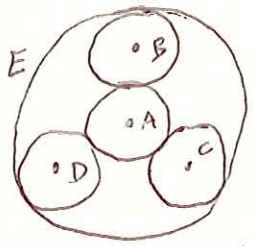
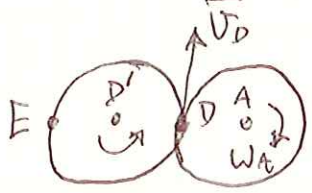
PROB. 15-119



$r_A = r_B = r_C = r_D = 3''$, $r_E = 9''$

$\omega_A = \left(150 \frac{REV}{MIN}\right)\left(\frac{MIN}{60\,s}\right)\left(\frac{2\pi}{REV}\right) = 15.71 \frac{RAD}{s}$ CW

$\alpha_A = 0$ FIND $\vec{a}_D$, $\vec{a}_E$



VELOCITY

GEAR A: $\vec{v}_D = \cancel{\vec{v}_A}^{\,0} + \omega_A \hat{k} \times \vec{r}_{D/A}$

$$\vec{v}_D = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_A \\ -3 & 0 & 0 \end{vmatrix} = -[0 - (\omega_A)(-3)]\hat{j} = (-3\omega_A)\hat{j} \ \frac{IN}{s}$$

$$\vec{v}_D = (-3)(-15.71)\hat{j} = (47.13)\hat{j} \ \frac{IN}{s}$$

GEAR D: $\vec{v}_D = \cancel{\vec{v}_E}^{\,0} + \omega_D \hat{k} \times \vec{r}_{D/E}$ NO SLIPPING

$$\vec{v}_D = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_D \\ 6 & 0 & 0 \end{vmatrix} = -[0 - (\omega_D)(6)]\hat{j} = (6\omega_D)\hat{j}$$

$6\omega_D = 47.13 \Rightarrow \omega_D = 7.855 \frac{RAD}{s}$ ↻

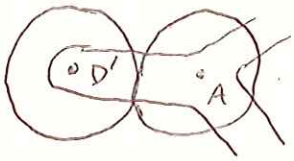
$\vec{v}_{D'} = \cancel{\vec{v}_E}^{\,0} + \omega_D \hat{k} \times \vec{r}_{D'/E}$

$$\vec{v}_{D'} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_D \\ 3 & 0 & 0 \end{vmatrix} = -[0 - (\omega_D)(3)]\hat{j} = (3\omega_D)\hat{j}$$

$$\vec{v}_{D'} = (3)(7.855)\hat{j} = (23.56)\hat{j} \ \frac{IN}{s}$$

PROB. 15-119 CONT.

SPIDER: $\vec{v}_{D'} = \cancel{\vec{v}_A}^{\,0} + \omega_S \vec{r}_{D'/A} = \omega_S(-6)\hat{i}$



$\vec{v}_{D'} = (-6\omega_S)\hat{i}\ \frac{IN}{S}$

$-6\omega_S = 23.56 \Rightarrow \omega_S = -3.927\ \frac{RAD}{S}$ ↻

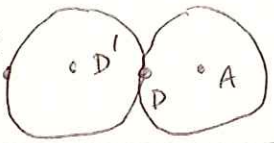
ACCELERATION

SPIDER: $\vec{a}_{D'} = \cancel{\vec{a}_A}^{\,0} + \cancel{\alpha_S \hat{k} \times \vec{r}_{D'/A}}^{\,0} - \omega_S^2 \vec{r}_{D'/A}$

$\alpha_S = 0$ SINCE $\alpha_A = 0$

$\vec{a}_{D'} = -(-3.927)^2(-6)\hat{i} = (92.55)\hat{i}\ \frac{IN}{S^2}$

GEAR D: $\vec{a}_E = \vec{a}_{D'} + \alpha_D \hat{k} \times \vec{r}_{E/D'} - \omega_D^2 \vec{r}_{E/D'}$



$\vec{a}_E = (92.55)\hat{i} - (7.855)^2(-3)\hat{i}$

$\boxed{\vec{a}_E = (277.6)\hat{i}\ \frac{IN}{S^2}}$

$\vec{a}_D = \vec{a}_E + \alpha_D \hat{k} \times \vec{r}_{D/E} - \omega_D^2 \vec{r}_{D/E}$

$\vec{a}_D = (277.6)\hat{i} - (7.855)^2(6)\hat{i}$

$\boxed{\vec{a}_D = (-92.55)\hat{i}\ \frac{IN}{S^2}}$