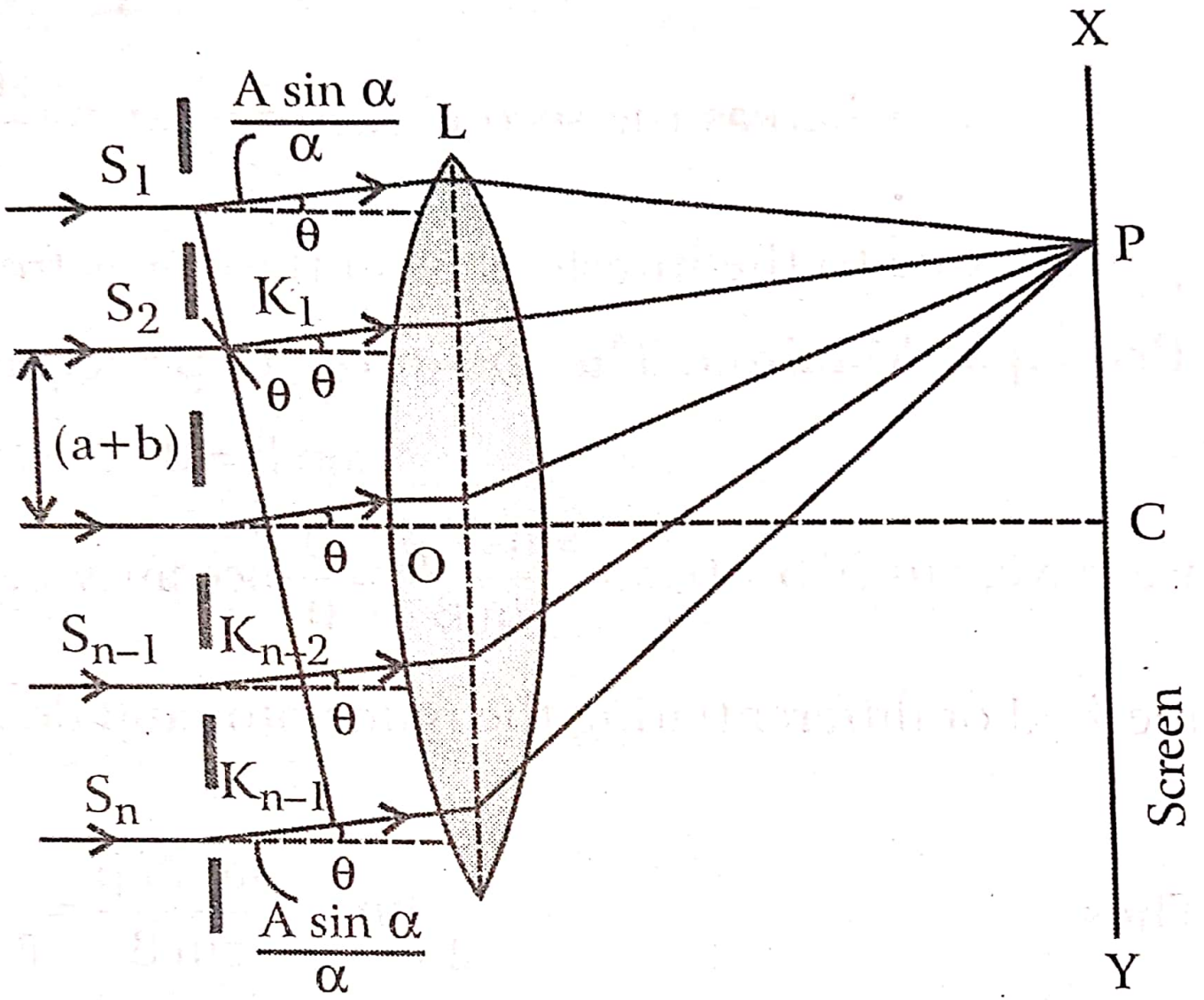


Fig. 12

Diffraction at N-Slit

(1) Path difference $= (a+b)\sin\theta$.

(2) Phase difference $= \frac{2\pi}{\lambda}(a+b)\sin\theta = 2\beta$.

(3) $\boxed{\beta = \frac{\pi}{\lambda}(a+b)\sin\theta}$

(4) Resultant amplitude $R' = A\frac{\sin\alpha}{\alpha}\frac{\sin N\beta}{\sin\beta}$

Resultant intensity at P.

$$I = R'^2 = A^2\frac{\sin^2\alpha}{\alpha^2}\cdot\frac{\sin^2 N\beta}{\sin^2\beta}.$$

(5) Principal maxima.

$\sin\beta = 0$ | $\boxed{\beta = \pm n\pi}$

$\therefore \beta \to \pm n\pi$ $\frac{\sin N\beta}{\sin\beta} = \lim_{\beta\to\pm n\pi}\frac{d}{d\beta}\frac{\sin N\beta}{\sin\beta}$ = [illegible]

$= N$

$\boxed{\therefore I \propto N^2}$ for Principal maxima.

$$\boxed{I = A^2\frac{\sin^2\alpha}{\alpha^2}N^2}$$

$$\boxed{(a+b)\sin\theta = \pm n\lambda}$$

(6) Minima.

$\sin N\beta = 0$ | $\sin\beta \neq 0$

$$\boxed{N\beta = \pm m\pi}$$

$$\boxed{N(a+b)\sin\theta = \pm m\lambda}$$

$m \neq 0, N, 2N, 3N, \ldots$

$m = 1, 2, 3, \ldots\ldots N-1$

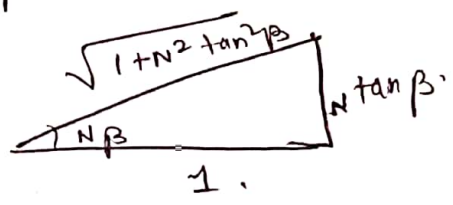
$\therefore (N-1)$ minima b/w two successive principal max.

N-slit

(7) Secondary maxima.

$$\frac{dI}{d\beta} = 0 \Rightarrow A^2 \frac{\sin^2\alpha}{\alpha^2} \cdot 2\left[\frac{\sin N\beta}{\sin\beta}\right] \frac{N\cos N\beta \sin\beta - \sin N\beta \cos\beta}{\sin^2\beta} = 0,$$

$$\therefore \tan N\beta = N \tan\beta$$



$$\sin N\beta = \frac{N\tan\beta}{\sqrt{1+N^2\tan^2\beta}}$$

$$\frac{\sin^2 N\beta}{\sin^2\beta} = \frac{(N^2\tan^2\beta)/(1+N^2\tan^2\beta)}{\sin^2\beta}$$

$$= \frac{N^2\tan^2\beta}{(1+N^2\tan^2\beta)\sin^2\beta}$$

$$= \frac{N^2}{1+(N^2-1)\sin^2\beta}$$

$$I'_{SM} = A^2 \frac{\sin^2\alpha}{\alpha^2} \cdot \frac{N^2}{[1+(N^2-1)\sin^2\beta]}$$

Ration ⟶

$$\frac{I_{SM}}{I_{PM}} = \frac{1}{1+(N^2-1)\sin^2\beta}.$$

greater the value of N, the weaker are Secondary maxima.

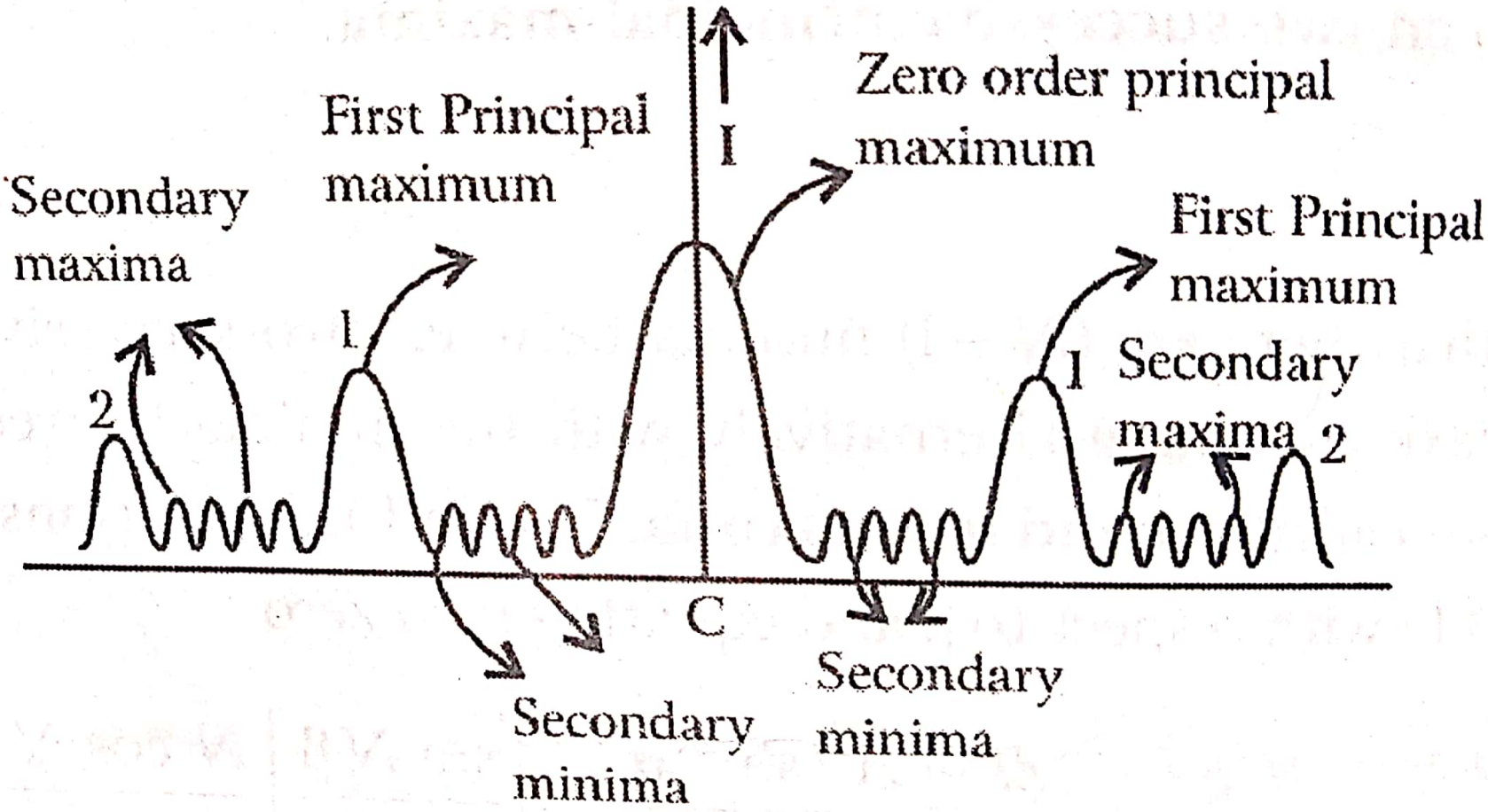


Fig. 14