Steering Gear Mechanism

The steering gear mechanism is used for changing the direction of two or more of the wheel axles with reference to the chassis, so as to move the automobile in any desired path.

Usually the two back wheels have a common axis, which is fixed in direction with reference to the chassis and the steering is done by means of the front wheels.

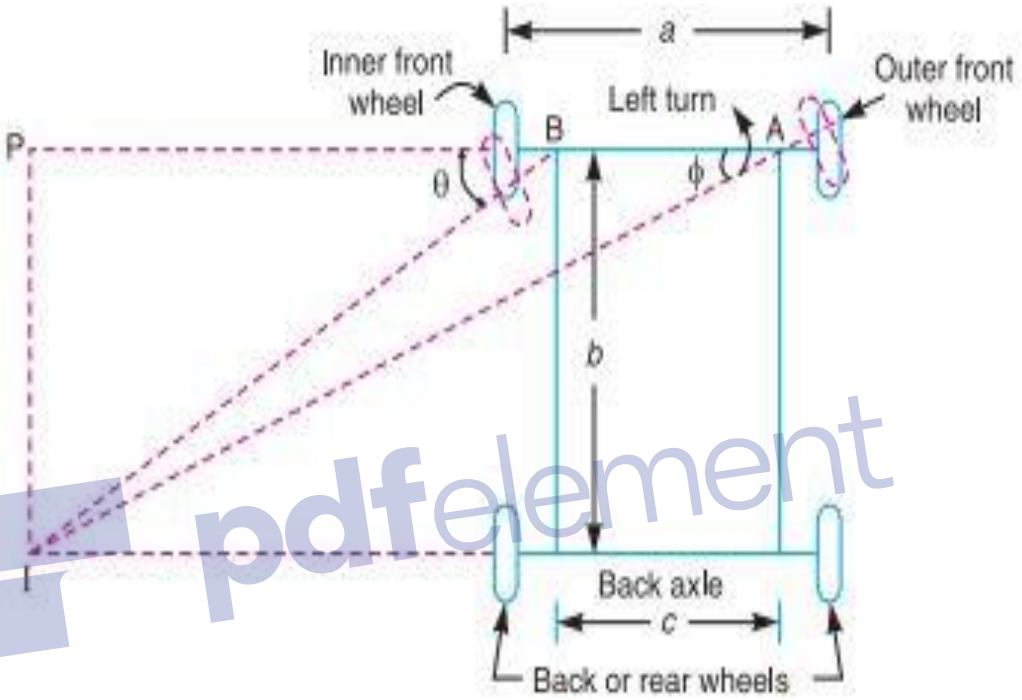
In automobiles, the front wheels are placed over the front axles, which are pivoted at the points Aand B, as shown in Fig.

These points are fixed to the chassis.

The back wheels are placed over the back axle, at the two ends of the differential tube.

When the vehicle takes a turn, the front wheels along with the respective axles turn about the respective pivoted points. The back wheels remain straight and do not turn.

Therefore, the steering is done by means of front wheelsonly.



Let a = Wheel track,

b = Wheel base, and

c = Distance between the pivots A and B of the front axl

Now from triangle IBP,

$$\cot \theta = \frac{BP}{IP}$$

and from triangle IAP,

$$\cot \phi = \frac{AP}{IP} = \frac{AB + BP}{IP} = \frac{AB}{IP} + \frac{BP}{IP} = \frac{c}{b} + \cot \theta$$

$$\therefore \cot \phi - \cot \theta = c / b$$

Davis Steering Gear

The Davis steering gear is shown in Fig. It is an exact steering gear mechanism. The slotted links AMand BHare attached to the front wheel axle, which turn on pivots Aand Brespectively. The rod CDis constrained to move in the direction of its length, by the sliding members at P and Q. These constraints are connected to the slotted link AMand BHby a sliding and a turning pair at each end. The steering is affected by moving CDto the right or left of its normal position. C′D′ shows the position of CDfor turning to the left.

Leta= Vertical distance between ABand CD,

b= Wheel base,

d= Horizontal distance between ACand BD,

c= Distance between the pivots Aand Bof the front axle.

x= Distance moved by ACto AC′= CC′= DD′, and

α= Angle of inclination of the links ACand BD, to the vertical.

From triangle $A\,A'C$,

$$\tan\alpha = \frac{A'C}{AA'} = \frac{d}{a} \qquad \ldots(ii)$$

From triangle $BB'D'$,

$$\tan(\alpha - \theta) = \frac{B'D'}{BB'} = \frac{d-x}{a} \qquad \ldots(iii)$$

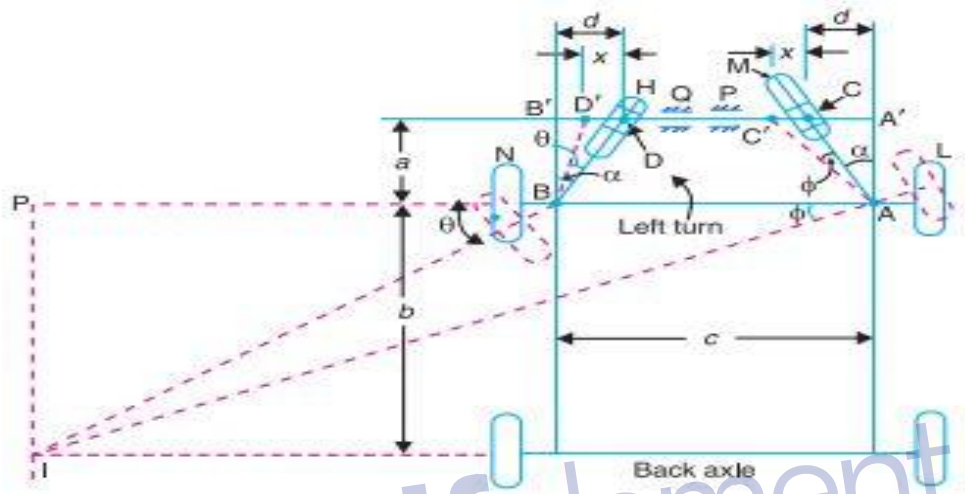


Fig. 9.16. Davis steering gear.

We know that $$\tan(\alpha + \phi) = \frac{\tan\alpha + \tan\phi}{1 - \tan\alpha . \tan\phi}$$

or $$\frac{d + x}{a} = \frac{d/a + \tan\phi}{1 - d/a \times \tan\phi} = \frac{d + a\tan\phi}{a - d\tan\phi}$$

...[From equations (*i*) and (*ii*)]

$$(d + x)(a - d\tan\phi) = a(d + a\tan\phi)$$

$$a.d - d^2\tan\phi + a.x - d.x\tan\phi = a.d + a^2\tan\phi$$

$$\tan\phi(a^2 + d^2 + d.x) = ax \quad \text{or} \quad \tan\phi = \frac{a.x}{a^2 + d^2 + d.x} \qquad ...(iv)$$

Similarly, from $\tan(\alpha - \theta) = \frac{d - x}{a}$, we get

$$\tan\theta = \frac{ax}{a^2 + d^2 - d.x} \qquad ...(v)$$

We know that for correct steering,

$$\cot\phi - \cot\theta = \frac{c}{b} \quad \text{or} \quad \frac{1}{\tan\phi} - \frac{1}{\tan\theta} = \frac{c}{b}$$

In a Davis steering gear, the distance between the pivots of the front axle is 1.2 metres and the wheel base is 2.7 metres. Find the inclination of the track arm to the longitudinal axis of the car, when it is moving along a straight path.

Solution.Given : c = 1.2 m ; b= 2.7 m

Let α= Inclination of the track arm to the longitudinal axis.

We know that

1.2 /tan 0.222

222.7

c/bα= = =×

or α= 12.5°

Ackerman Steering Gear

The Ackerman steering gear mechanism is much simpler than Davis gear. The difference between the Ackerman and Davis steering gears are :

1. The whole mechanism of the Ackerman steering gear is on back of the front wheels; whereas in Davis steering gear, it is in front of the wheels.
2. The Ackerman steering gear consists of turning pairs, whereas Davis steering gear consists of sliding members.