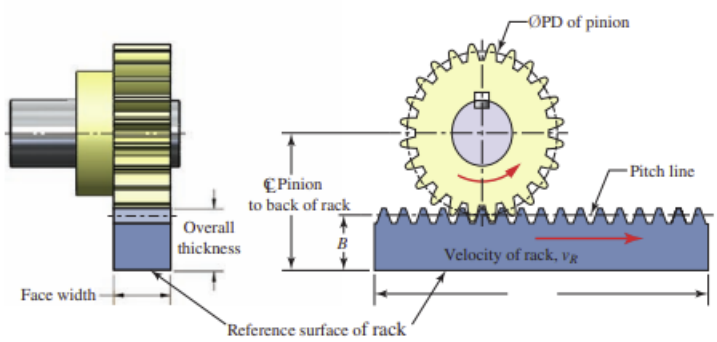
2.5 Rack and Pinion

2.5.1 Anatomy



2.5.2 Nomenclature

P_d = diametral pitch (teeth/in)
N_p = number of teeth on the pinion
D_p = pitch diameter (in)
n_P = angular speed of the pinion (rpm)
v_t = pitch line velocity of the pinion
B = distance from pitch line to back (in) (tab. 8-10)
$B - C$ = distance from back of the rack to the pinion centerline (in)
V_{rack} = speed of rack (ft/min)
s_{rack} = distance rack travels (ft)
t = time (s)
θ_p = number of revolutions of the pinion (rev)

2.5.3 Formulae

$$\text{pitch line speed: } v_t = \frac{D_P n_P}{2}$$

$$\text{speed of rack: } V_{\text{rack}} = \frac{\pi D_P n_P}{12}$$

$$\text{distance rack travels: } s_{\text{rack}} = \frac{D_P \theta_P}{2}$$

2.5.4 Analysis Method

1. Find pitch diameter D_p

$$D_p = \frac{N}{P_d}$$

2. Find distance from pitch line to back B from the table

TABLE 8–10 Example rack specifications

Diametral pitch	Pitch line to back (B)	Overall thickness	Face width	Nominal length [ft]
64	0.109	0.125	0.125	2
48	0.104	0.125	0.125	2
32	0.156	0.187	0.187	4
24	0.208	0.250	0.25	4
20	0.450	0.500	0.5	6
16	0.688	0.750	0.75	6
12	0.917	1.000	1	6
10	1.150	1.250	1.25	6
8	1.375	1.500	1.5	6
6	1.333	1.500	2	6
5	1.300	1.500	2.5	6
4	1.750	2.000	3.5	6

3. Find distance from back of the rack to the pinion centerline $B - C$

$$B - C = B + \frac{D_p}{2}$$

4. Find the velocity of the rack V_{rack}

$$V_{\text{rack}} = \left(\frac{\pi}{6}\right)\left(\frac{D_p n_p}{2}\right)$$

5. Find the time it takes to move the rack some distance

$$t = 60\left(\frac{s_{\text{rack}}}{V_{\text{rack}}}\right)$$

6. Find the number of revolutions required to move the rack that far

$$\theta_p = \left(\frac{6}{\pi}\right)\left(\frac{2s_{\text{rack}}}{D_p}\right)$$

2.6 Gear Trains

train value: $TV = (VR)_1(VR)_2 \cdots = \dfrac{N_{\text{output}}}{N_{\text{input}}} = \dfrac{n_{\text{input}}}{n_{\text{output}}}$

3 Fucking Fluids

3.1 Regenerative vs Non-Regenerative Circuits

There may be a question about the suitability of regenerative vs non regenerative circuits. They have their own advantages and disadvantages.