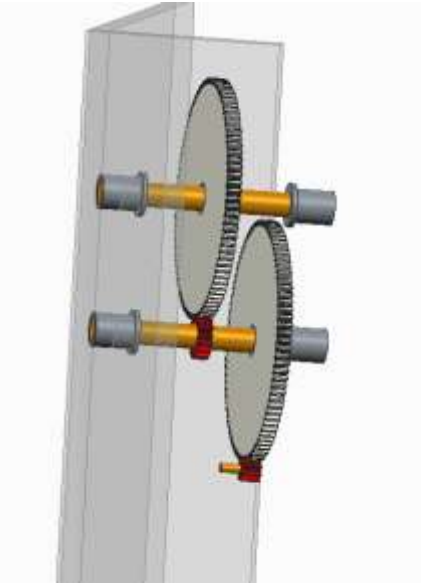
Gear box for BWM power Generation

Team P14418

Initial Torque Requirements

- Calculated using 45 Watt Output
- User Input speed of 55 Rpm



Torque, on the other hand, is typically not constant throughout a transmission system. Remember that power equals the product of torque and speed. Since *power in* = *power out*, we know that for a gear train

$$H = T_i\omega_i = T_o\omega_o \qquad (18\text{–}1)$$

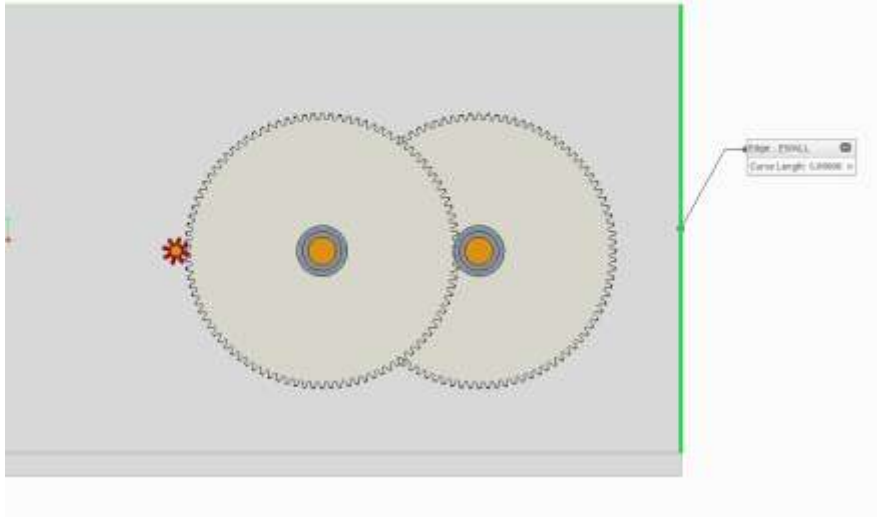
With a constant power, a gear ratio to decrease the angular velocity will simultaneously increase torque. The gear ratio, or train value, for the gear train is

$$e = \omega_o/\omega_i = T_i/T_o \qquad (18\text{–}2)$$

Power (watts)	Power Required (hp)	Angular	Torque (ft-lbf)
45	0.060345	55	5.762523025
45	0.060345	330	0.960420504
45	0.060345	3960	0.080035042

Gear Analysis

- Teeth Stress: 61,692 Psi
- Over 10,000 Hour Lifetime (with 2.62 factor of safety)
- Bending Stress FoS >10



$$\sigma = \begin{cases} W^t K_o K_v K_s \dfrac{P_d}{F} \dfrac{K_m K_B}{J} & \text{(U.S. customary units)} \\ W^t K_o K_v K_s \dfrac{1}{bm_t} \dfrac{K_H K_B}{Y_J} & \text{(SI units)} \end{cases} \quad (14\text{–}15)$$

where for U.S. customary units (SI units),

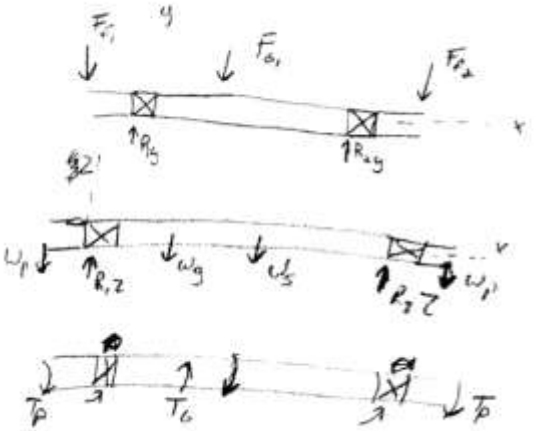
W^t is the tangential transmitted load, lbf (N)
K_o is the overload factor
K_v is the dynamic factor
K_s is the size factor
P_d is the transverse diametral pitch
F (b) is the face width of the narrower member, in (mm)
K_m (K_H) is the load-distribution factor
K_B is the rim-thickness factor
J (Y_J) is the geometry factor for bending strength (which includes root fillet stress-concentration factor K_f)
(m_t) is the transverse metric module

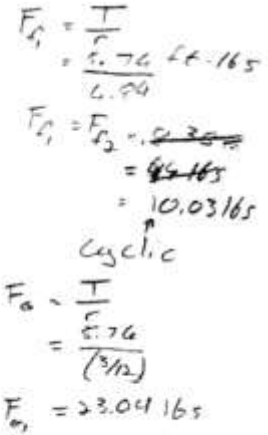
$$V = \pi dn/12 \quad (13\text{–}34)$$

where V = pitch-line velocity, ft/min
d = gear diameter, in
n = gear speed, rev/min

Shaft Design

- Force from pedals is not constant
- Locations not finalized
- Keyed shaft vs. Not keyed
- Retaining rings vs. other axial constraints
- Stepped shaft to fit into bearings





Questions

How do the pedals attach to the crank?
How will the crank attach to the driving shaft?
What if the square hole is larger than the proposed 5/16" shaft?
How are we stabilizing the shaft from shimmying back and forth?
How will we attach the gear to the shaft?
How will we keep them lined up?
How will we mount the motor?
How will we wire the motors?

Questions

Do they need ventilation?
Do the gears need lube?
Where or at what points are the highest stresses?
What type of stress or fatigue will we experience in pedal design?
How will we package the electronics?
How do we estimate gear life?
What factor of safety is recommended?
Will pressfitting a gear be an issue with a keyed shaft?
What tolerance is acceptable for gear teeth meshing?