EQUIVALENT LINKAGES OF COMPRESSOR MECHANISMS

Numerical variant of an old graphical method

Although the equivalent linkage of a reciprocating pistonn compressor is well known, the equivalent linkages of other types of compressors are not.

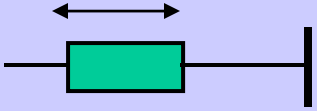
The method will be illustrated on two compressor mechanisms

1. Reciprocating piston compressor
2. Rotary vane compressor with eccentric vanes

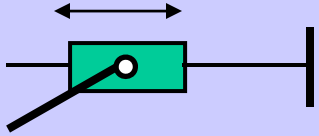
EQUIVALENT KINEMATIC PAIRS

Joint

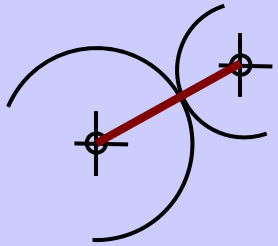
Slider

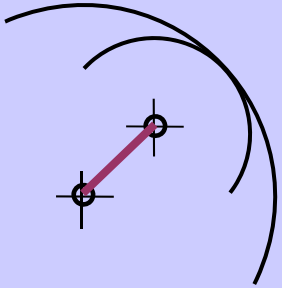


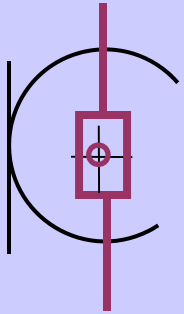
Slider and joint

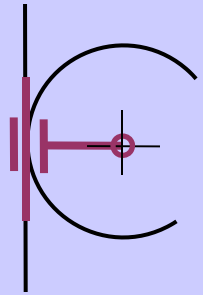


Contacting surfaces



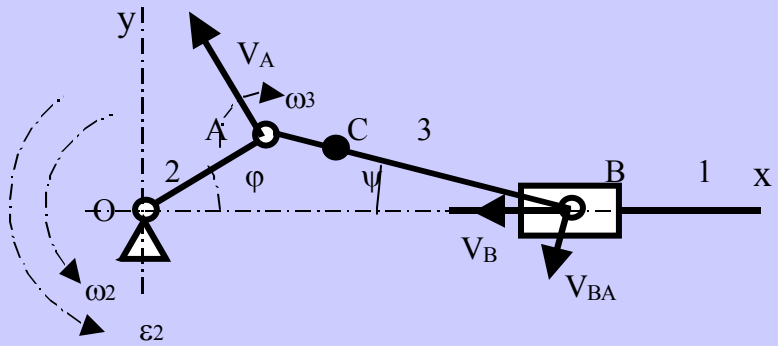






RECIPROCATING PISTON COMPRESSOR

VELOCITY

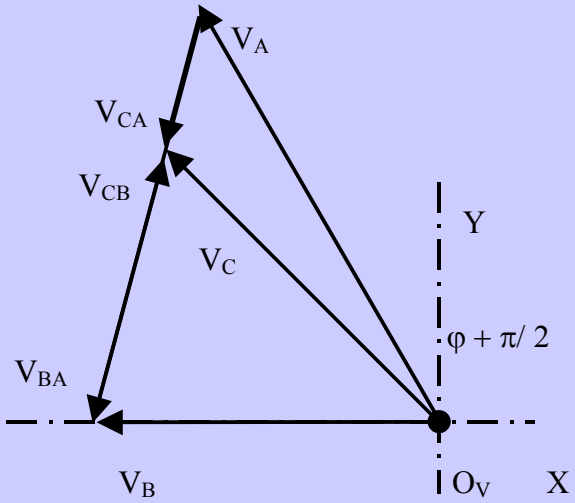


$$\mathbf{V_B = V_A + V_{BA}}$$

$$V_A = r \cdot \omega_2$$

$$\omega_3 = \frac{V_{BA}}{L_3}$$

$$\sin\psi = \frac{r_2}{L_3} \cdot \sin\varphi$$



RECIPROCATING PISTON COMPRESSOR

Velocity

Projected into x axis

$$V_B \cdot \cos\pi = V_A \cdot \cos\left(\varphi + \frac{\pi}{2}\right) + V_{BA} \cdot \cos\left(\frac{3\pi}{2} - \psi\right)$$

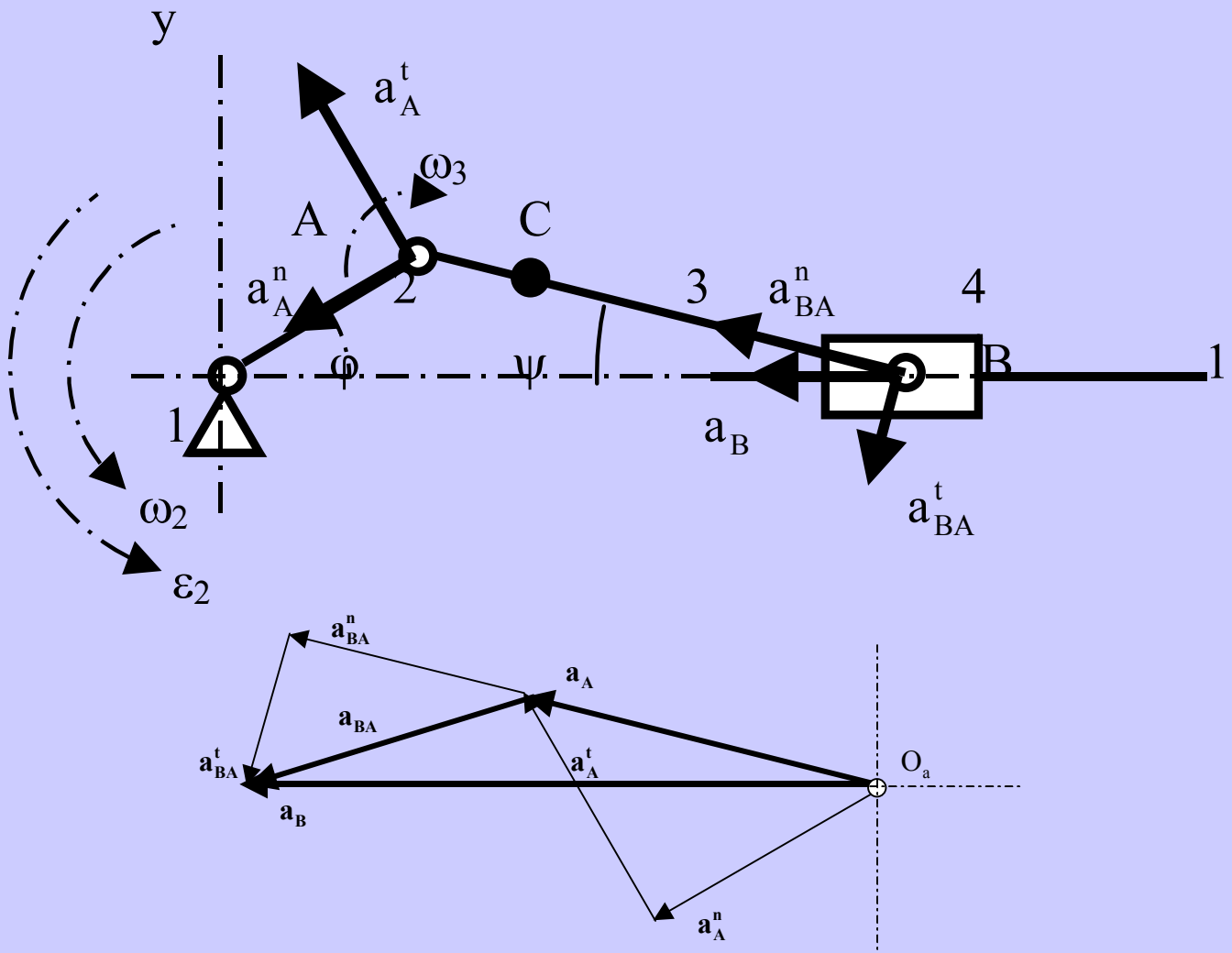
Projected into y axis

$$V_B \cdot \sin\pi = V_A \cdot \sin\left(\varphi + \frac{\pi}{2}\right) + V_{BA} \cdot \sin\left(\frac{3\pi}{2} - \psi\right)$$

Unknown magnitudes of V_B and V_{BA} can be calculated

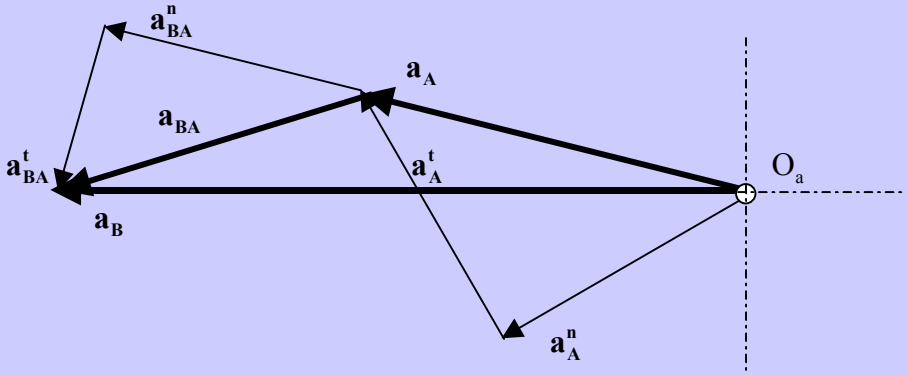
RECIPROCATING PISTON COMPRESSOR

ACCELERATION



RECIPROCATING PISTON COMPRESSOR

ACCELERATION



$$\mathbf{a_B} = \mathbf{a_A} + \mathbf{a_{BA}} \qquad \omega_3 = \frac{v_{BA}}{L_3};\quad a^n_{BA} = L_3 \cdot \omega_3^2 = \frac{v^2_{BA}}{L_3}$$

$$\mathbf{a_B} = \mathbf{a^n_A} + \mathbf{a^t_A} + \mathbf{a^n_{BA}} + \mathbf{a^t_{BA}} \qquad a^n_A = r_2 \cdot \omega_2^2;\quad a^t_A = \varepsilon \cdot r_2$$

a^t_{BA} has the direction of v_{BA}

RECIPROCATING PISTON COMPRESSOR

ACCELERATION

$$a_B \cdot \cos\pi = a_A^n \cdot \cos(\varphi + \pi) + a_A^t \cdot \cos\left(\varphi + \frac{\pi}{2}\right) + a_{BA}^n \cdot \cos(\pi - \psi) + a_{BA}^t \cdot \cos\left(\frac{3\pi}{2} - \psi\right)$$

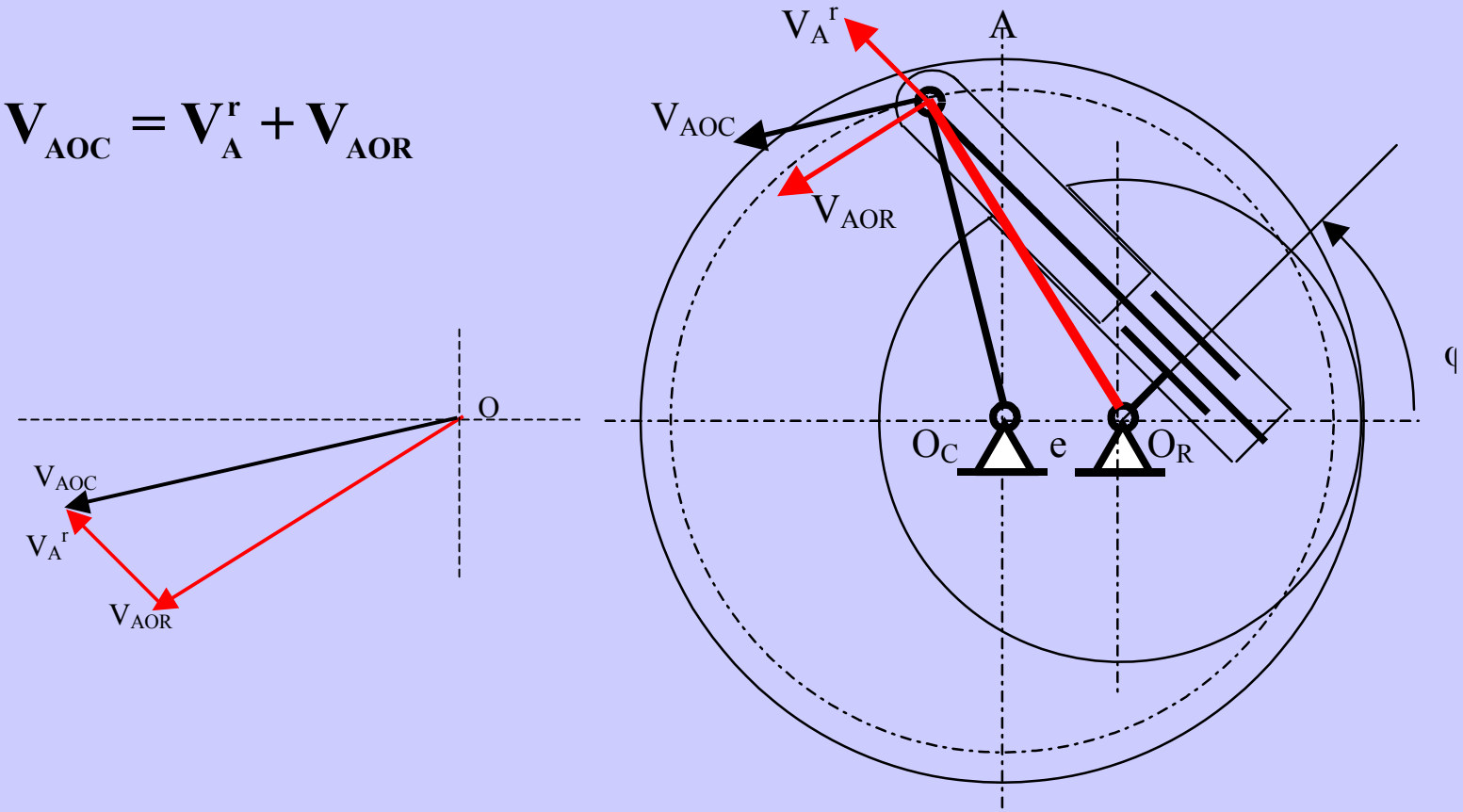
$$a_B \cdot \cos\pi = a_A^n \cdot \cos(\varphi + \pi) + a_A^t \cdot \cos\left(\varphi + \frac{\pi}{2}\right) + a_{BA}^n \cdot \cos(\pi - \psi) + a_{BA}^t \cdot \cos\left(\frac{3\pi}{2} - \psi\right)$$

Unknown magnitudes of a_B and a_{BA}^t can be calculated

ROTARY VANE COMPRESSOR WITH ECCENTRIC VANES

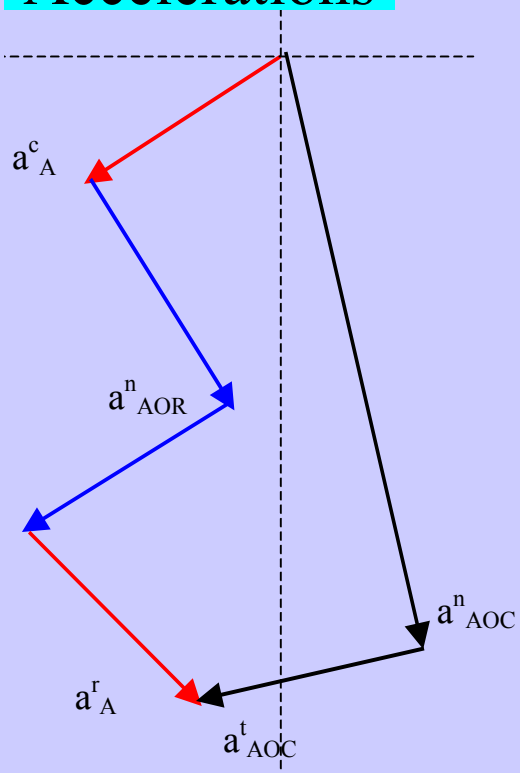
Velocity

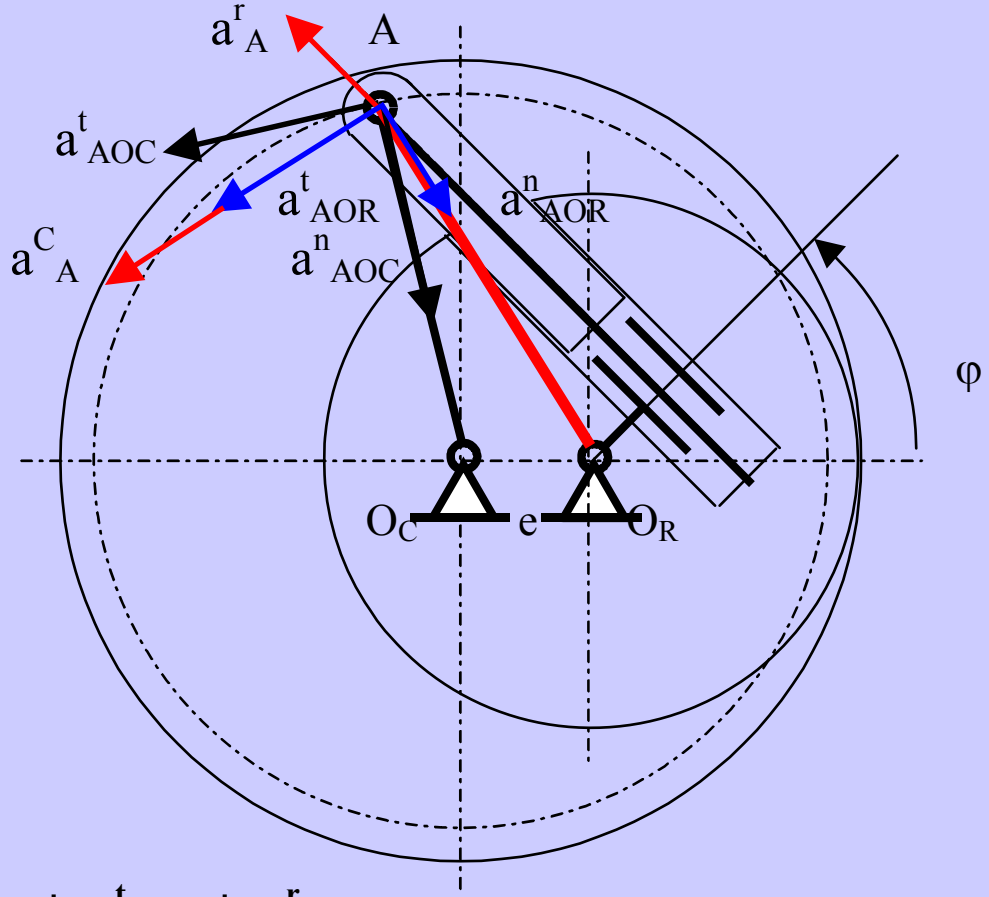
$$\mathbf{V_{AOC} = V_A^r + V_{AOR}}$$



ROTARY VANE COMPRESSOR WITH ECCENTRIC VANES

Accelerations



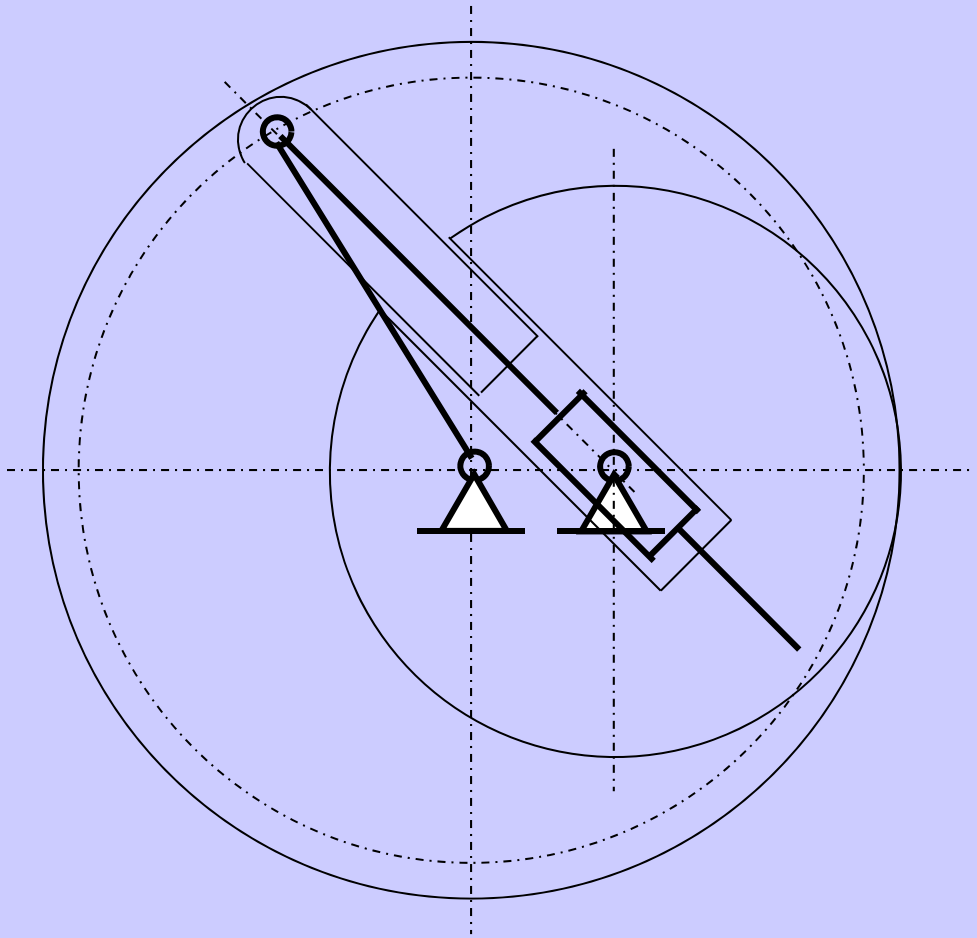


$$\mathbf{a}_A = \mathbf{a}^c_A + \mathbf{a}_{AOR} + \mathbf{a}^r_A$$

$$\mathbf{a}^n_{AOC} + \mathbf{a}^t_{AOC} = \mathbf{a}^c_A + \mathbf{a}^n_{AOR} + \mathbf{a}^t_{AOR} + \mathbf{a}^r_A$$

$$\mathbf{a}^C_A = 2 \cdot \boldsymbol{\omega} \times \mathbf{v}^r_A; \ \left|a^c_A\right| = 2 \cdot \omega \cdot v^r_A \cdot \sin\left(\omega, v^r_A\right) = 2 \cdot \omega \cdot v^r_A$$

ROTARY VANE COMPRESSOR WITH CONCENTRIC VANES



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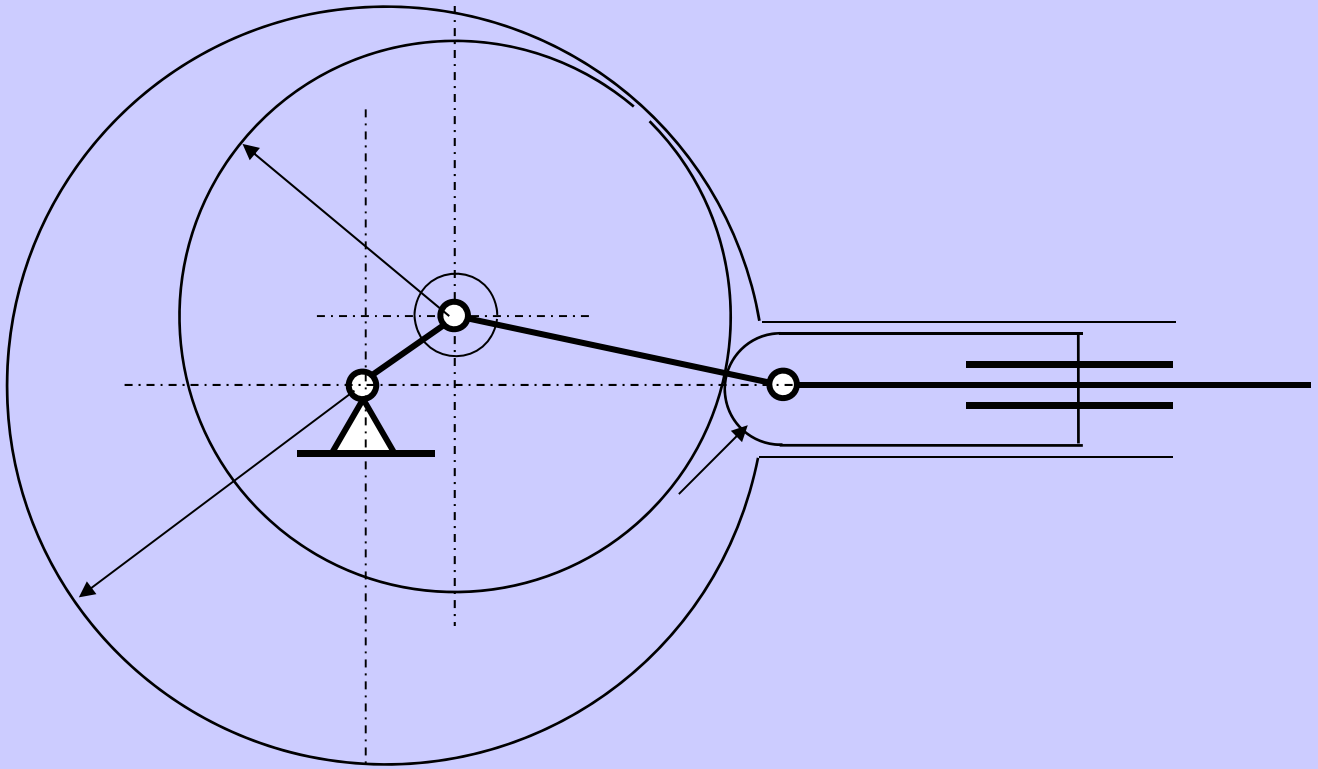
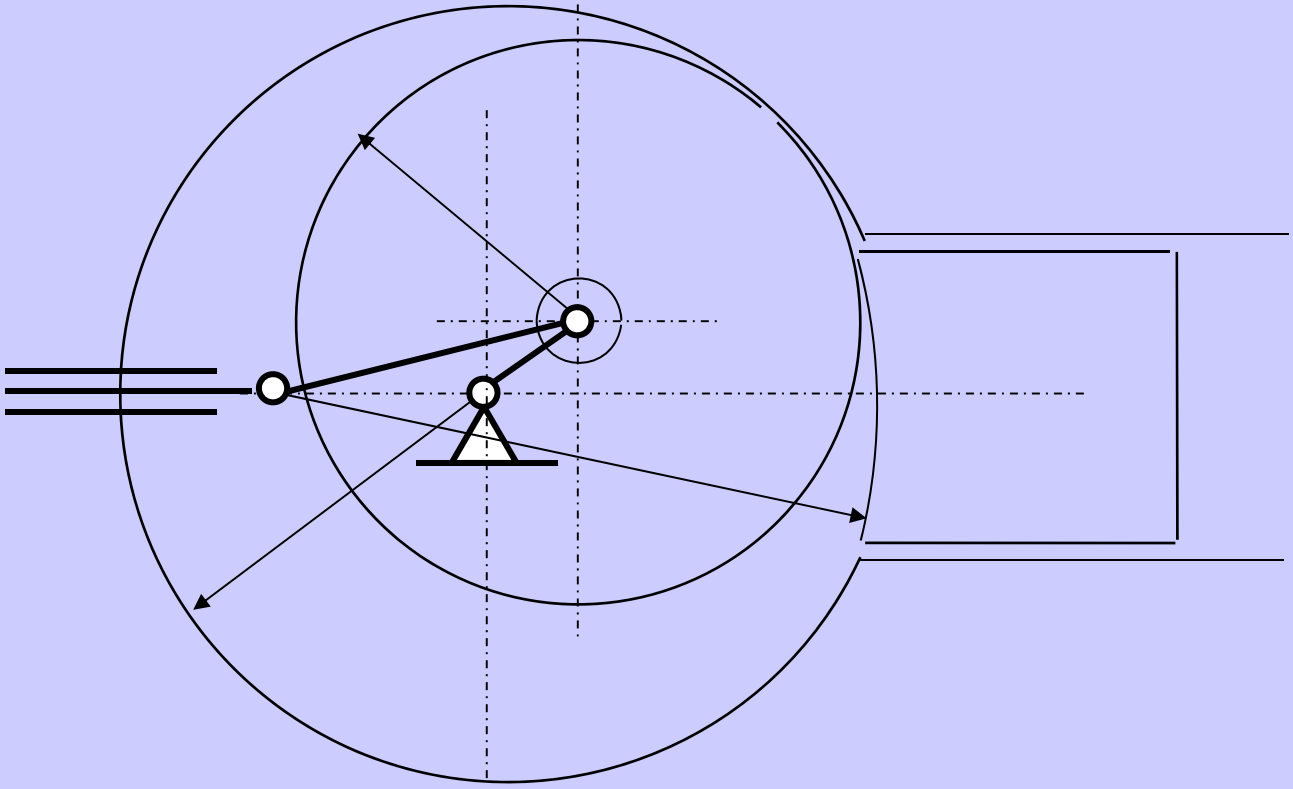
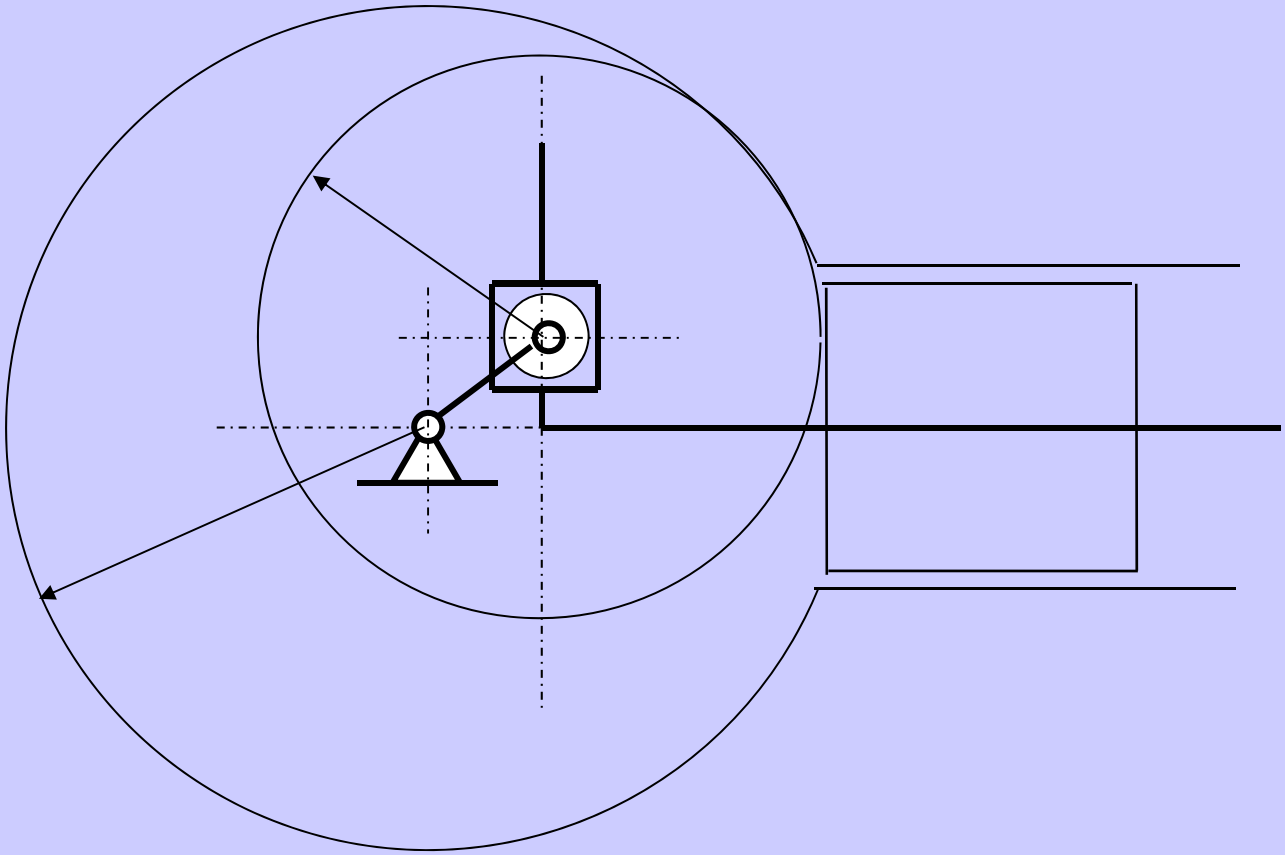
ROLLING PISTON COMPRESSOR



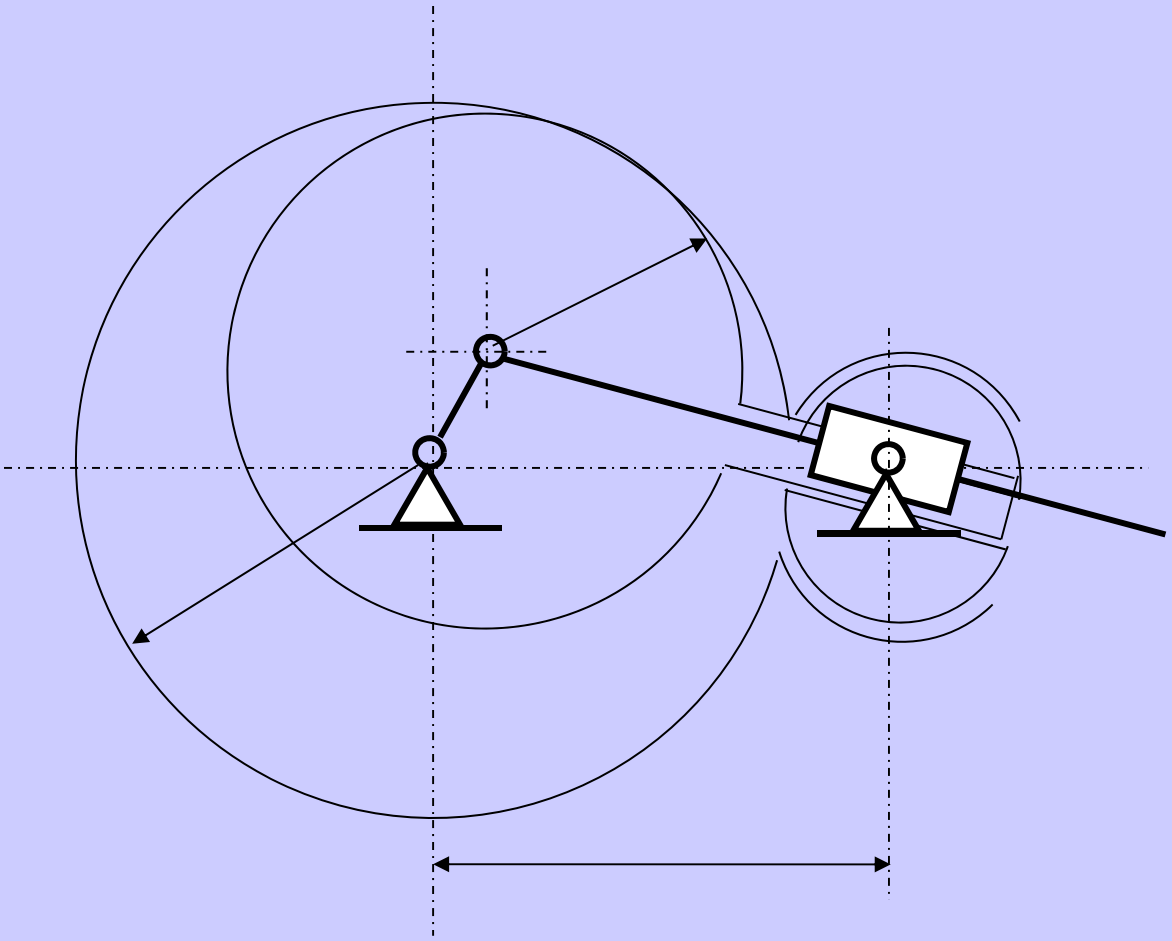
ROLLING PISTON COMPRESSOR



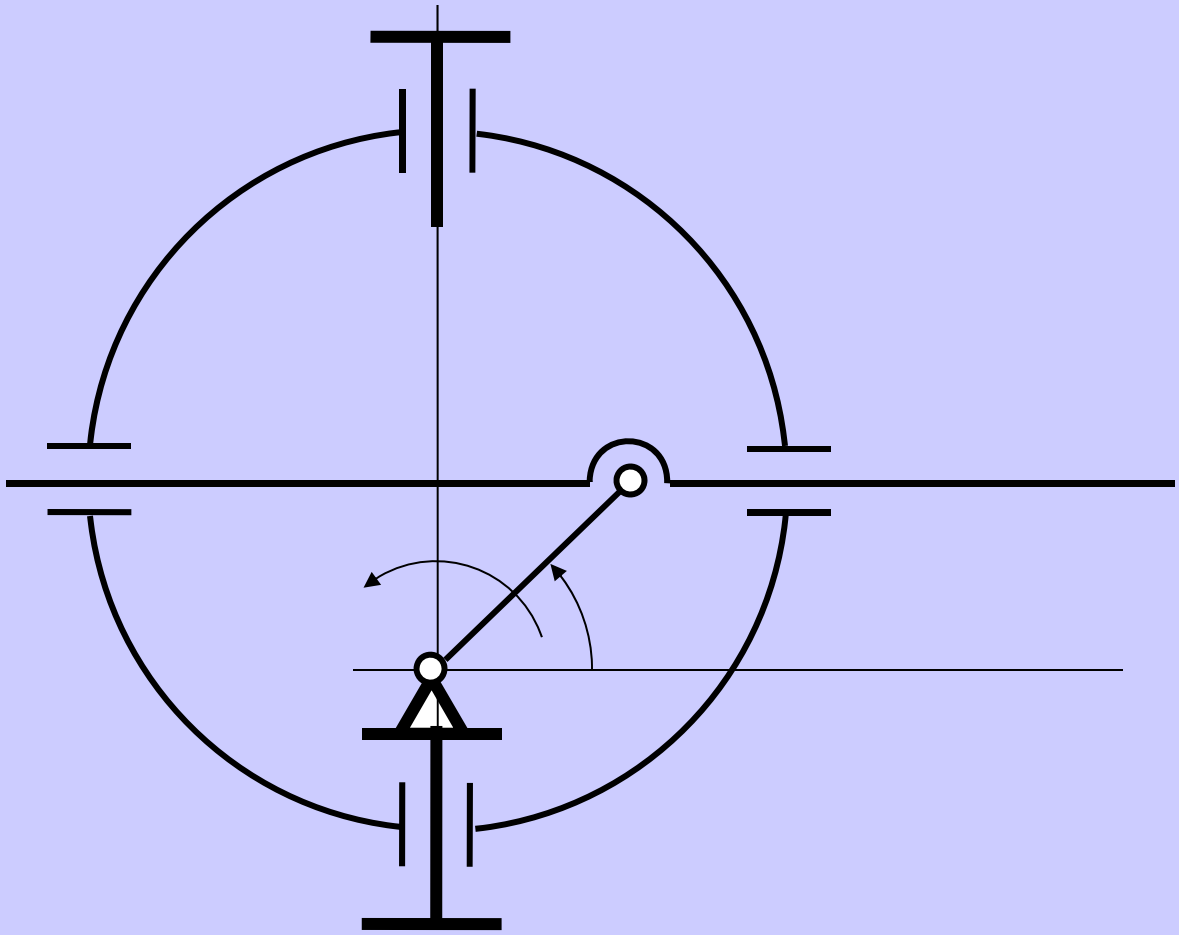
ROLLING PISTON COMPRESSOR



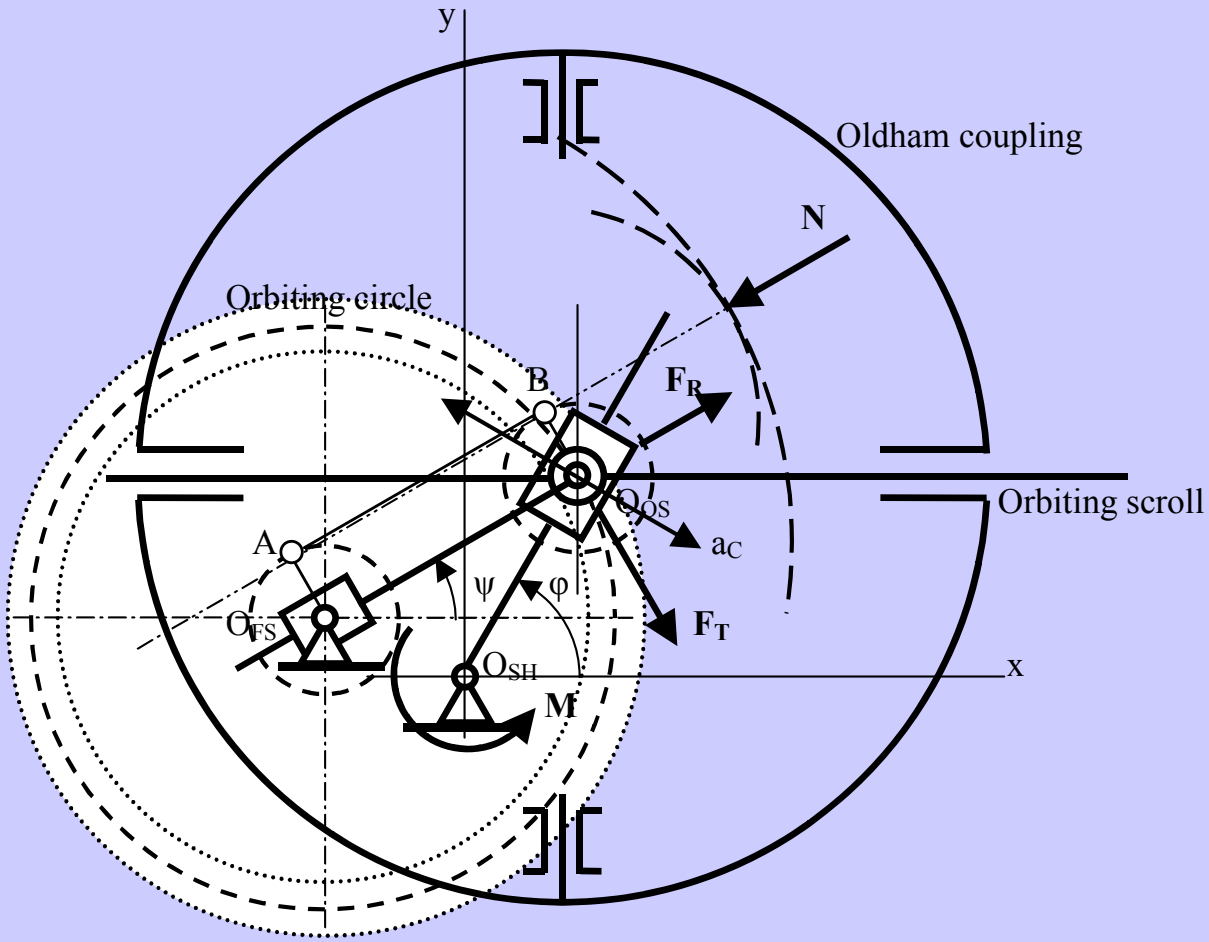
SWING PISTON COMPRESSOR



SCROLL COMPRESSOR WITH FIXED ORBITING RADIUS



RADIALLY COMPLIANT SCROLL COMPRESSOR



THANK YOU
FOR YOUR ATENTION