<u>Dragt 94 cont.</u>

the potential energy stored in the springs is given by

$$V = \frac{1}{2} k \sum_b (\vec{P}_b - \vec{E}_b)^2 = \frac{1}{2} k \sum_b \left(\vec{R}_{CM} + \frac{a}{\sqrt{3}} \hat{f}_b^{*} - \frac{d}{\sqrt{3}} \hat{f}_b \right)^2$$

$$= \frac{1}{2} k \sum_b \left\{ \vec{R}_{CM}^{\,2} + \frac{a^2}{3} + \frac{d^2}{3} + \frac{2a}{\sqrt{3}} \vec{R}_{CM} \cdot \hat{f}_b^{*} - \frac{2d}{\sqrt{3}} \vec{R}_{CM} \cdot \hat{f}_b - \frac{2ad}{3} \hat{f}_b^{*} \cdot \hat{f}_b \right\}$$

$$= \frac{3}{2} k \vec{R}_{CM}^{\,2} + \frac{1}{2} k (a^2 + d^2) - \frac{kad}{3} \sum_b \hat{f}_b \cdot \hat{f}_b^{*}$$ since

$\sum_b \vec{R}_{CM} \cdot \hat{f}_b = 0$ because $\sum_b \hat{f}_b = 0$ etc. Also,

$\hat{f}_b^{*} = \mathcal{R} \hat{f}_b$ where $\mathcal{R}$ is the rotation which rotates $\hat{e}_j$ into $\hat{e}_j^{*}$, $\hat{e}_j^{*} = \mathcal{R} \hat{e}_j$. Thus,

$$\boxed{V = \frac{3}{2} k \vec{R}_{CM}^{\,2} - \frac{kad}{3} \sum_b \hat{f}_b \cdot (\mathcal{R} \hat{f}_b) + \text{constant}}$$ and

we see that V breaks up into a rotational and a