Total Power Input to System:

The following equations can be used to quantify the amount of Power inputted to the system by the consumer.

➔ This can then be used to find a relation between the current generator's required Power input.

To improve performance of generator,
decrease angular velocity

$$P_{T,in} = T_{net} * \omega$$

Where: ω *= minimum angular velocity*

T_{net} *= net torque*

$P_{T,in}$ *= total power input to system*

$$T_{net} = I_{equiv} * \alpha$$

Where: α *= constant angular acceleration*

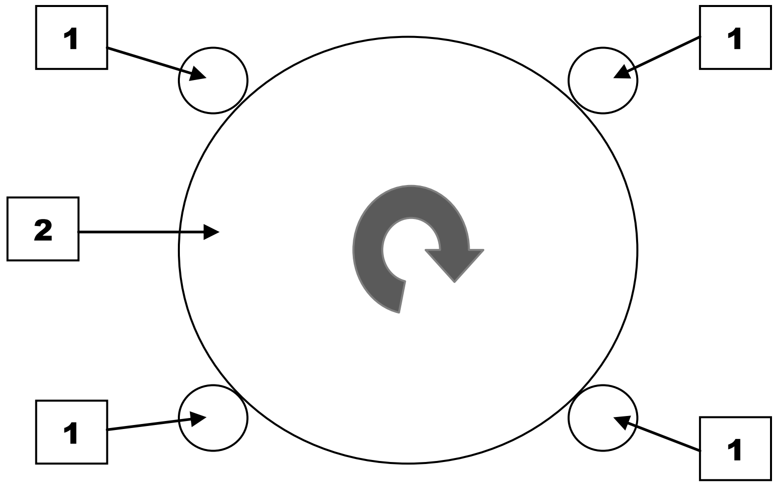
T_{net} *= net torque*

I_{equiv} *= equivalent Mass Moment of Inertia*

$$I_{equiv} = I_A * \alpha_A + n^2 * I_B * \alpha_A$$

$$n = \frac{(\alpha_A)}{(\alpha_B)}$$

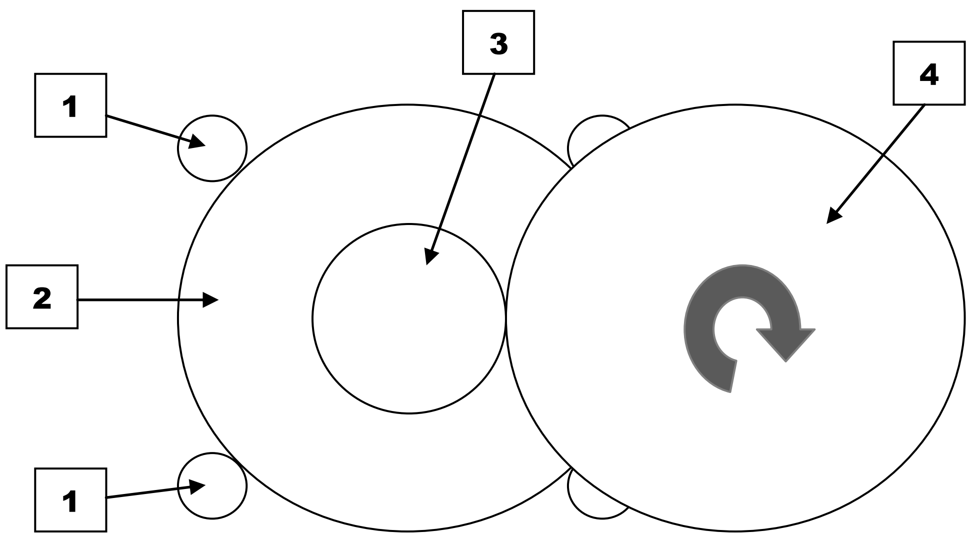
Current Generator Gearbox:



Gear 1 : Radius = 0.1565 inches

Gear 2 : Radius = 3.405 inches

Proposed Generator Gearbox:



Gear 1 : Radius = 0.1565 inches

Gear 2 : Radius = 3.405 inches

Gear 3 : Radius = TBD

Gear 4 : Radius = TBD

Angular Kinematics Equations:

$$\omega^2 = \omega_0 + \alpha t$$

$$\theta_0 + \omega_0 t + \tfrac{1}{2}\alpha t^2$$

$$\omega_0^{\,2} + 2\alpha(\theta - \theta_0)$$

Relating the crank and motor angular velocities:

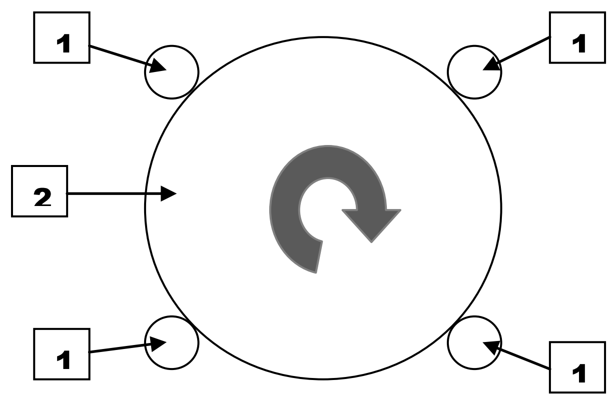
Since $V = \omega * r$

Where: *V = tangental velocity*

ω = angular velocity

r = radius of tangential velocity path

$$\omega_1 r_1 = \omega_2 r_2$$



Current Model Analysis:

$$\omega_1 = \omega_2 * \frac{r_2}{r_1}$$

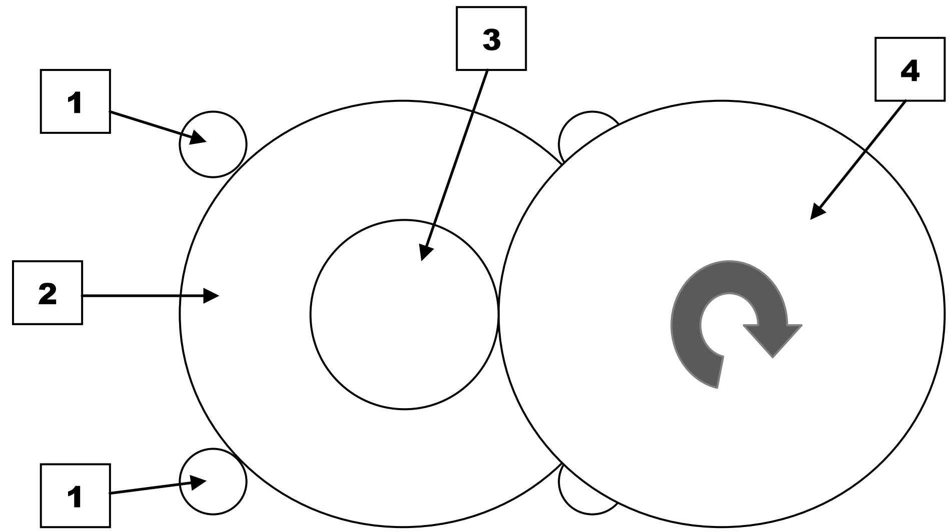
If minimum angular velocity of crank is 130 rpms,
then ω_1 = 2830 rpms

ω_2 = 130 rpms

Proposed Concept Model Analysis:

We can work backwards to find required Gear 3 and Gear 4 radii, based on a desired angular velocity at the new crank location:

$$\omega_4 = \omega_2 * \frac{r_3}{r_4}$$



For example:

To get desired crank input of 90 rpms
Radius 4 equals 3.405" and Radius 3 equals 2.36"

To get desired crank input of 60 rpms
Radius 4 = 3.405" and Radius 3= 1.57"

How Static Torque is Impacted:

$$T = F \ x \ r$$

Where: *T = Torque*

$F = Force$

r = radius (moment arm)

$$F_1 r_1 = F_2 r_2$$

Rearranging torque relationships between gears in proposed gearbox will give:

$$T_4 = T_1 \frac{r_4}{r_3}$$

Final Relationship Examples

If angular velocity of 90 rpms is desired:

Radius 4 = Radius 2

Radius 3 = 2.36”

Torque required to break static equilibrium increases by ratio of 1.44

If angular velocity of 60 rpms is desired:

Radius 4 = Radius 2

Radius 3 = 1.57”

Torque required to break static equilibrium increases by ratio of 2.17