- example for power screw

problems 8-5, 8-6

load = 5000 lb

ACME TREADS $p = \frac{1}{2}''$ = lead $\ell = np$ (n=1 lead) Diameter = 3" $\mu = 0.05$

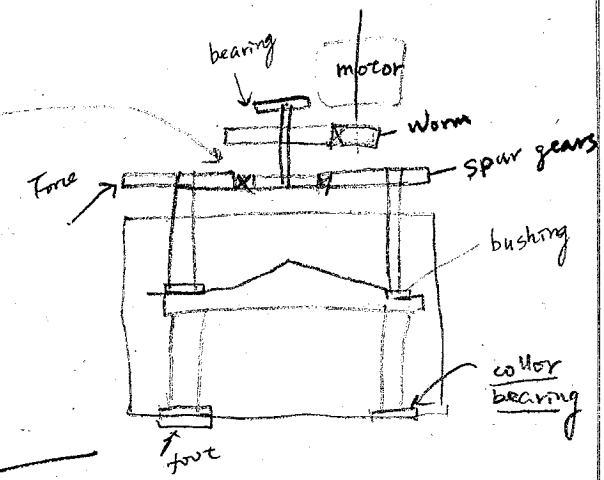
motor 1720 rpm

$\mu_c = 0.06$

$d_c = 5''$

gear efficiency $e_b$ = 95%

Speed ratio = 75 : 1 (gears)

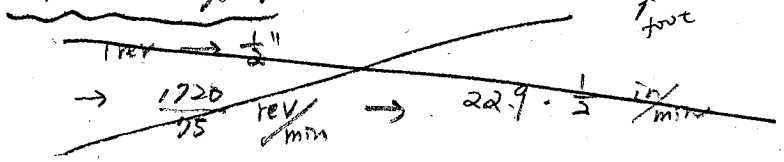



⇒ horse power rating of the motor ?

Sol:

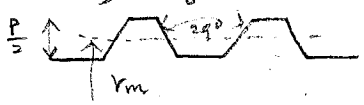
motor 1720 rpm

Speed ration 75:1




Full load 5000 lb → each screw → 2500 lb preferred pitch

ACME thread, Fig 8.3 , $p = \frac{1}{2}''$ → d = ?




$$T_{raise} = \frac{F d_m}{2}\left(\frac{\ell + \pi \mu d_m \sec\alpha}{\pi d_m - \mu \ell \sec\alpha}\right) + \frac{F \mu_c d_c}{2}$$

(raise: F → 2500; $\mu$ → 0.05; $\mu_c$ → 0.06; $d_c$ → 5)

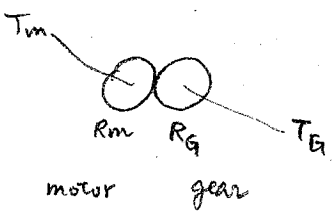
$r_m$ =

$d_m = d - \frac{p}{2} = 3 - \frac{\frac{1}{2}}{2} = 2.75''$

$2\alpha = 29° \rightarrow \sec\alpha = 1.033$

$$T_G = \frac{2500 \cdot \frac{2.75}{2}}{2}\left(\frac{\frac{1}{2} + \pi \cdot (0.05)\, 2.75 \cdot 1.033}{\pi (2.75) - (0.05)\,\frac{1}{2}\,(1.033)}\right) + \frac{2500 \cdot 0.06 \cdot 5}{2}$$

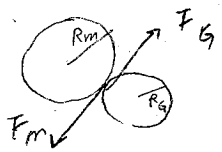
$= 753$ lb-in → 77.6 → 375




distance is the same

$\text{Speed}_m \cdot R_m = \text{Speed}_G \cdot R_G$

$\Rightarrow \frac{\text{Speed}_m}{\text{Speed}_G} = 75 = \frac{R_G}{R_m}$




Force is the same

$F_m = F_G$

torque

$F_m \cdot R_m = T_m$ $\quad F_G \cdot R_G = T_G$

$\Rightarrow F_m = \frac{T_m}{R_m}$ $\quad \Rightarrow F_G = \frac{T_G}{R_G}$

Torque is proportional to gear radius

$$\frac{T_m}{R_m} = \frac{T_G}{R_G} \Rightarrow T_m = \frac{R_m}{R_G} \cdot T_G$$ torque ratio

Speed is inversely proportional to gear radius

$$\frac{V_m}{V_g} = \frac{R_g}{R_m} = 75 = \frac{T_G}{75} = \frac{753}{75}$$

Horse power = HP (lb·in, shaft speed rev/min)

$$= \frac{T \cdot n}{63000}$$

eg. 9.4K

efficiency 95%

$$= \frac{\left(\frac{753}{75 \cdot 0.95} \cdot 2\right) \cdot 1720}{63000}$$

2 gear side

lost to gears

$T_{mout}$ 95% = $T_m \cdot 2$ → screw

$$\Rightarrow T_{mout} = \frac{753}{75 \cdot 0.95} \cdot 2$$

$$= 0.58 \text{ HP}$$

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go back for bolt