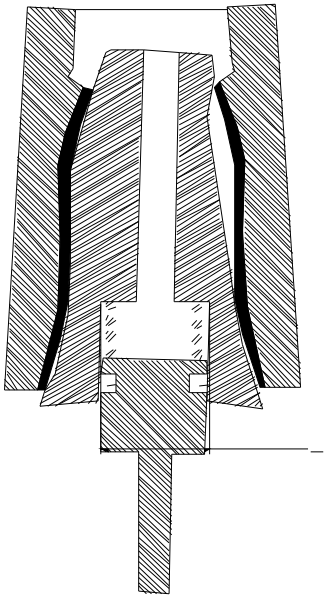
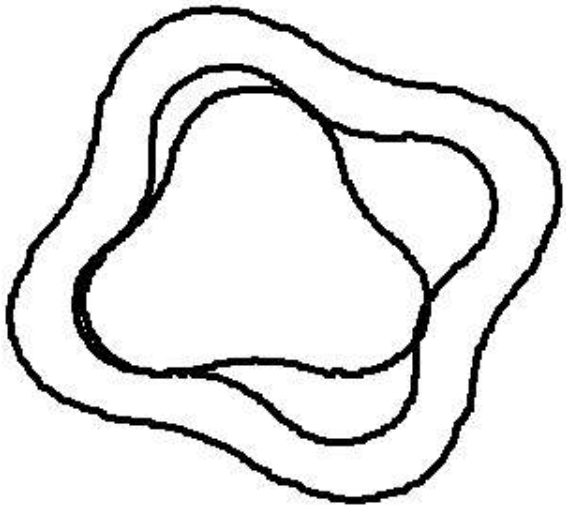
Mathematical problems for Moineau pumps

A progressive cavity pump (PCP) or a Moineau pump has two parts rotating relative to each other and moving in an eccentric track relative to each other.
The shapes in an axial cross section can be made of pieces of hypocycloids connected with epicycloids. Alternative it can be a curve with a constant distance to hypocycloids.
In the axial direction the cross section is rotated around the z-axis so the external part have at least one thread.
For n-teeth shape running inside an n+1 teeth shape the internal part have (n+1)/n times the teeth of the external part.
The center of the internal element is offset relative to the center of the external element and moving in a circle with the radius e (eccentricity). The speed of displacement of the centers is -n times the speed of the rotation speed of the internal element if the external element is stationary.
A further feature can be achieved by making the pump conical. If both elements have a larger cross section in one end the axial force will determine the compression between the two elements. In that configuration one of the elements can be free to move in axial direction and the pump pressure act on a surface can presses the two elements together. By adjusting the area of the surface where the pressure compresses the two parts the closing force for the pump can be adjusted. If the pump has to give a constant flow the cross section of the cavities has to be constant (if thread height is constant) in the z direction. Keeping the cross section of the cavities constant (area between external surface and internal surface) can be obtained by decreasing the eccentricity towards the large end of the pump. Eccentricity has to be increased linear if the parts are rigid.





* For n-teeth running inside n+1 teeth: make an expression for as well internal as well as external element with different eccentricities.
* If the pump were conical in z-direction what would be the expression for the elements if the cross section of the cavities and thread height thread height should be constant for a linear increasing eccentricity in the z direction.
* Expression describing the flow for the pump above (Length L, Speed v (Hz))
* The pump making a pressure P: What would be the axial force on inner or external element as a function of the turning angle?
* What would be the radial forces as a function on turning angle?