- $$\boxed{\frac{dp}{d\theta} = -\gamma \cdot \frac{p}{V} \frac{dV}{d\theta} + (\gamma-1)\, \frac{1}{V} \cdot \frac{dQ}{d\theta}}$$

- $$Q = \frac{Q_{tot}}{2} \left[1 - \cos\left(\pi \left(\frac{\theta - \theta_d}{\Delta\theta_{comb}} \right) \right) \right]$$

$$\Rightarrow \boxed{\frac{dQ}{d\theta} = \frac{Q_{tot}}{2} \cdot \left[\frac{\pi}{\Delta\theta_{comb}} \sin\left(\frac{\theta - \theta_d}{\Delta\theta_{comb}} \right) \right]}$$

- $$V = \frac{V_c}{2} \left[1 - \cos\theta + \beta - \sqrt{\beta^2 - \sin^2\theta} \right] + \frac{1}{\tau - 1} \cdot V_c$$

↳ $V_c = \frac{\pi D^2}{4} \cdot 2R$; $\tau = \frac{V_{max}}{V_{min}}$; $\beta = \frac{L}{R}$

$$\Rightarrow \frac{dV}{d\theta} = \frac{V_c}{2} \left[\sin\theta - \left(\frac{-2\sin\theta \cdot \cos\theta}{2\sqrt{\beta^2 - \sin^2\theta}} \right) \right]$$

$$= \boxed{\frac{V_c}{2} \sin\theta \left[\frac{\cos\theta}{\sqrt{\beta^2 - \sin^2\theta}} + 1 \right]}$$

Méthode de Rounge-Kouta d'ordre 2 :

$$\begin{cases} p_{i+1} = p_i + \frac{h}{2} (K_1 + K_2) \\ K_1 = f(\theta_i, p_i) \\ K_2 = f(\theta_i + h, p_i + h K_1) \end{cases}$$

- $$f(\theta_i, p_i) = -\gamma \cdot \frac{p_i}{V(\theta_i)} \cdot \frac{dV}{d\theta}(\theta_i) + (\gamma - 1) \frac{1}{V(\theta_i)} \cdot \frac{dQ}{d\theta}(\theta_i)$$