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A Geometric Study of the Discharge Port used in Scroll Compressors

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Background/Introduction

Scroll compression has become the prevalent technology used air-conditioning and refrigeration systems. The compression chamber consists of two spiral shaped vanes that form pairs of chambers. A crankshaft Imposes an orbital translation on one of the vanes, which reduces the volume of the chambers, thereby compressing the gas trapped within the chamber. A hole is placed at the center of the fixed spiral. The moving spiral will uncover the hole, which serves as an exhaust port.

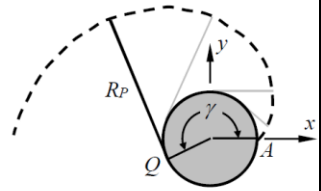
This project studies the exhaust flow area as a function of crank angle. Additionally, the project assesses the sensitivity of the exhaust flow area to the defining spiral parameters, along with the size and placement of the port.

Methodology

Utilized:

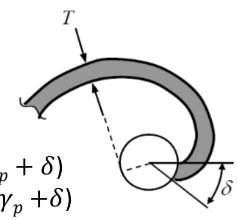
- The equations an vane wall is based on an involute curve with generating radius R_g and involute angle, γ_p.

$$x_{pi} = \gamma_p R_g sin\,(\gamma_p) + R_g \cos(\gamma_p)$$
$$y_{pi} = -\gamma_p R_g cos\,(\gamma_p) + R_g \sin(\gamma_p)$$



- Form the outer wall of a scroll vane, with thickness, T.

$$T = \delta R_g$$



$$x_{po} = \gamma_p R_g sin\,(\gamma_p + \delta) + R_g \cos(\gamma_p + \delta)$$
$$y_{po} = -\gamma_p R_g cos\,(\gamma_p + \delta) + R_g \sin(\gamma_p + \delta)$$

- Form a mating set of involute vanes x_m, y_m positioned at a crank angle $\emptyset$.

$$R_{or} = \pi R_g - R_g \delta$$
$$x_m = -x_p - R_{or} \cos(\emptyset)$$
$$y_m = -y_p - R_{or} \sin(\emptyset)$$

- Create exhaust port of radius R_p and center (X_{pc}, Y_{pc}).

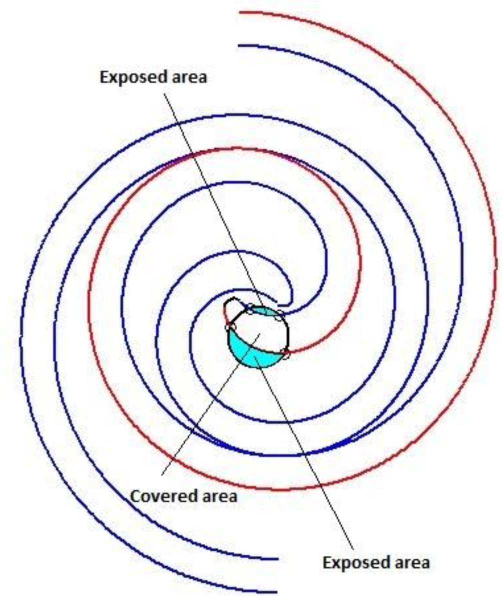
$$X_p = X_{pc} + R_p \cos(\theta)$$
$$Y_p = Y_{pc} + R_p \sin(\theta)$$

- Locate γ_p and θ at intersection of port and scroll vane.

$$X_{pc} + R_p cos(\theta) = \gamma_p R_g sin\,(\gamma_p) + Rg\cos(\gamma_p)$$
$$Y_{pc} + R_p sin(\theta) = -\gamma_p R_g cos\,(\gamma_p) + Rg\sin(\gamma_p)$$

Conclusions

- Geometry of mating vanes of a scroll compressor was created from the basic defining parameters.
- A general method to calculate the exhaust flow area was generated.
- The next goal for this project is to perform a study to optimize the location of exhaust port to reduce volume losses during the whole exhaust process.



The exposed area with a specific crank angle $\emptyset$.