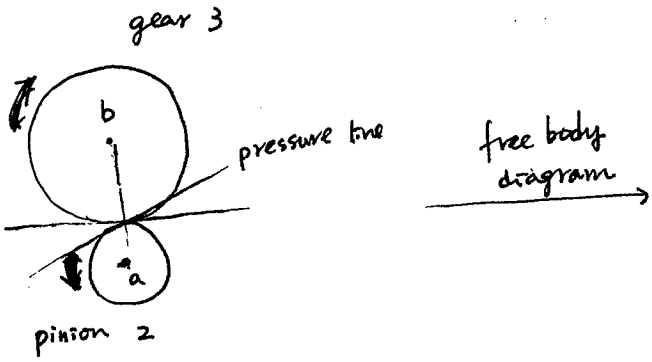
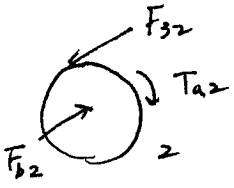
Gear Force Analysis – Spur Gears

F_{32} ⇒ force from gear 3 to gear 2

F_{a2} ⇒ force from shaft a to gear 2





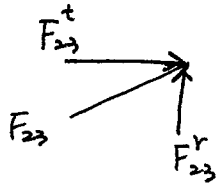
t : tangential

r : radial

gear 3

Transmitted load → $W_t = F_{23}\cos\phi$

$\text{Torque} = W_t \cdot \frac{d_3}{2} = T_{b3}$



$W_r = F_{23}\sin\phi$

$W_t \cdot \frac{d}{2} = \text{Torque}$

$H.P.\ (\text{Horse Power}) = \frac{W_t \cdot V}{33000}$ (tangential force)

$V = \frac{\pi d n}{12}$ feet/min (d: in → pitch diameter; n: rpm)

$W_{att} = \text{Torque} \cdot \omega$ (Torque: N.m or lb.in; ω: rad/sec)

$= \text{Torque} \cdot \frac{2\pi n}{60}$

$= \frac{\text{Torque}\ (\text{lb.in}) \cdot 2\pi n}{33000 \cdot 12}$

pitch velocity V_p often used to characterize speed of gears

$$V = \frac{\pi \cdot d n}{12}$$ d: inch (pitch diameter)
n: rpm
V: ft/min

horse power transmitted

$$H = \frac{W_t \cdot V}{33000}$$ W_t in lb, V_p in ft/min

$$= \frac{W_t \pi d n}{33000 \cdot 12}$$

see example 13-5 yourself

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
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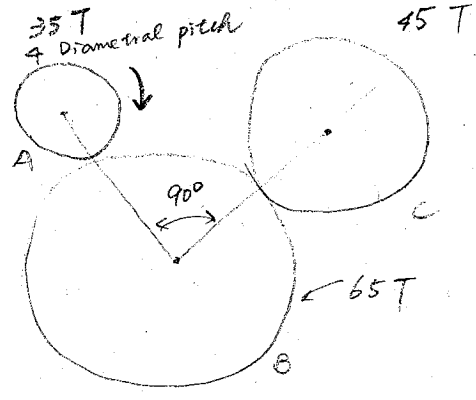
ex/



A: 4 hp at 600 rpm
pressure angle 20°

(1) torque each shaft must transmit

(2) tooth load each gear must be designed

(3) force applied to the idler shaft

Diametral pitch $= \frac{N}{d}$

(1)

$d_A = \frac{35}{4} = 8\frac{3}{4}$ in

$d_B = \frac{65}{4} = 16\frac{1}{4}$ in

$d_C = \frac{45}{4} = 11\frac{1}{4}$ in

horse power on A $4 = \frac{W_t \cdot \pi \cdot 8\frac{3}{4} \cdot 600}{33000 \quad 12} \Rightarrow W_t = 96.04$ lb

Torque on A $= W_t \cdot \frac{d_A}{2} = 96.04 \cdot \frac{8\frac{3}{4}}{2} = 420$ lb-in

" " B $= 0$ (∵ B is idler, no power (torque) out put

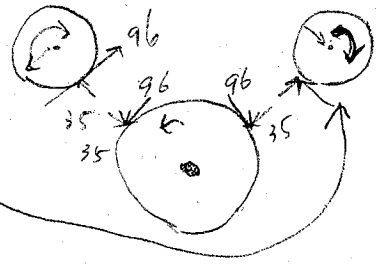
" " C $=$?

power $= T_A W_A = T_B W_B = T_C W_C$

$\rightarrow w_c = W_A \frac{N_A}{N_C} = W_A \cdot \frac{d_A}{d_C}$

$$4 = \frac{W_t \cdot \pi \cdot 11\frac{1}{4} \cdot 600 \cdot \left[\frac{8\frac{3}{4}}{11\frac{1}{4}}\right]}{33000 \quad 12}$$

$\Rightarrow W_t = 96.04$



Torque at C $= W_{t,c} \cdot \frac{d_c}{2}$

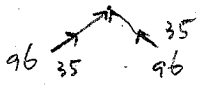
$= 96.04 \cdot \frac{11\frac{1}{4}}{2} = 540$ lb.in

(2) force

tangential force $W_{t,A} = 96$

redial " $W_{r,A} = 96 \cdot \tan 20° = 35$

(3) force at idler



$F_B = \sqrt{(96+35)^2 + (96+35)^2} = 185$ lb

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