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 in 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.

Methodology
Utilized:
- The equations an vane wall is based on an involute curve with generating radius $R_g$ and involute angle, $\gamma_p$.

\[
x_{pi} = \gamma_p R_g \sin(y_p) + R_g \cos(y_p)
\]
\[
y_{pi} = -\gamma_p R_g \cos(y_p) + R_g \sin(y_p)
\]

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

\[
T = \delta R_g
\]
\[
x_{po} = \gamma_p R_g \sin(y_p + \delta) + R_g \cos(y_p + \delta)
\]
\[
y_{po} = -\gamma_p R_g \cos(y_p + \delta) + R_g \sin(y_p + \delta)
\]

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

\[
R_{ar} = \pi R_g - R_g \delta
\]
\[
x_m = -x_p - R_{ar} \cos(\emptyset)
\]
\[
y_m = -y_p - R_{ar} \sin(\emptyset)
\]

- 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 $y_p$ and $\theta$ at intersection of port and scroll vane.

\[
x_{pc} + R_p \cos(\theta) = \gamma_p R_g \sin(y_p) + R_g \cos(y_p)
\]
\[
y_{pc} + R_p \sin(\theta) = -\gamma_p R_g \cos(y_p) + R_g \sin(y_p)
\]

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.