Roots Type Blower (cycloidal profile)

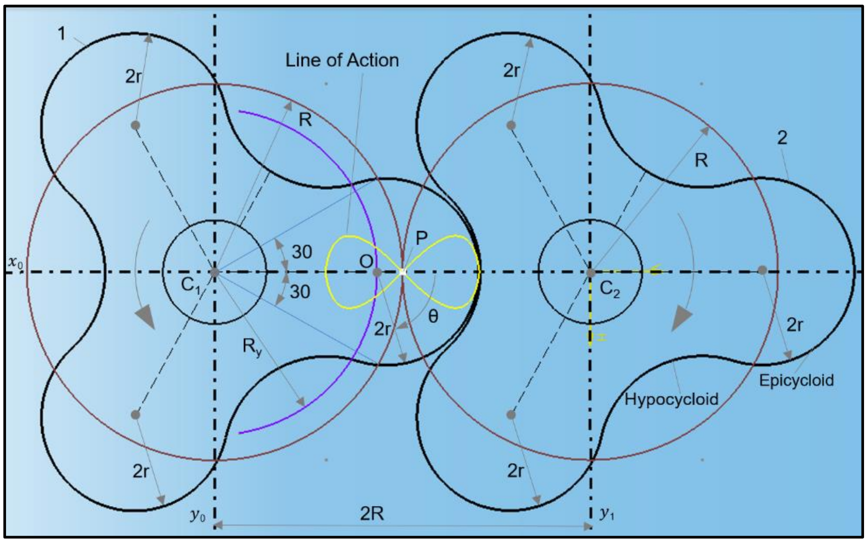

Figure 1

r = Rolling circle radius

R = Base circle radius

Ry = Reference base circle radius

P = Pitch point

z = Number of lobes

Angular distance between 2 lobes = $\frac{360}{2\,z}$

θ = Variable angle parameter

φ = Angle of rotation of the vane

The vane profile as shown is formed by epicycloid and hypocycloid with following equations.

Epicycloid:

$$x = r\,(2\,z + 1)\cos\varphi - r\cos((2\,z + 1)\,\varphi)$$

$$y = r\,(2\,z + 1)\sin\varphi - r\sin((2\,z + 1)\,\varphi)$$

Hypocycloid:

$$x = r\,(2 - 1)\cos\varphi + r\cos((2\,z - 1)\,\varphi)$$

$$y = r\,(2 - 1)\sin\varphi - r\sin((2\,z - 1)\,\varphi)$$

The roots type blower consists of two vanes with conjugate profiles meshing with each other. Two vanes 1 and 2 are mounted on shafts at the points C1 & C2 with centre distance of 2*R. Hence, the vanes are rotatable and rotate in opposite direction. Two vanes rotate inside a casing to create enclosed areas to carry the fluid from inlet to outlet through ports. Unlike cycloidal gears, there is no power transmission between vanes.

A small air gap is maintained between two vanes as well as vanes and casing and hence, vanes are driven by external timing gears which are driven by belt drive.

Principle:

In figure 2, a set of rolling circles and base circles is shown. The green circle rotates inside the base circle 1 without slipping and the constant point on it traces a hypocycloidal path. On the other hand, the red circle traces an epicycloid on the same base circle 1. Following the same procedure with base circle 2, and green rolling circle rotating on it without slipping, then the epicycloid is traced by green and the hypocycloid by red circle. This motion of rolling circles creates a conjugate pair of cycloidal profile.

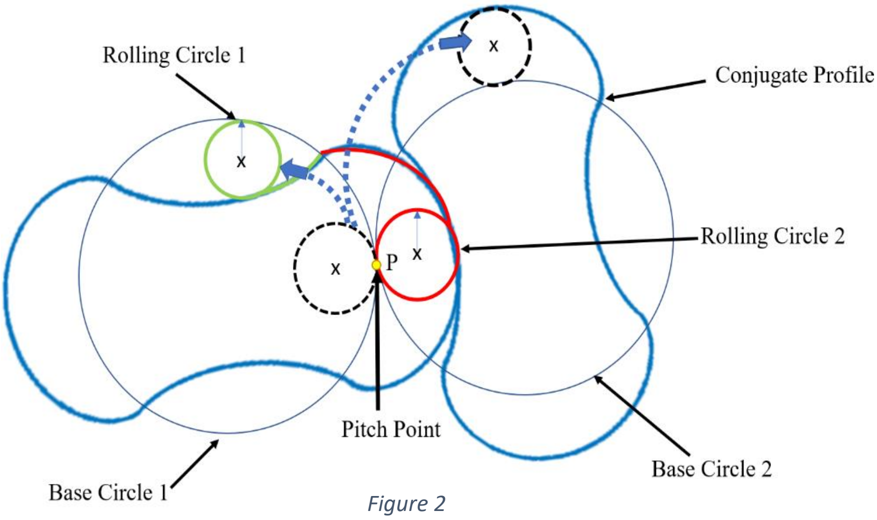

Figure 2

Line of action:

The line of action (as shown in figure 1 with yellow color) is a path traced by the point of contact of two vanes for one complete rotation. The following equations are obtained for the line of action.

$$x = 2\,r\sin(\theta - \varphi) - R_y\sin\varphi$$

$$y = 2\,r\cos(\theta - \varphi) + R_y\cos\varphi$$

$$R\sin(\theta - \varphi) - R_y\sin\theta = 0$$