Chain of bicycle moves through two sprockets, a big and a small, the bigger one is towards the paddle side and the smaller one is towards the rear wheel side.

Consider a bicycle in which the bigger sprocket has the following:

Teeth: N_1, Radius: r_1, Angular speed: ω_1

And the smaller sprocket has the following:

Teeth: N_2, Radius: r_2, Angular speed: ω_2

Let the linear speed of chain be v. Find a relationship between ω_1 and ω_2.

Solution

Since chain is moving with constant linear speed,

$\omega_1 \times r_1 = \omega_2 \times r_2$

So, $2\pi r_1 \times \omega_1 = 2\pi r_2 \times \omega_2$

So, circumference $\times$ ω=constant

For chain to fit properly on both sprockets, teeth must be equally spaced.

So, circumference α N

So, $N \times \omega$=constant

Hence, $N_1\omega_1 = N_2\omega_2$