Diffraction Grating: [Plane Transmission grating]

Diffraction grating is an optical instrument consisting of large number of narrow parallel slits (transparent lines) of equal widths and which are separated from one another by equal sized opaque spaces.

If, $a = width\ of\ opaque\ space$

$b = width\ of\ transparent\ space$

Then, $(a+b)$ is called as grating element (grating spacing)

Further, If, $N = number\ of\ lines\ per\ unit\ length$

Then, grating element $(\boldsymbol{a}+\boldsymbol{b}) = \frac{1}{N}$

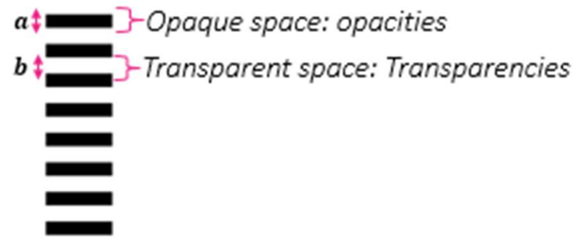

Fig: Plane transmission grating

Note:
If $N\ is\ number\ of\ lines\ per\ mm$
Then, $(a+b) = \frac{1}{N}$; $the\ unit\ of\ (a+b)\ will\ be\ mm.$

- **Diffraction grating is better than two slit set up for measuring wavelength!!!**

By using more slits, we get more interference patterns (both destructive and constructive). Due to this, the maxima become much brighter. This effectively increases the resolution of the experiment, making it easier to measure the distance between consecutive maxima more accurately. Hence, calculation of wavelength will be more accurate.

Theory of diffraction grating:

The diffraction of plane wavefront through diffraction grating is shown in figure.

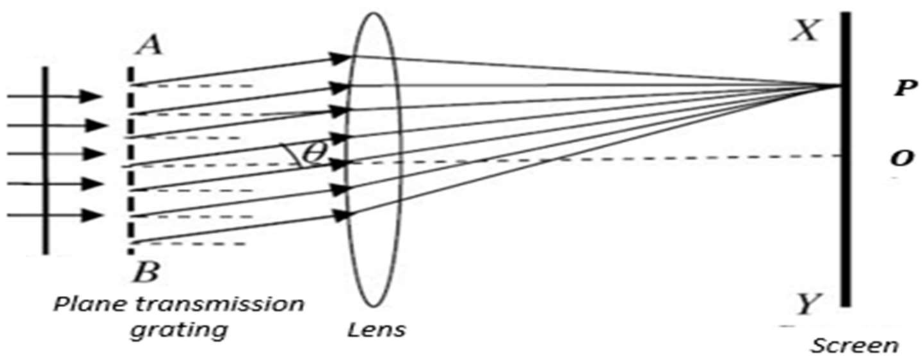

Figure: Diffraction through diffraction grating

Here, point O is equidistant from each slit on either side of the center of diffraction grating. Hence, point O is the point of central maximum.

Consider a point P on the screen. The path difference between two waves reaching point P from two consecutive slits is:

$$Path\ difference = (a+b)\ sin\theta \qquad [\because \text{for any two successive slits}]$$

Note that, in diffraction grating, the diffraction pattern with multiple slits appears as interference pattern in double slit experiment. i.e., the condition for maxima will be:

$$path\ difference = n\lambda \qquad ; n = 1,2,3, \dots \dots \dots$$

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