STEERING SYSTEM Introduction

The steering makes it possible to change direction. The steering must be reliable and safe; there must not be too much play in the steering. It must be possible to steer accurately. It steering must not require too much effort. Therefore, power steering is frequently used.
There are direct and indirect steering systems. Direct steering systems have less delay than indirect systems. They therefore respond quicker when the steering wheel is turned. However, it takes more effort to turn the steering wheel. Indirect steering systems have a larger number of pivot points. This means that there is more chance of play.
The steering wheel is almost never directly in line with the steering box/ steering rack. Therefore, universal joints are fitted in the steering column (the shaft that connects the steering wheel to the steering box/ steering rack). A rubber vibration damper (frequently a rubber disc) absorbs impacts and vibrations and accommodates minor changes in alignment.
To prevent the steering wheel causing injury during an accident, various safety constructions are used. These include: safety steering columns, compressible steering columns, telescopic steering columns, hinged steering columns and retracting steering columns.
Adjuster systems are used to adjust the position of the steering wheel to the optimal position desired by the driver. These make it possible to adjust the height and reach of the steering wheel. Steering boxes/ racks, steering joints etc. are lubricated. Steering joints and steering racks use grease, indirect steering boxes use oil. The oil must be resistant to high pressures. Therefore, special additives are added to the oil (EP additives).
Suspension and king pin angles ensure the desired steering characteristics. Suspension angles are: camber, toe-in/toe-out, camber change in bends, King Pin Inclination (KPI) and the caster angle.
Suspension and steering angles can change for various reasons: parts of the suspension can bend, joints can wear and rubbers can weaken. It is therefore recommended to regularly check the suspension and steering angles (align).
Alignment is understood to mean: the checking and adjusting of the suspension and steering to ensure that all of the wheels under all driving conditions will be in the positions that the manufacturer designed to ensure perfect vehicle behaviour. Before starting with alignment, various checks must be made. Optical or microprocessor controlled alignment equipment is used to align the suspension and steering.

The steering system of the motor vehicle must meet the following conditions.

(a) Enable the drives to control accurately the path taken by the vehicle at all times.

(b) Be light and easy to control

(c) Be self centering.

(d) Be as direct as possible in action

(e) Not be affected by the action of the suspension and the braking system.

-The steering system consists of the following parts

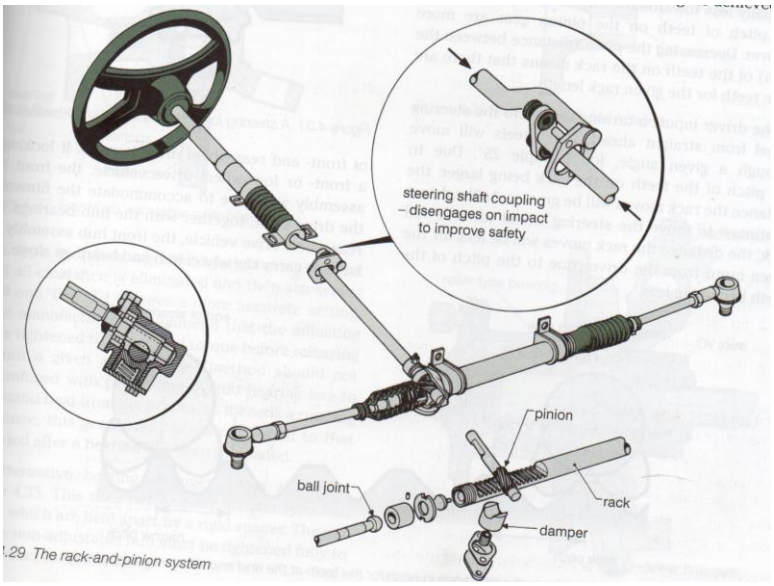
(i) Steering wheel

(ii) Steering column

(iii) Steering gear box

(iv) System of roots and levers

(i) Ball joints



.29 The rack-and-pinion system

BEAM AXLE STEERING LINKAGES

-Where a beam Axle is used the drop arm is connected to the track arm of one stub axle by a drag link. The track arm of the opposite stub axle is connected to the first track arm by a truck rod. The track rod is arranged transversely and its length is adjustable during wheel alignment process. The drag link may be arranged transversely or longitudinally. Track rod has the **FUNCTION** of keeping the front wheels parallel with each other when the vehicles are running straight ahead.

INDEPENDENT SUSPENSION STEERING LINKAGE

-Where independent front suspension is used the steering system has to be modified to suit the particular suspension.

(i) **THREE-PIERCE TRACK ROD LINKAGE**

This steering linkage system uses a three piece track rod and a transfer idle arm. The drop arm is horizontal and its end is connected to the centre track rod.

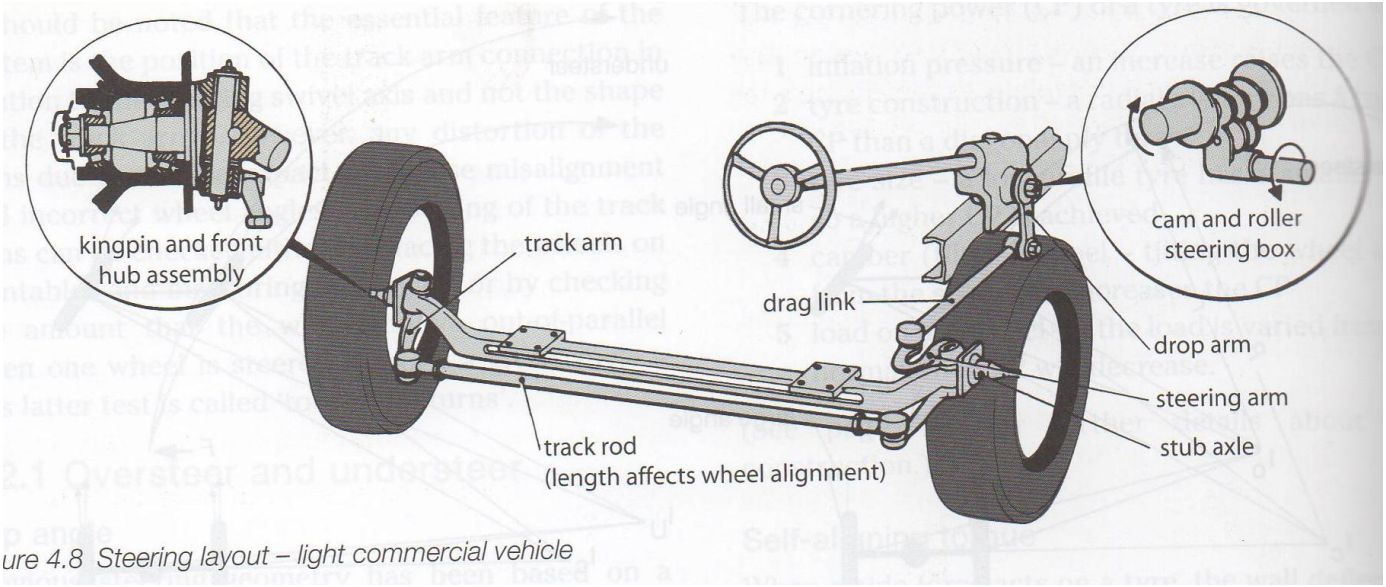
-The outer opposite end of the track rod is connected to the one end of idle arm. Then the outer track rods are connected to there respective track arms as shown in the diagram.

(ii) **SPLIT TRACK ROD**

In this steering linkages the track of a rack-and pinion steering gearbox is used the gearbox is used acts as the centre of track rod and short adjusted track rods connects the end of the track arms at each side in modern I.F.S design that stub axle is bolted to the suspension unit.

STEERING GEOMETRY

-In order to have an effective control of the steering of the vehicle the wheel must rotate with a true rolling motion. This must be in all conditions in order to reduce tyre and bearing.



ure 4.8 Steering layout – light commercial vehicle

ACKERMAN LAYOUT

- When connecting true rolling motion can be obtained only if produced axis through the track arms meet at a single points. This point must be on the produced centre line of the rear axle.
- The front wheels on the inside of the corner have therefore to be turned through a greater angle than the outer wheel.
- This is accomplished by the Ackerman layout. In this layout the track arms are arranged such that when the vehicle is in the straight ahead positioned their centre line if produced would interest on the vehicle centre line at the differential unit. It follows that track rod is shorter than the distance between the kingpins.

STEERING GEARBOX

The steering gearbox provides the driver with a lever to enable him/her to ever a large force at the road wheel by applying a small force at the steering wheel the steering gearbox also changes they rotary motion of steering wheel to the reciprocating motion of the drag link or track rod.

1. **WORM AND ROLLER.**

The roller follower is fitted to the rocker shaft and it engages with the hour glass type worm. It follows the spiral gear of the worn when rotated. This type has a high efficiency and is used in commercial vehicle.

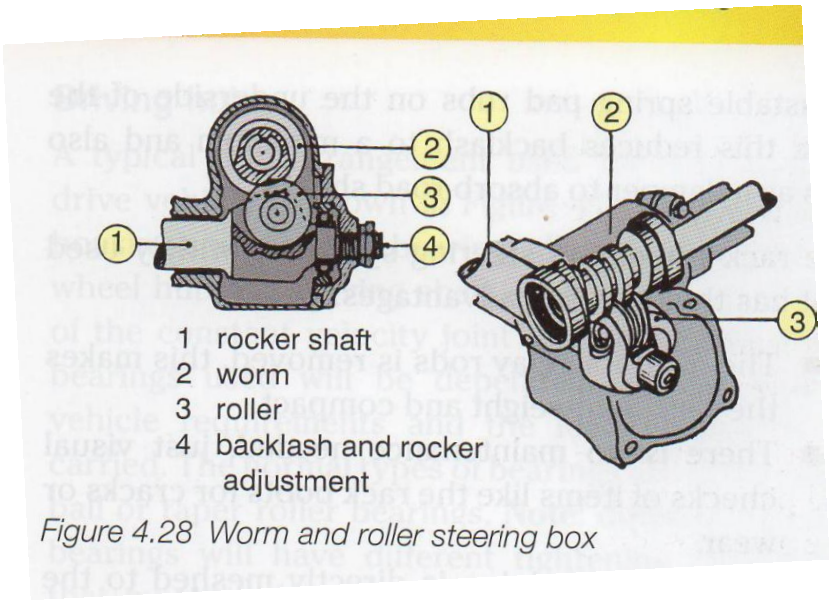
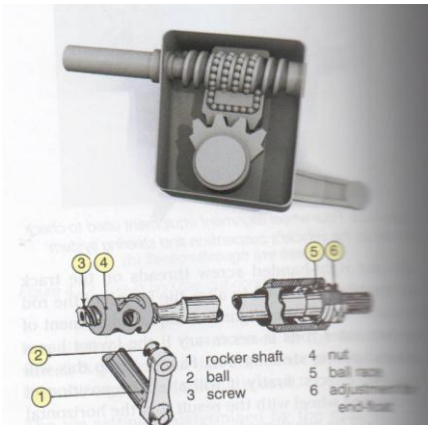


Figure 4.28 Worm and roller steering box

2. **WORM AND NUT**

- A phosphor bronze or steel nuts act on a mould stud which is formed on the steering column rotation of nut is prevented by a ball mounted on the rocker arm. When the steering column is rotated the nuts moves along a thread driving a rocker arm rocker shaft and drop arm.



3. WORM AND SECTOR

This consists of a case hardened steel worm and sector both are supported in bearing in a High alloy casing. The worm is at the ended of the steering column and the centre is in rocker shaft.

-Also mounted in the rocker shaft are the drop arms which drive steering linkages. The end float in the steering column is eliminated by lines. The entire must be positions directly below the worm to keep the backlash to a minimum.

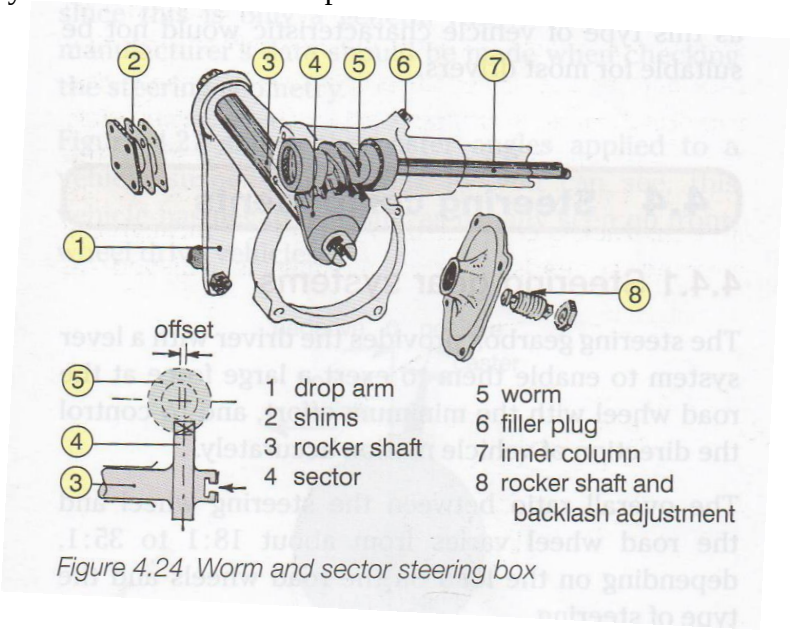


Figure 4.24 Worm and sector steering box

4. CAM AND PEG

-A tapered peg on the rocker arm engages with a special cam on the steering column rotation of the cam drives the peg forward and backward. This gives a motion to the drop arm. The peg should be mounted on a needle roller bearing to reduce friction and thereby increases efficiency.

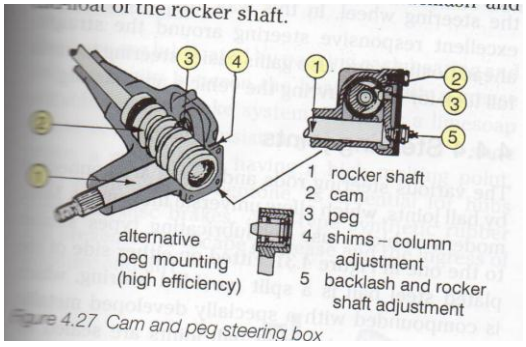


Figure 4.27 Cam and peg steering box

5. RECIRCULATING BALLS

A high efficiency is achieved by using a nut and steel balls which moves a long threads a transfer tube allows the balls to recirculate on slotted nuts which is fixed into the rocker arm.

As the nut moves on the worm the motion is transferred to the rockshaft and drop arm.

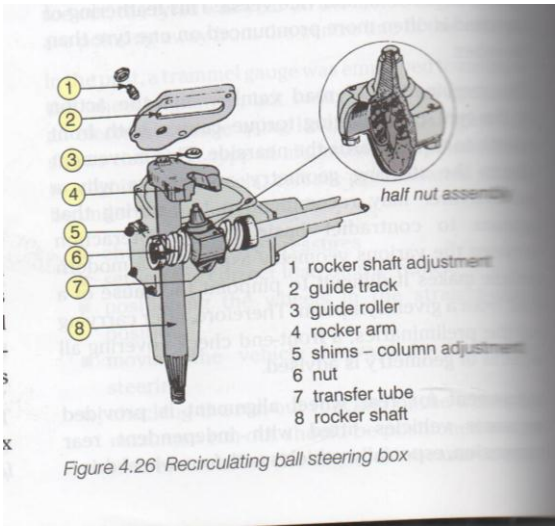


Figure 4.26 Recirculating ball steering box

6. RACK AND PINION

This type is often used with I.F.S where the racks acts as the centre of the three pieces track rod. The pinion is connected to the steering column a U-joint which allows the steering box to be mounted each end of the rack has a ball and a socket connected to the track rod.

- Spring loaded pads acts on the other side of the track rod reduce the backlash.

(a) CASTOR ANGLE

-Steering system will tend to maintain a straight course. This strengthening out is known as self centering and it occurs automatically after the vehicle has negotiated a corner when steering a vehicle the self-centering action has to be overcome by the driver to enable him feel his steering.

-Self centering effect is usually obtained by tilting the king pins backwards at the top. The angle formed by the kingpin centre line and the vertical is called **CASTOR ANGLE**. The distance between the two lines at the ground is called castor trail.

-Castor angle varies with vehicle but is usually between and 50.Too large a castor angle causes a hard steering and to small.

-Small castor angle courses the vehicle to wonder where I.F.S units are used the whole assembly may be tilted in the original design.

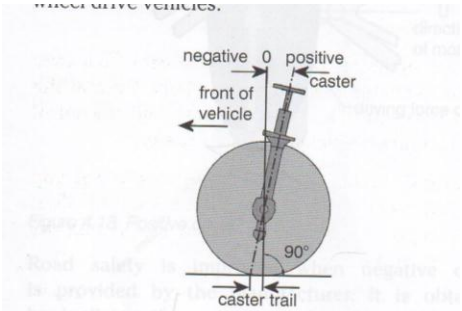


Figure 4.21 Wheel caster applied to front-suspension system

(b) CAMBER ANGLE

Camber angle for a wheel is obtained by tilting the wheel outward at the top.

The angle formed between the centerline of the wheel and the vertical plain camber is usually less than five.

-The tilting of the wheel is obtained by inclining the stub axle this makes the wheel easier

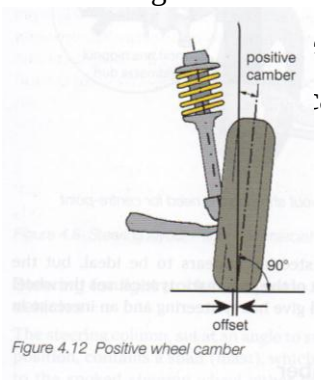


Figure 4.12 Positive wheel camber

provides lighter steering. This tilting

camber and small suspension defects.

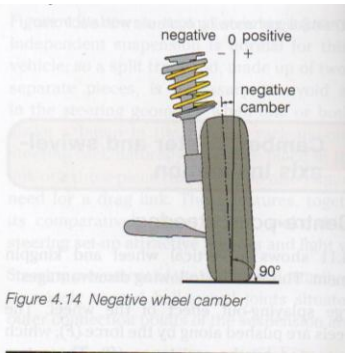


Figure 4.14 Negative wheel camber

(c) **KINGPIN INCLINATION ANGLE:**

This is obtained by tilting the kingpin inwards at top to assist in achieving centre point steering without excessive camber angle.

The angle between the centre line of the kingpin and the vertical plane is known as the kingpin.

Inclination angle (kpl). This angle is usually between 5-10 The effect of the combined use of camber and kingpin inclination are :

(i) To provide easier steered

(ii) Reduce the effective of braking when the vehicle is being steered.

(iii) Provides a self centering

(iv) Reduce stress and balance the load on the wheel bearing.

The sizes of the camber and kingpin inclination angle are reduced by using dished wheels. This makes the tyre centre line to be moved closer to kingpin the tyre centre line to be moved closer to kingpin centre line.

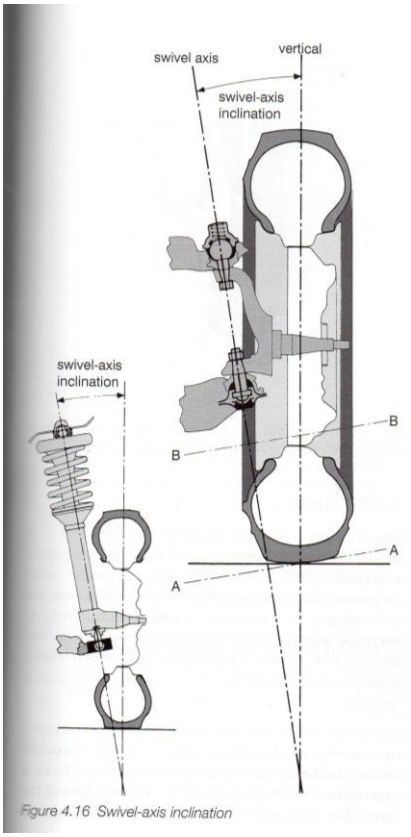


Figure 4.16 Swivel-axis inclination

WHEEL ALIGNMENT

-The roads wheels of a motor vehicle can be said to be aligned when all the wheel are in line and parallel when vehicle is moving in a straight path. This enables the vehicle to have a free rolling motion of the wheels on the road.

Before checking the wheel for correct alignment the following parts should be checked and corrected if necessary:

(i) All tyre for correct pressure

(ii) Tyre for their thread condition.

(iii) Wheel hub bearing for correct adjustment and free play.

(iv) Kingpin & bushes for excessive wear.

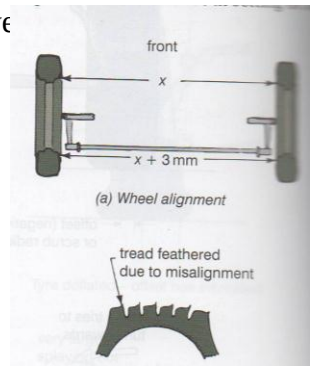
(v) Ball joint for excessive wear.

(vi) Swiral point of suspension unit for excessive free movements.

(vii) Shackle pins and bushes for excessive wear side movements.

(viii) Spring u-bolts for lightness.

- A simple method of checking the wheel for correct alignment is done by parking the vehicle on a smooth level ground the front wheel are set in a straight a head position. A straight edge is placed against the wheel are containing the edge properly result should be similar in both side of the ve



TOE-IN

- The toe –in of the wheel is the difference in the distance between the wheel rims as tyre tread centre.
- This is measured at the stub axle height behind an in front of the axle. Toe-in is usually between 0.8mm and 4.8mm and it is necessary because of the use of the camber. Toe-in must be increased as the camber angle increases.
- In the vehicle with the front wheel drive the wheel tend to van in toe-out is used instead of toe-in the adjustment of toe-in as toe-out is carried out by altering the length of the track rod(rods) to same extent if is a trial and error process.