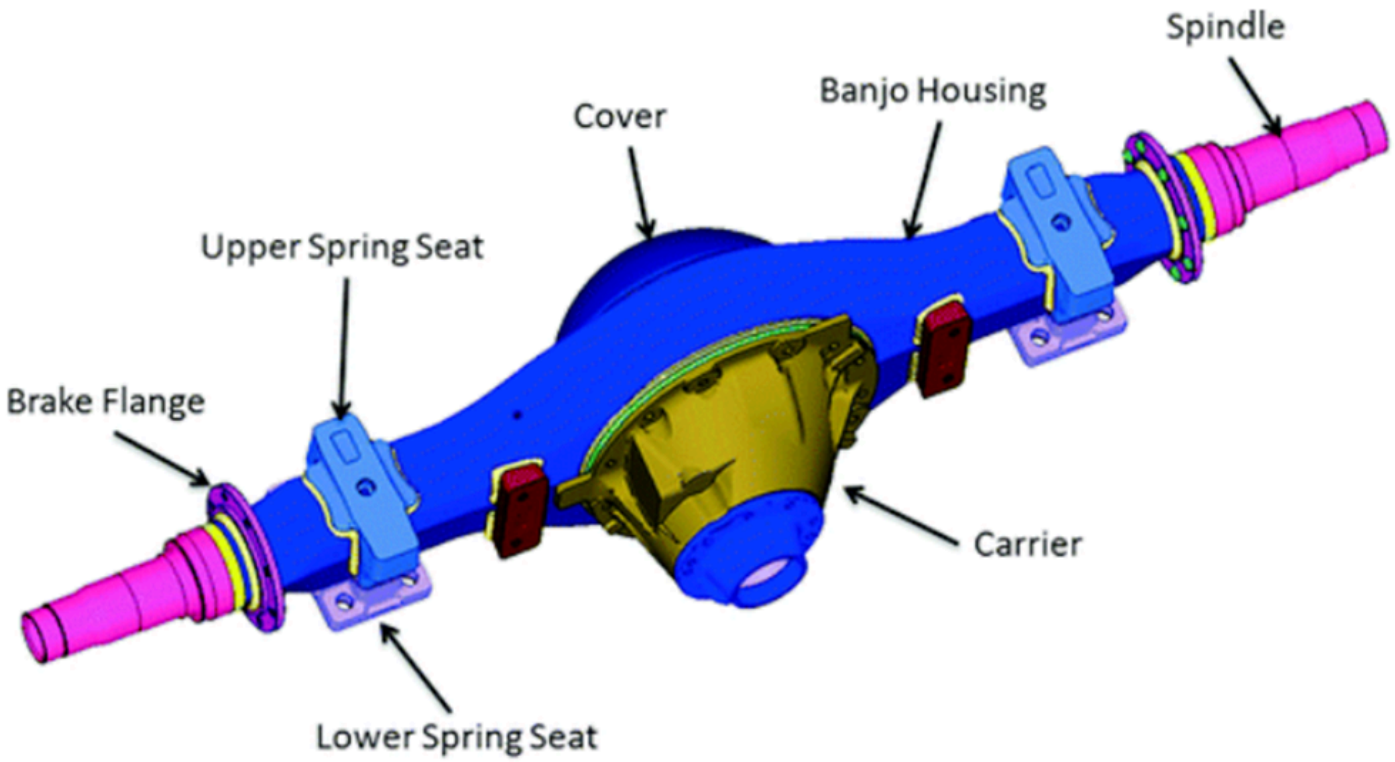
In the split type housing two halves are bolted to the differential housing.



Benjo type-

Benjo type housing is welded and made into a single piece. The differential carrier is bolted to the housing.

Power is transmitted from the final drive to the wheel hub through the two axle shafts. The axle shafts inner end has external splines which sit in the sun gear's splines.

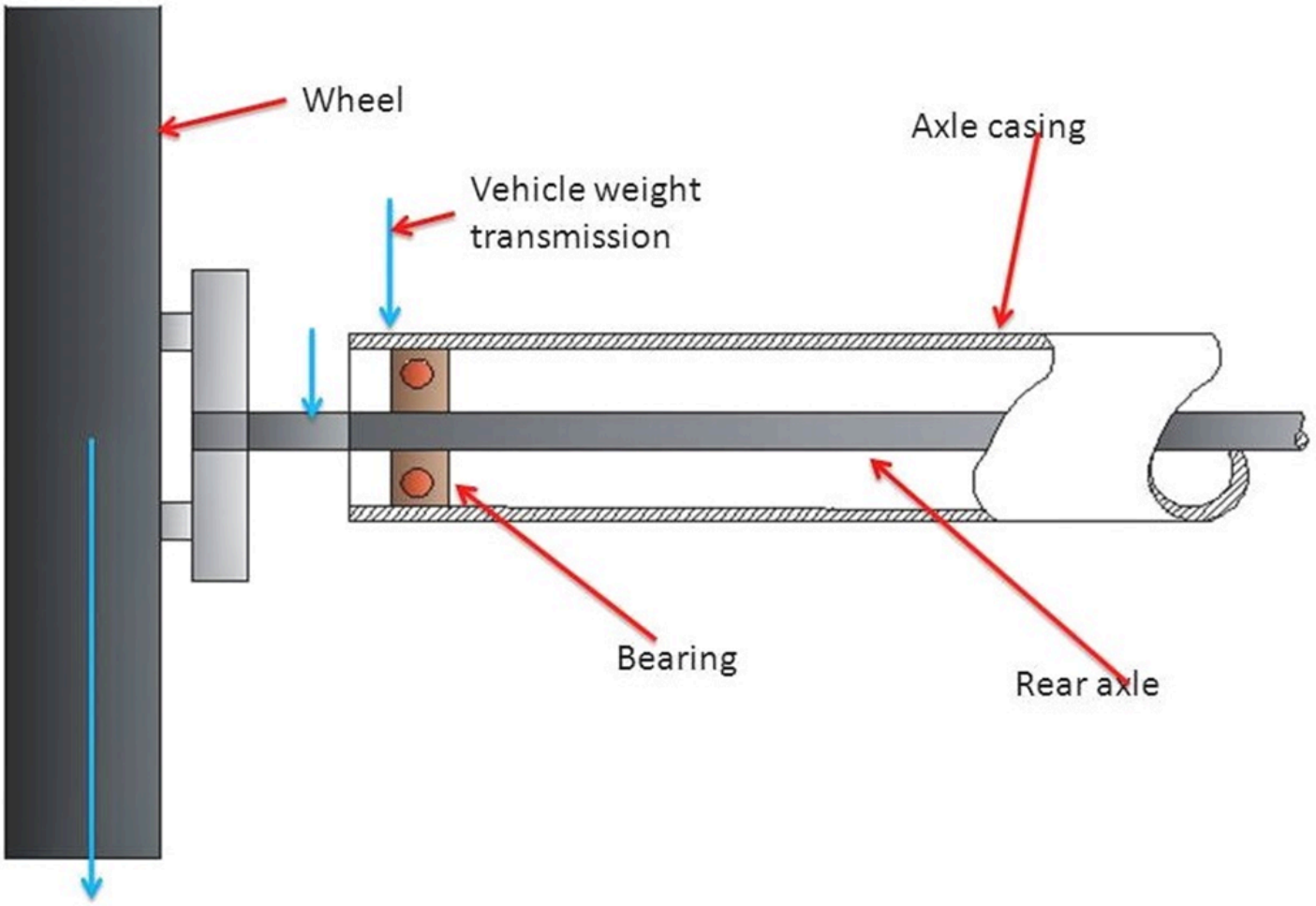


Types of rear axles

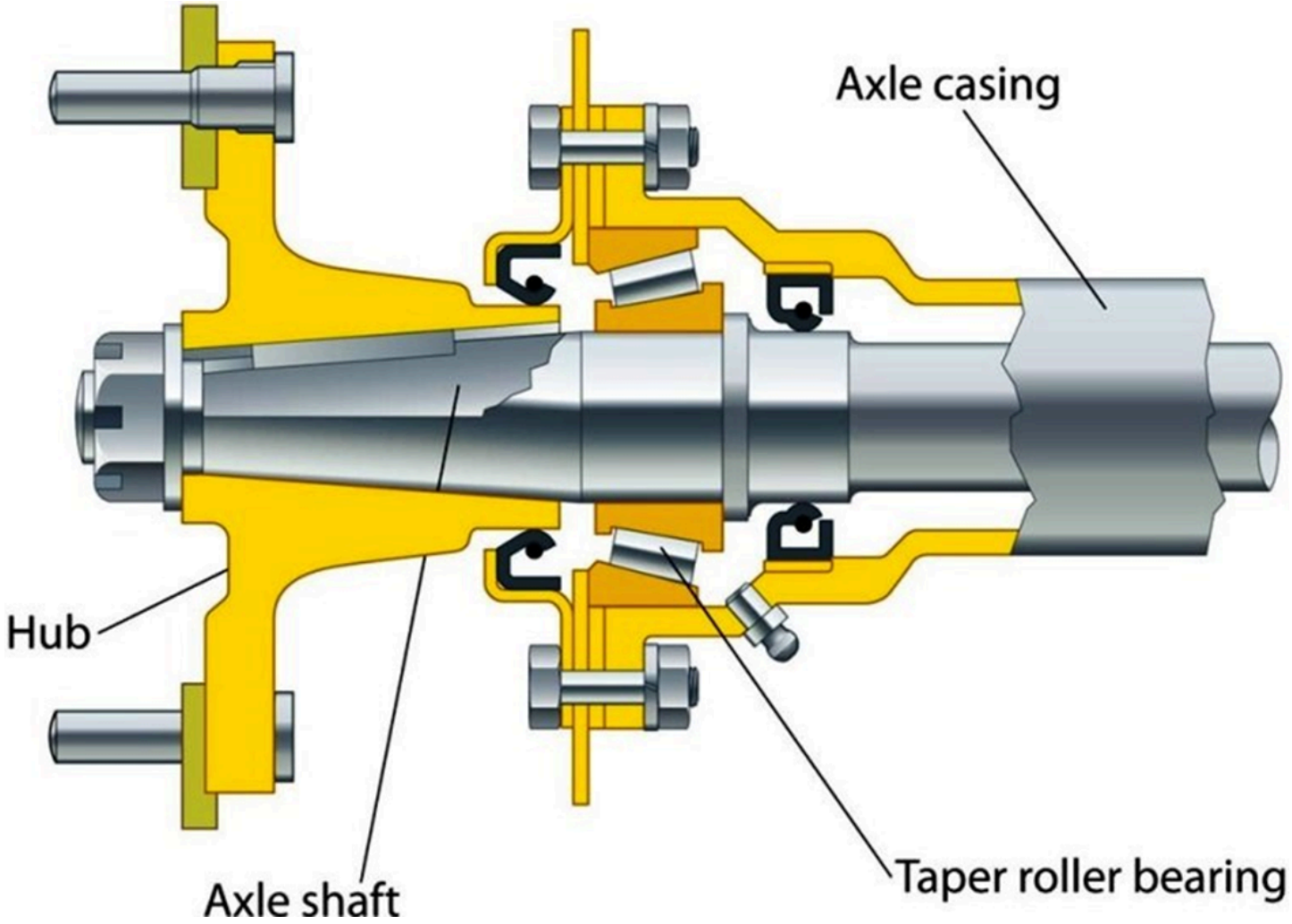
Three types of rear axles are used depending upon the mounting of the hub.

Semi-floating axle

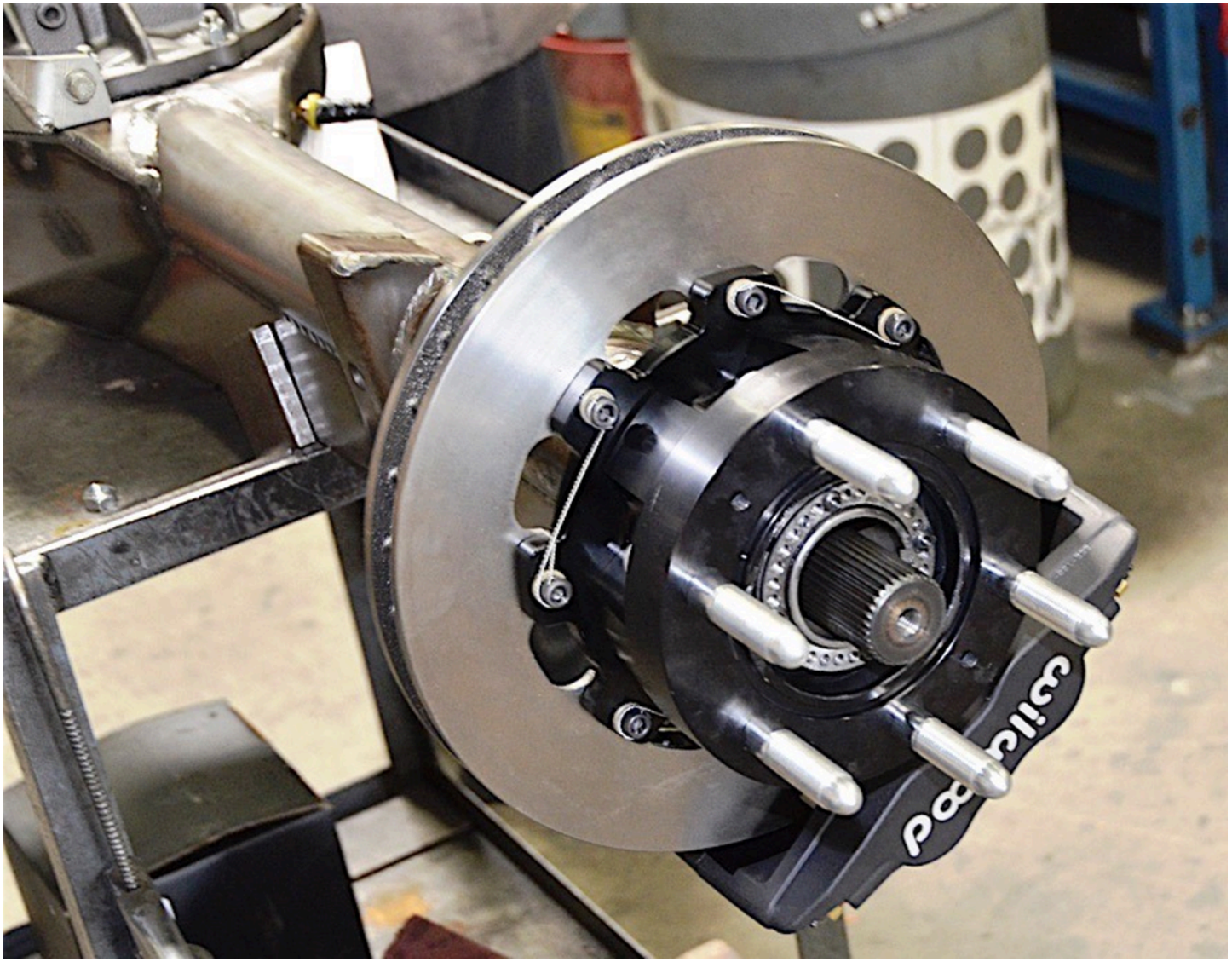
In this type of axle,the hub is directly fitted on the axle shaft inside axle casing. It has to support all the loads. Therefore, it needs to be of a larger size, for the same torque output, than any other type. The inner end of the axle is supported by the differential side gear. It is thus relieved weight of vehicle by the axle housing. The outer end has to support the weight of the vehicle and take end thrust.Hence, this construction is called Semi floating rear axle.The semi-floating axle is the simplest and cheapest of all other types and widely used on cars.



The inner end of the axle is splined to the differential side gear.The outer end is flanged and the wheel is bolted directly to it. In some design, the hub of the wheel is keyed to the outer end of the axle. The vehicle load is transmitted to the axle through the casing and the bearing, which causes the bending or shearing of the axle.



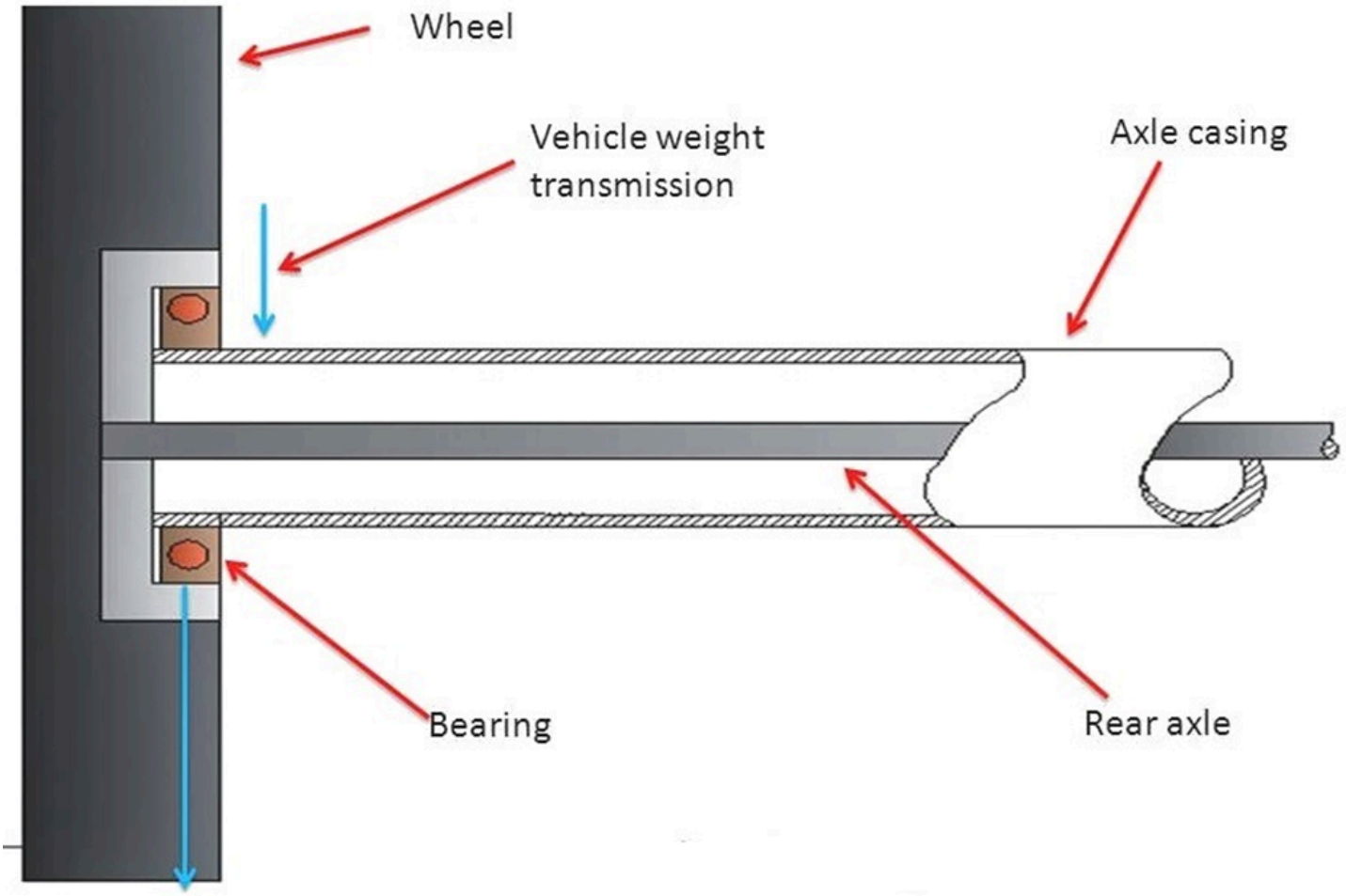
The bearing is held on the axle by a retainer. Most axle bearings are pre-lubricated. With this arrangement, the brake drum, the wheel, and the bearings retainer plate must be removed in order to withdraw the axle shaft. This arrangement results in the axle shaft helping to support the weight of the vehicle in addition to transmitting rotation to the wheels.



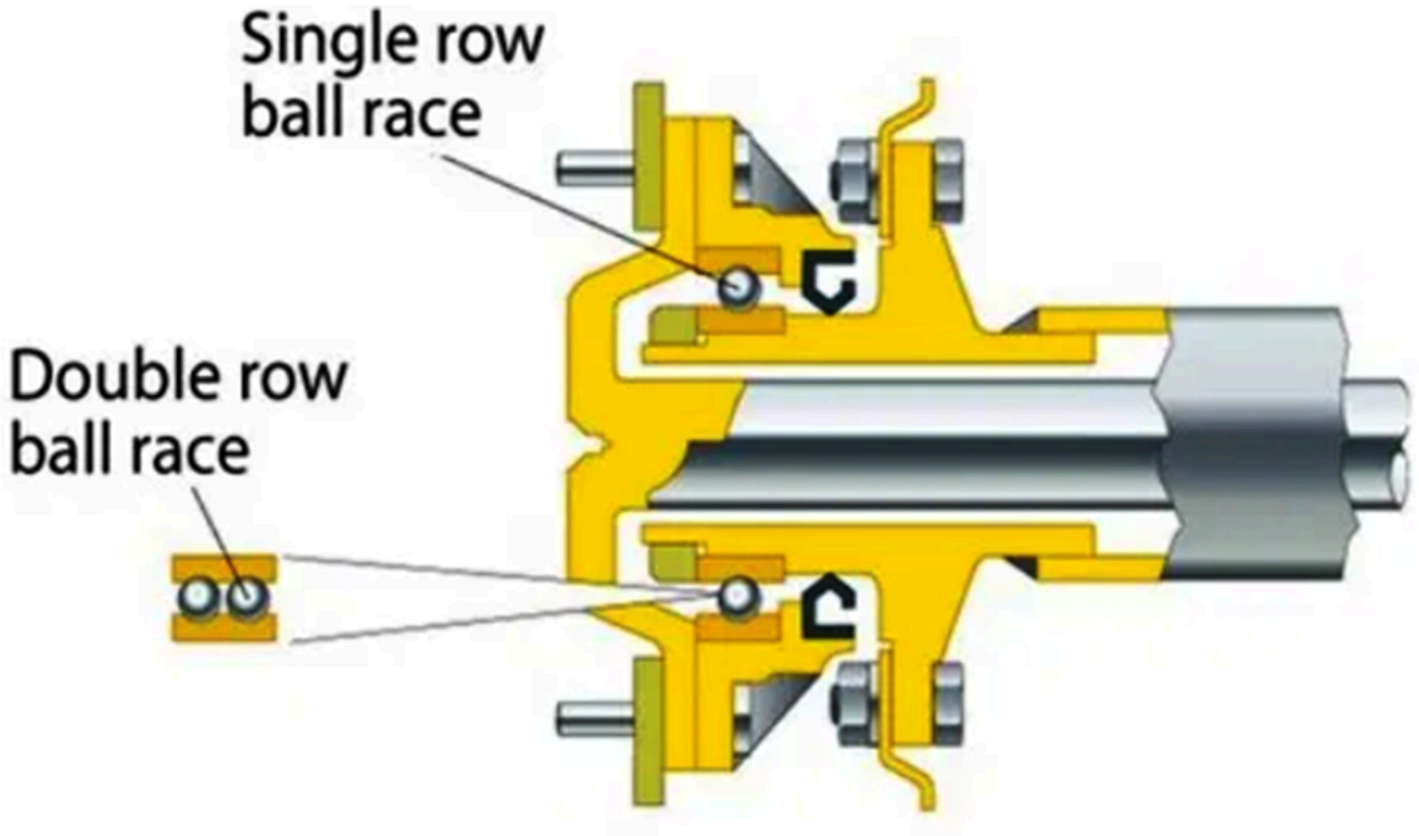
The axle shaft rests on the bearing in the axle housing. In this, the axle shaft takes the vehicle load as well as the driving thrust.

Three quarter floating axle

Wheel hub is supported by the single bearing located in the centre of the wheel hub. The wheel hub runs on the axle housing. The axle shaft is keyed rigidly to the wheel hub. This arrangement provides the driving connection and maintains the alignment of the wheel.



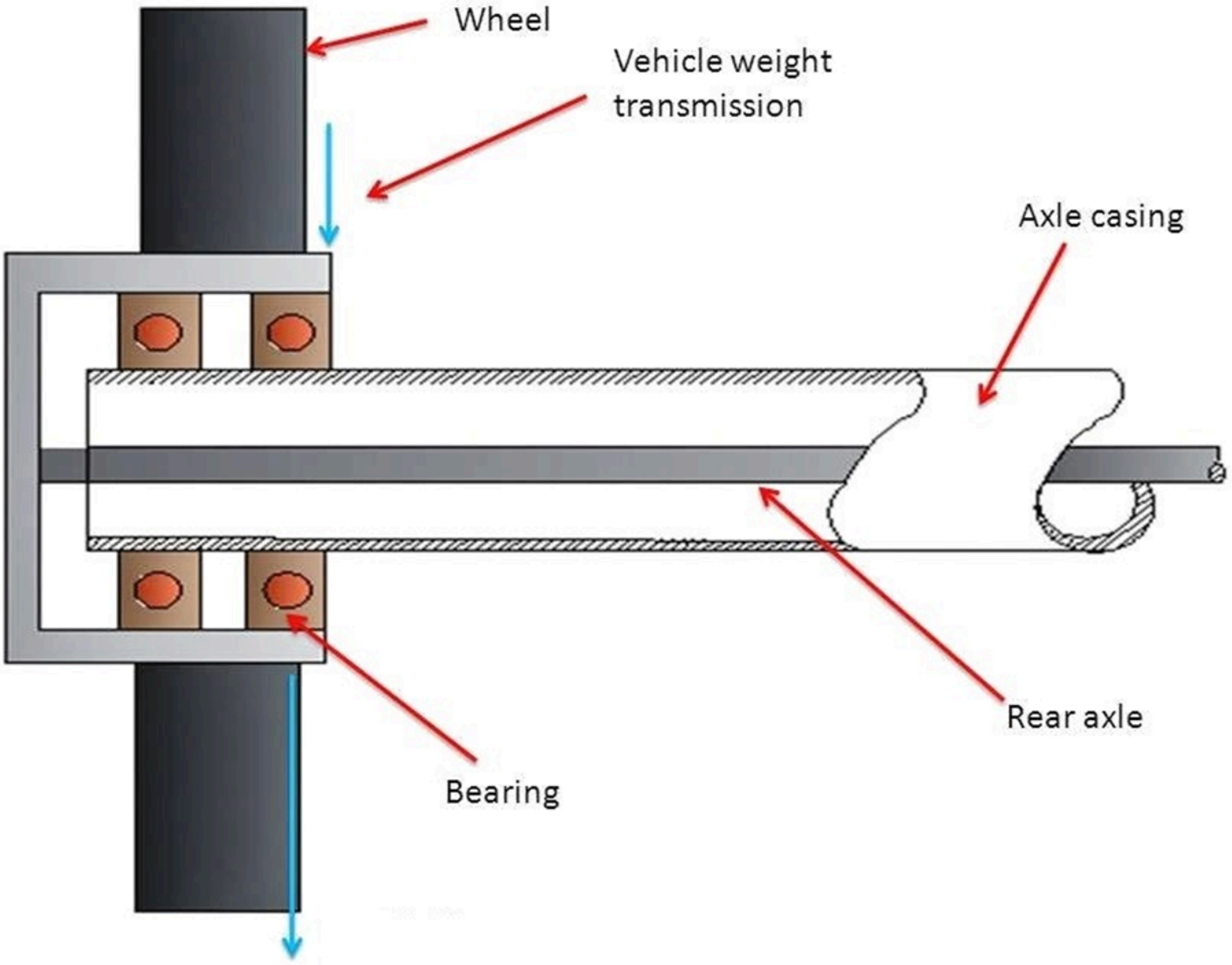
The other end of the hub is connected to the axle shaft. As such the axle shaft takes only a partial load of the vehicle.



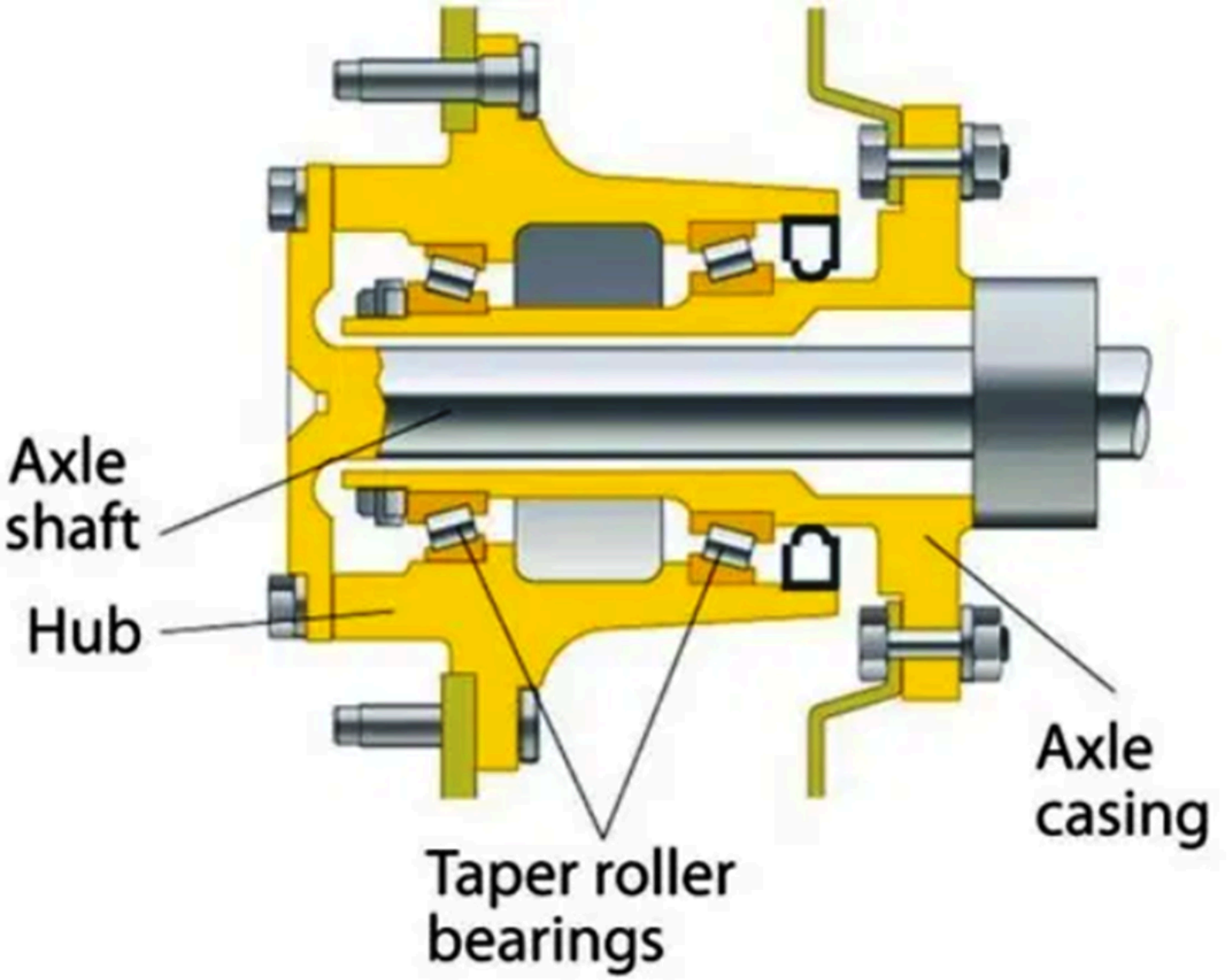
This axle is not supported by bearings at either end. The three quarter floating axle has only one bearing at the outer end.

Fully floating axle

In this type of axle, the hub is mounted on the axle housing on two taper roller bearings. The axle shaft takes only the driving thrust. The vehicle's load is taken by the axle housing.



Both semi floating and 3/4 floating axles cost less .Load carrying capacity is less. Axle shaft bends on excess load. Bearing life is poor.



Fully floating axles used heavy taper roller bearings and carried high loads. Axle shaft gives good life. Cost of a full float axle is high.

Final Drive (Differential)- function

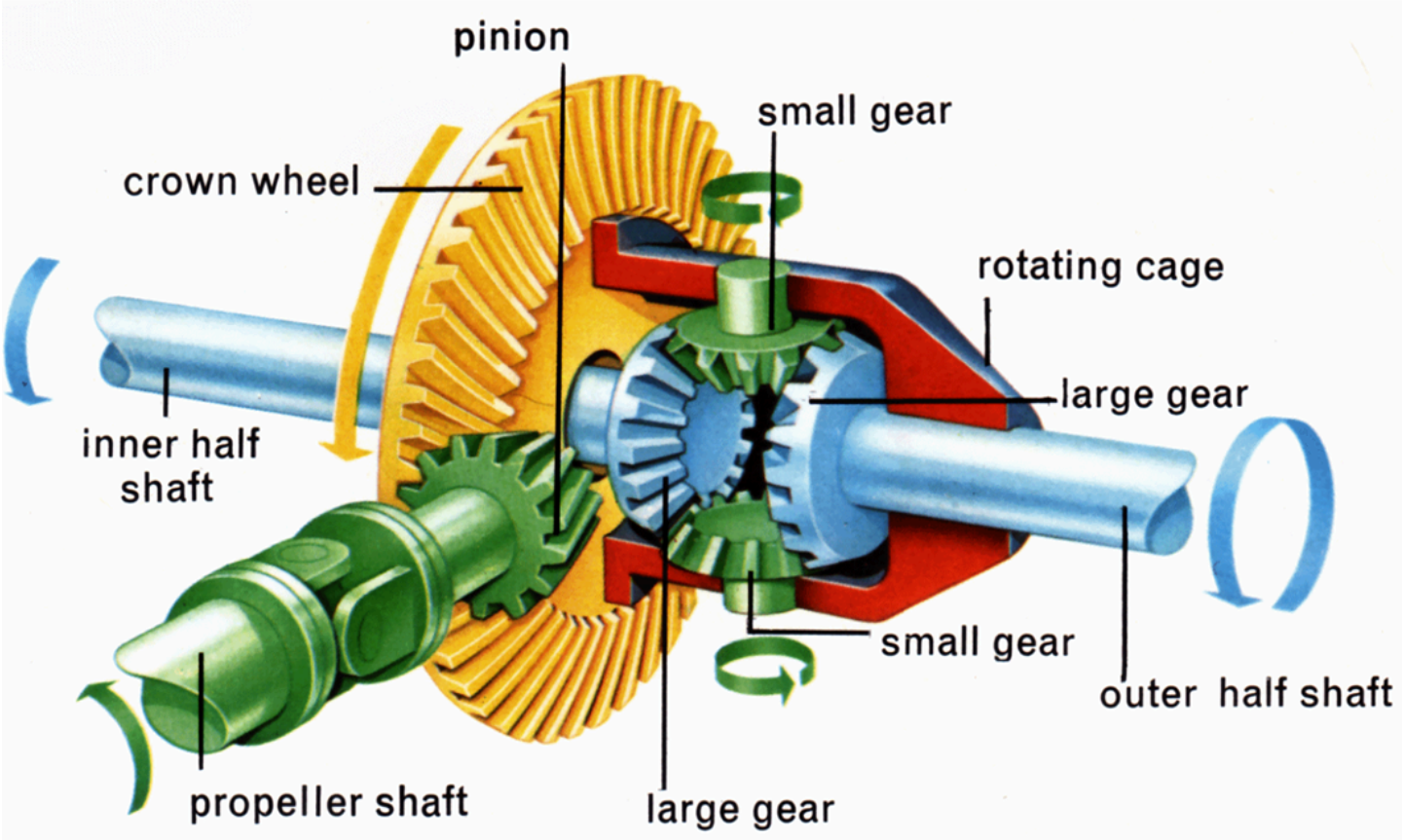
The final drive serves two purposes

It transmits power at a right angle.

It increases the torque by reducing the speed.

Internal parts of differential

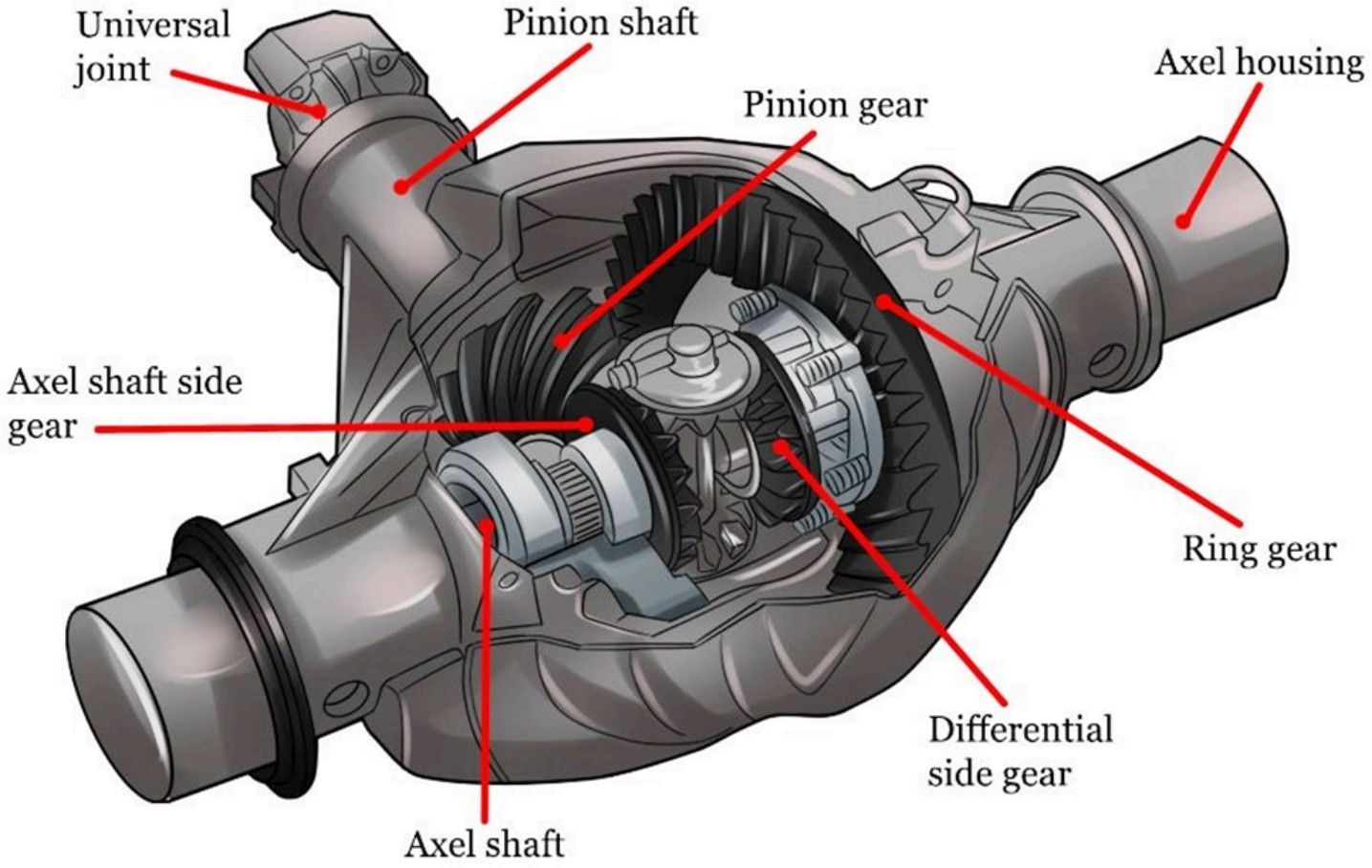
The final dive consists of a pinion,crown wheel and a differential cage . Inside the cage the spider-cross with planetary gears are assembled. Also two sun gears are assembled on both sides of the planetary gears .The sun gears have internal splines in which the axle shaft's spline end sits.The crown wheel is fixed on the cage .The axle shaft's splined end is fixed to the sun gears and the other end is bolted to the wheel hub.



When the vehicle is moving straight, the power is transmitted from the pinion to the crown wheel and to the cage .When the cage is rotating the spider also rotates along with the star gears . The sun gears are pushed by the star gears, and power is transmitted to the axle shafts. During a straight line run the star gears do not rotate on their axis.

Need for the differential

When the vehicle makes a turn, the inner wheel has more grip on the road than the outer wheel. So the respective inner sun gear offers more resistance. At that time, the star gears rotate on their own axis and move the inner sun gear slowly and allow the sun gear to rotate faster. So the outer wheel travels more distance at the same time.



To examine differential action, raise the rear axle assembly till both wheels clearly ground and support them on two jacks. Rotate the RHS wheel by 1 turn in forward direction. You will observe LHS wheel runs in the opposite direction by 1 turn. While taking a LHS turn the outer wheel has to travel longer distances and turn several turns etc. compared to the left wheel. This is how the differential turns is achieved between the inner and outer wheels.

Necessity of a four wheel drive

In the four wheel drive mechanism, there is provision to supply power to all the four wheels, whenever it is needed. When the vehicle is moving on sand, slushy ground, traction between wheels and road is lost and the drive wheel tends to slip on the ground. In this condition, the vehicle cannot be pushed. Therefore, power is transmitted to other wheels also through the transfer case.

Purpose of transfer case

The transfer case is mounted in the back of the main transmission. It is sometimes called an auxiliary gearbox. The transfer case can transmit engine power either only to the rear wheels of the vehicle or to all the four wheels according to the driving requirements. The transfer case can also provide low or high speed transmission.A low speed transmission drive is mostly used when moving with the heavy load requiring high traction torque.

Operation of transfer case (Four wheel drive)

The transfer case consists of a main shaft on which the low range gear and the high range gear are fixed. These gears rotate freely on bushes. The sliding gear slides on the main shaft. An idler gear shaft is fixed between the main shaft and the rear differential drive shaft and the front differential driveshaft . A clutch locking drive gear is fixed on the front differential drive shaft .

During neutral position, the sliding gear and clutch drive gear are not engaged with their respective gears and power is not supplied to the front and rear wheels. When power is to be supplied to the rear wheels only, the front drive clutch gear is kept in neutral position and the sliding gear on the main shaft is engaged to low or high range gears, depending upon the requirements. In this condition, power flows only to the rear axle. When a vehicle is driven over slushy ground the drive' wheels tend to spin without moving the vehicle.

In this position, the clutch drive gear to the front wheels is engaged. Now power will be supplied to all the four wheels. When the lever is shifted to engage a high range four wheel drive position, the drive from the primary gearbox shaft goes to the main shaft. The main shaft's sliding gear engages with the high range gear and power is transmitted to the front wheel's drive output shaft and the rear wheel's output shaft through the idler gears.

When the lever is shifted to engage the low range four wheel drive position, the drive from the primary gear shaft goes to the main shaft. The main shaft's sliding gear engages with the low range gear and transmits the drive to the output shafts of the front and rear drive shafts through the idler gears.

Shifting mechanism in four wheel drive

The transfer case is provided with a shift mechanism to operate the four-wheel drive mechanism. A gear shifting lever is provided in the driver's cabin and it is connected to a clutch locking drive gear of the first gear through a shifting rod and fork. Similarly another lever is provided to engage the sliding gear with low range or high range gears, and is connected with the sliding gear through the shifting fork and rod.
