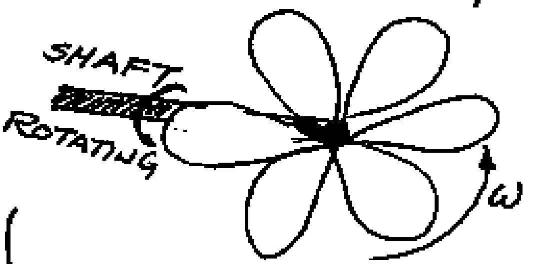
MECH 236 - BEER & JOHNSTON EXAMPLES

PROB. 15.7

p. 896

ROTARY BLADES of GAS TURBINE



SPEED $= n = 6900 \frac{rev.}{min.} \times \frac{2\pi\ rad.}{rev.} \times \frac{1\ min.}{60\ sec.} =$

$= 722.57 \frac{rad.}{sec.} = \omega_0$ ANG. VEL.

REQUIRES 4 min. to coast to a stop.

"Think of any fan that continues to spin after shut off."

a.) ? α, ang. acc.

SIMILAR TO LINEAR VEL.

$$\omega_f = \omega_0 + \alpha t$$

$$0 = 722.57 \frac{rad}{sec.} + \alpha(4 min.)$$

$$\frac{-722.57 \frac{rad}{sec.}}{4 min. \left(\frac{60\ sec.}{1\ min.}\right)} = \alpha = -3.0107 \frac{rad}{sec^2}$$

$\alpha = 3.011 \frac{rad}{sec^2}$ DECEL.

b.) ? # revolutions before stopping

ANGULAR DISPLACEMENT

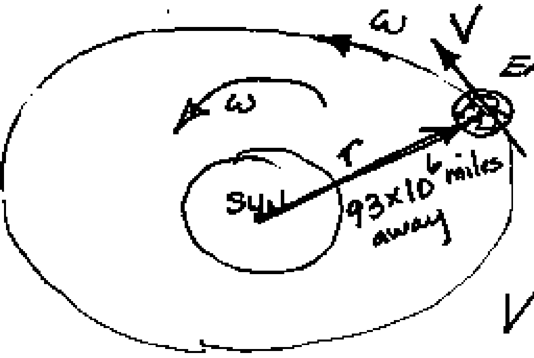
$$\theta_f = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$$

$$= 0 + \left(722.57 \frac{rad}{sec.}\right)(240\ sec.) + \frac{1}{2}\left(-3.0107 \frac{rad}{sec^2}\right)(240\ sec.)^2$$

$$\theta_f = 86.708 \times 10^3\ radians \times \frac{1\ rev.}{2\pi\ rad.}$$

$\theta = 13,800$ REVOLUTIONS BEFORE STOPPING

PROB. 15.17



$$\frac{1\ REVOL.}{365.24\ DAYS} \times \frac{2\pi\ rad.}{1\ rev.} \times \frac{1\ DAY}{24\ HR.} \times \frac{1\ HR.}{3600\ sec.} = \omega$$

$\omega = 199.11 \times 10^{-9} \frac{rad}{sec.}$ SLOW

$$V = r\omega = (93 \times 10^6\ mi.) \times \frac{5280\ ft}{1\ mile} \times \left(199.11 \times 10^{-9} \frac{rad}{sec.}\right)$$

$$= 97.77 \times 10^3 \frac{ft}{sec.} \times \frac{60\ mph}{88\ ft/sec.} = 66.7 \times 10^3\ mph.$$

$A_{TOT} = A^n + A^t = r\omega^2 + r\alpha$ No angular acceleration.

$= r\omega^2$ CENTRIPETAL ACC. ONLY

$$= (93 \times 10^6\ mi.) \times \frac{5280\ ft}{mi.} \times \left(199.11 \times 10^{-9} \frac{rad}{sec.}\right)^2$$

$A^n = 1.9467 \times 10^{-2} \frac{ft}{sec^2} = 0.0195 \frac{ft}{sec^2}$ Interesting!