$a[2.\sin n\alpha \cdot \cos(n-1)\alpha]$

Thus, $2A\cos\phi \sin\alpha = a[2\sin n\alpha \cdot \cos(n-1)\alpha]$

$$\therefore A\cos\phi = \frac{[a\sin n\alpha \cdot \cos(n-1)\alpha]}{\sin\alpha} \quad -(3)$$

Multiplying equation (1) by $2\sin\alpha$ and proceeding in a similar way it can shown that

$$A\sin\phi = \frac{[a\sin n\alpha \sin(n-1)\alpha]}{\sin\alpha} \quad ---(4)$$

Squaring equations (3) & (4) & adding,

$$A^2 = A^2(\sin^2\phi + \cos^2\phi)$$

$$= \frac{a^2\sin^2 n\alpha}{\sin^2\alpha}[\sin^2(n-1)\alpha + \cos^2(n-1)\alpha$$

$$= \frac{a^2\sin^2 n\alpha}{\sin^2\alpha}$$

$$\therefore A = a\sin n\alpha / \sin\alpha$$

Dividing eq. (4) by (3) we get

$$\tan\phi = \frac{A\sin\alpha}{A\cos\phi}$$

$$= \frac{a\sin n\alpha \cdot \sin(n-1)\alpha \cdot \sin\alpha}{\sin\alpha \cdot a\sin n\alpha \cdot \cos(n-1)\alpha}$$

$$= \tan(n-1)\alpha$$

$$\therefore \phi = (n-1)\alpha$$

where ϕ represents the epoch angle for the resultant vibration, n is the no. of SHMs vibrations