

Constrained Epicyclic Force Transmission System – Final Paper

Abstract

This document presents a constrained epicyclic mechanism demonstrating rotating force vectors, closed-loop force transmission, and distributed load behavior. The system is analyzed using geometry, force relationships, and power flow.

System Description

The system consists of a constrained sun gear, an internally meshing ring gear mounted on a rotating pin, and a rigid arm acting as a carrier. A cross-slide provides orbital input to the sun gear.

Key Geometry

Sun radius: 100 mm

Ring radius: 120 mm

Arm length: 10 mm

These three elements form a closed constraint triangle at the mesh point.

Kinematic Relationship

$$(\omega_{\text{ring}} - \omega_{\text{arm}}) / (\omega_{\text{sun}} - \omega_{\text{arm}}) = -200/240 = -5/6$$

Force Relationship

Input force at mesh: $F = 1 \text{ N}$

Torque at ring: $\tau = F \times r = 1 \times 0.12 = 0.12 \text{ N}\cdot\text{m}$

Energy per Cycle

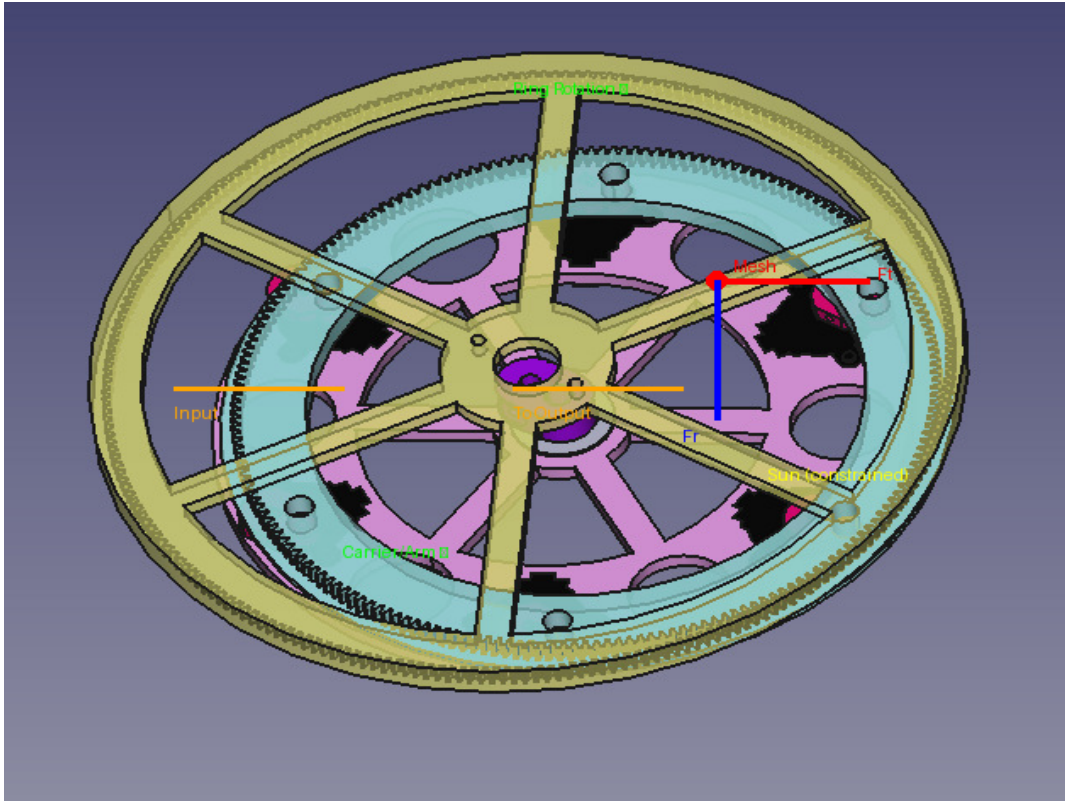
Work at ring (300° slip): $W = \tau \times \theta = 0.12 \times (5/6 \times 2\pi) \approx 0.628 \text{ J}$

Input work: $W = F \times \text{distance} = 1 \times (2\pi \times 0.01) \approx 0.0628 \text{ J}$

Interpretation

The system forms a rotating force vector at the mesh, which is transmitted through a closed constraint loop. Forces are distributed globally and depend on continuous motion and constraint.

Annotated System



Conclusion

This mechanism demonstrates how constrained geometry can produce a persistent force field and distribute load across a system. The behavior is fully consistent with classical mechanics and depends on continuous input and closed-loop constraints.