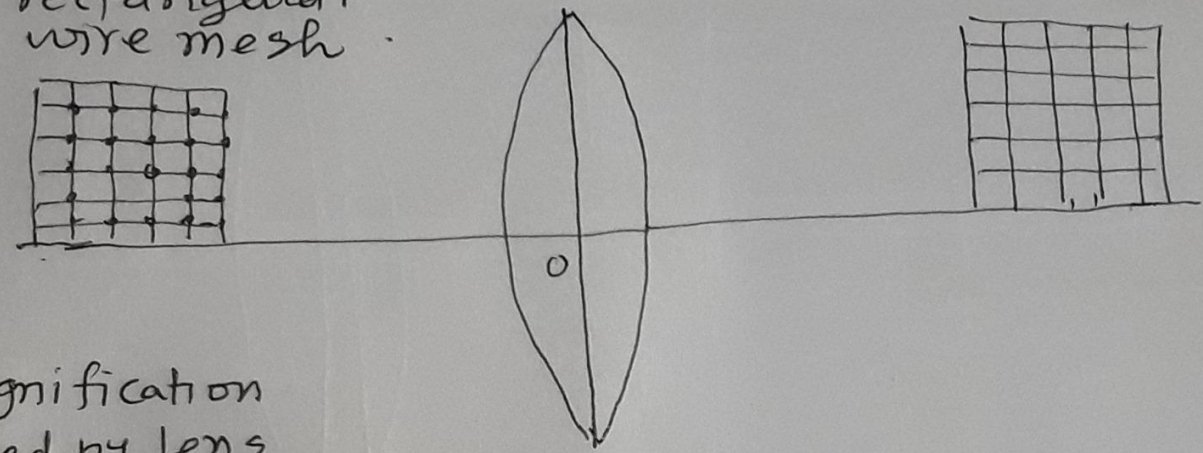
Distortion aberration

The various monochromatic aberrations (spherical aberrations, coma, astigmatism and curvature) are reduced by using stops. However, even using the stops, the image of plane square-like object (perpendicular to the axis) formed is not of shape are square object. This defect in image is known as distortion. It arises due to variation of magnification produced by a lens for different axial distances of square object. This distortion is of two types:

(1) Pin-cushion distortion, and

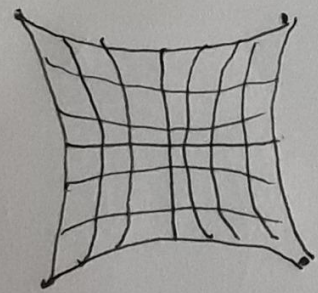
(2) Barrel-shaped distortion

rectangular wire mesh.

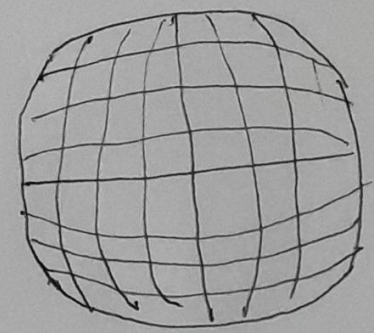


The magnification produced by lens for different object points is different.

This is the reason for producing distortion

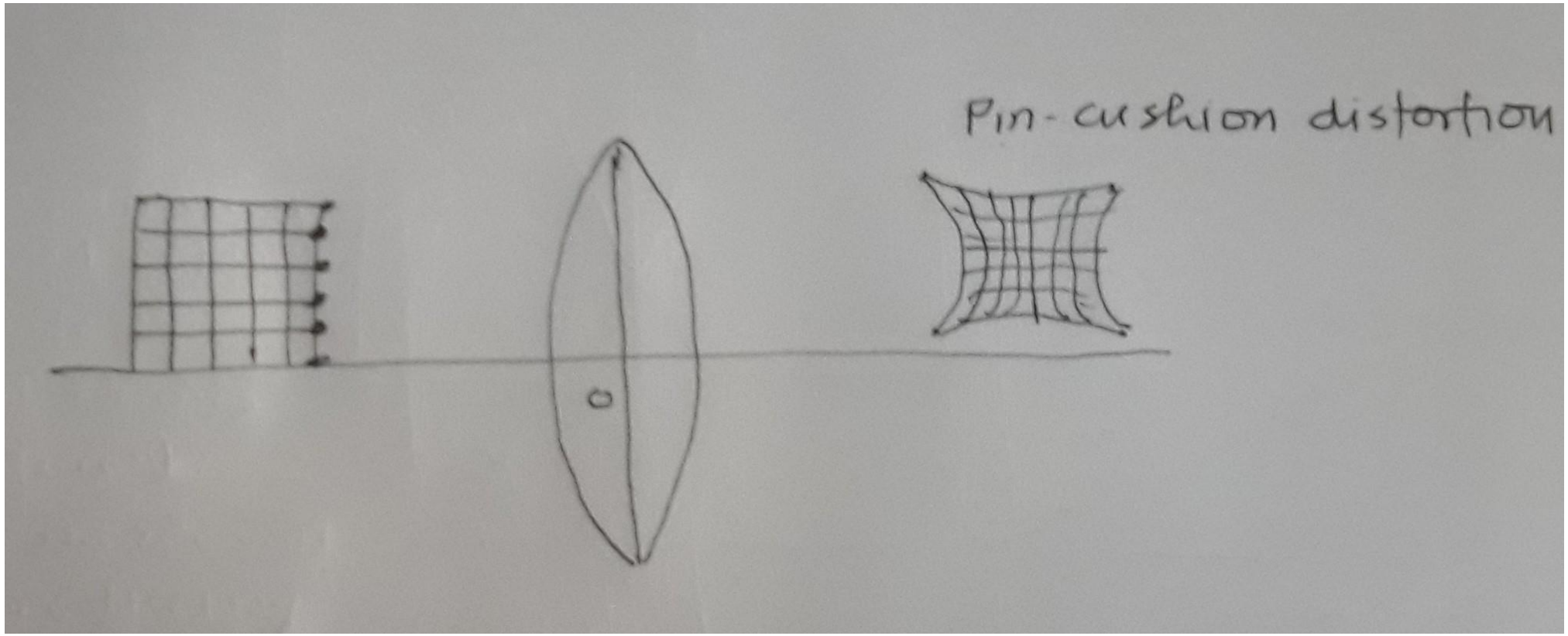


Pin-cushion distortion

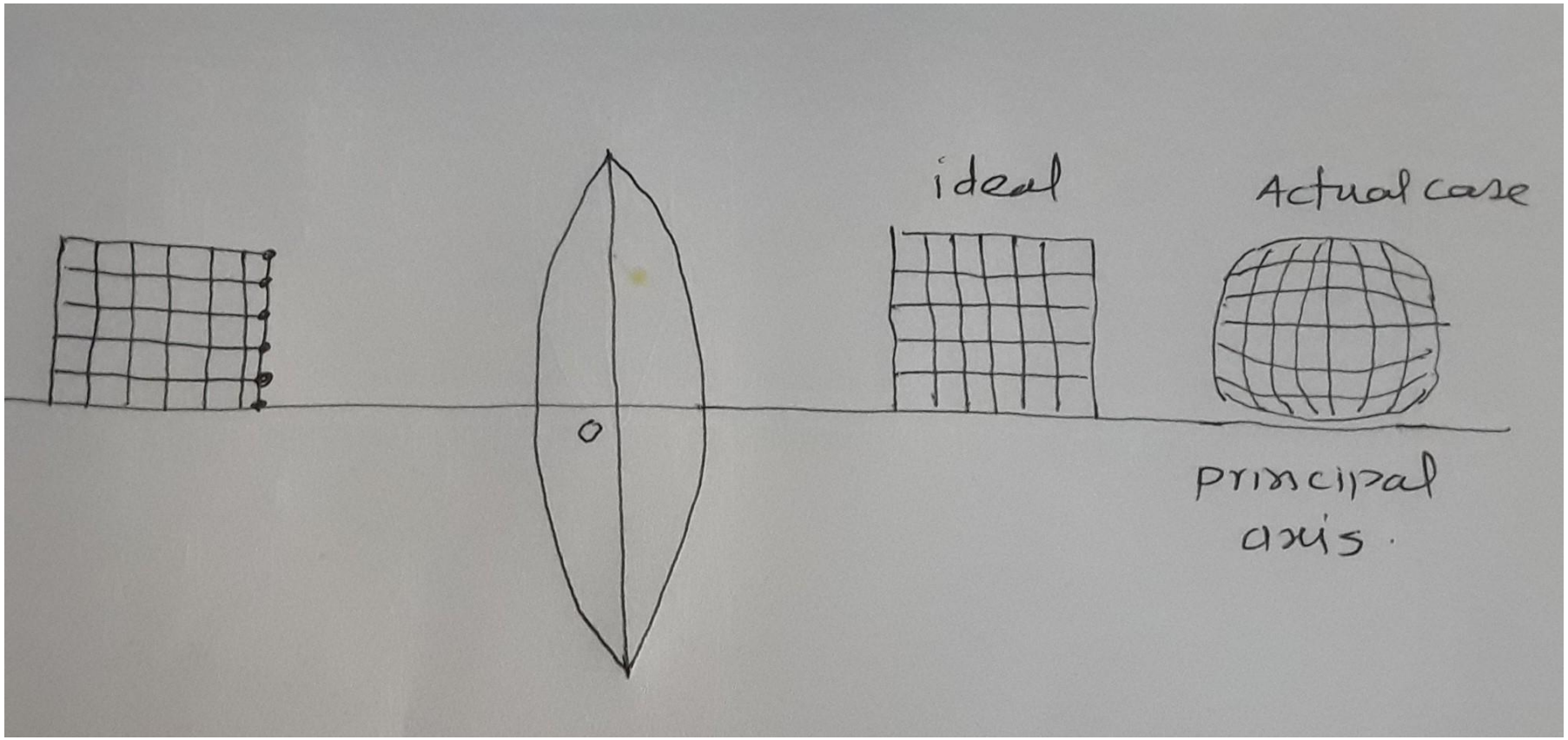


Barrel-shaped distortion

Pin-cushion distortion: If the magnification produced by the lens increases with the increase in distance of object points from axis, then outer parts of the image field of view are pulled outward such kind of aberration is called pin-cushion distortion.

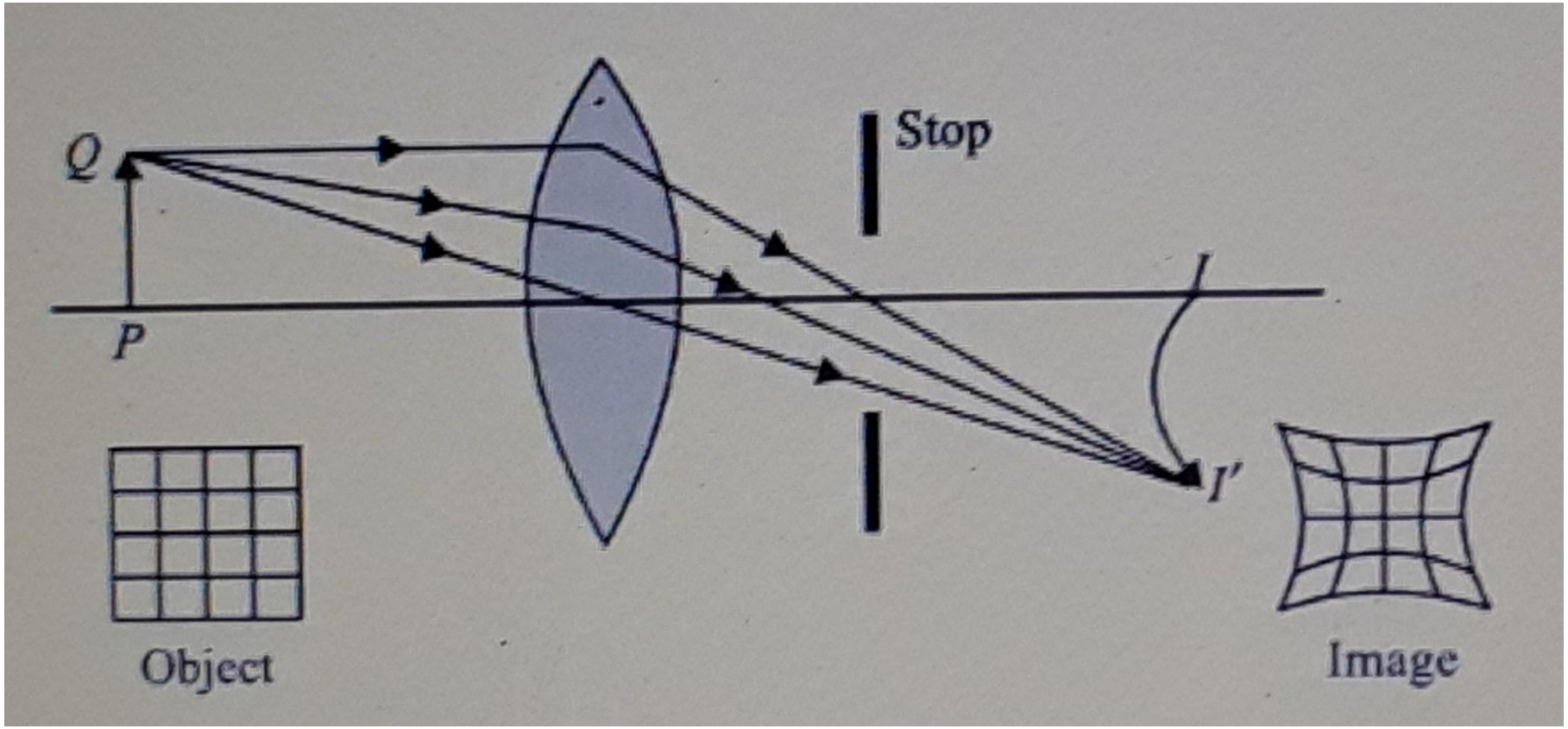


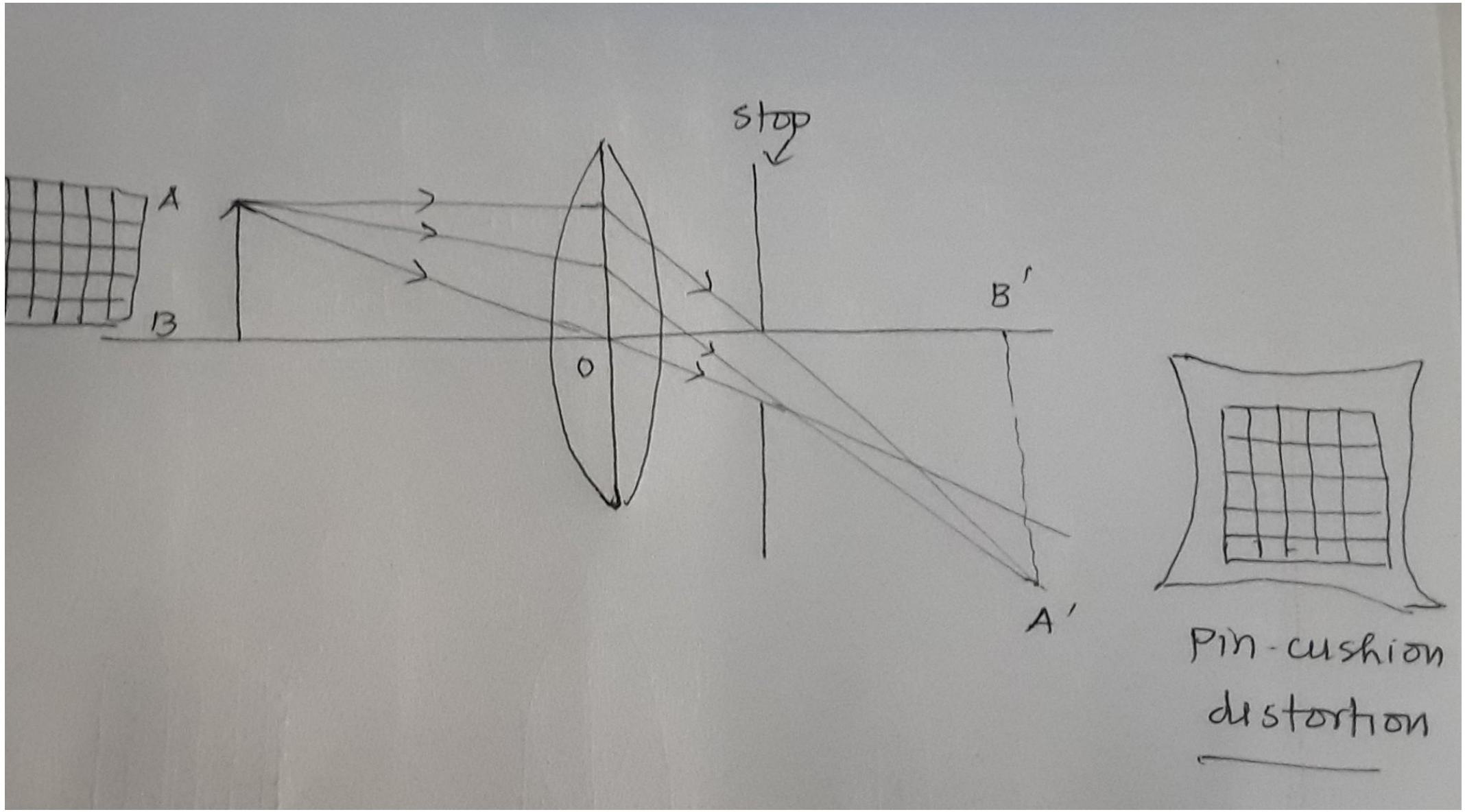
Barrel-shaped distortion: If the magnification produced by the lens decreases with the increase in distance of object points from axis, then outer parts of the image field of view are pulled inward such kind of aberration is called Barrel-shaped distortion.



Pin-cushion distortion

When stop is placed towards image side, then the magnification of the outer regions of the square object is greater than the magnification of the central portion and, hence, image gets the shape of pin-cushion as shown in Fig. 2

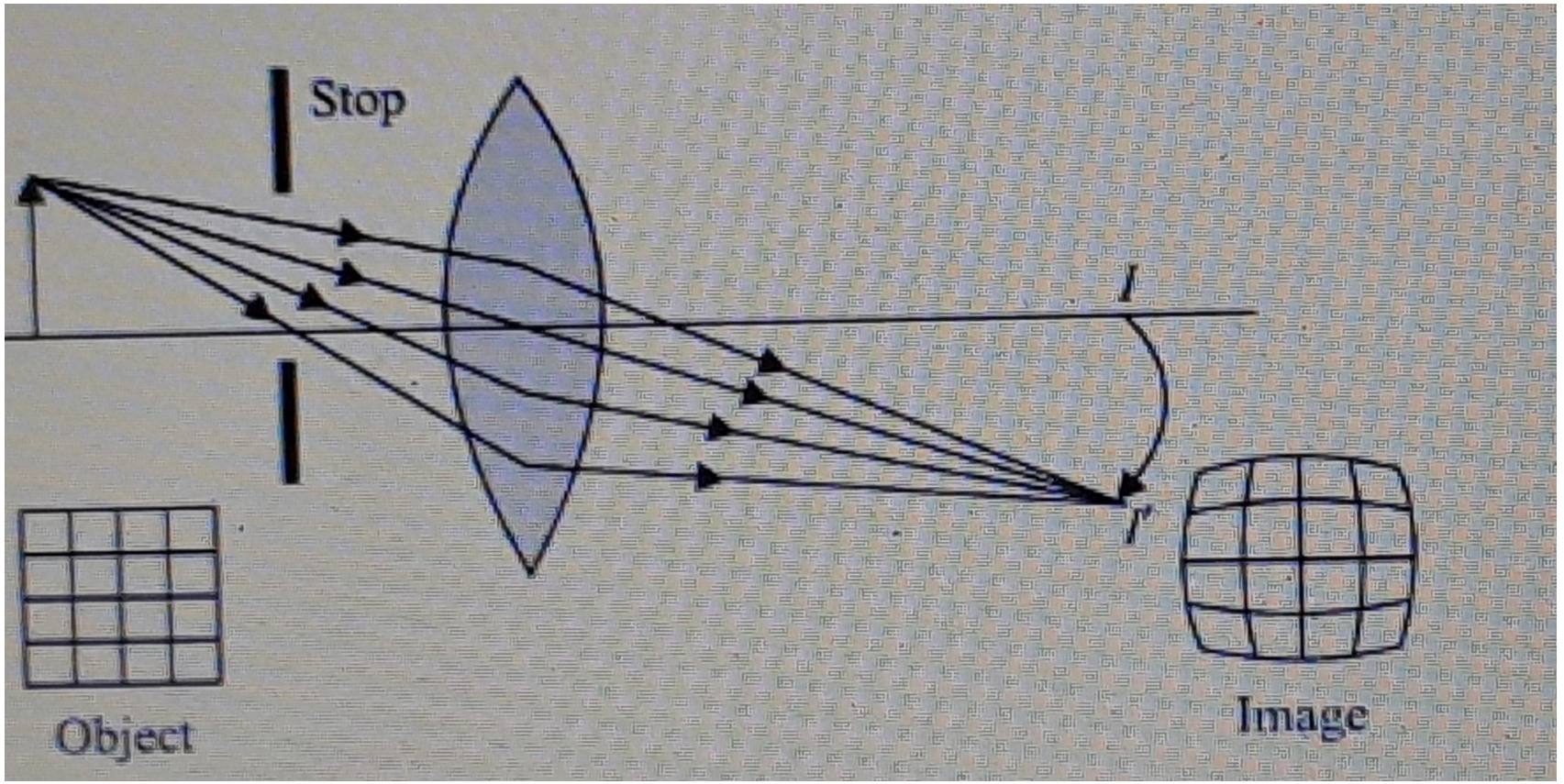


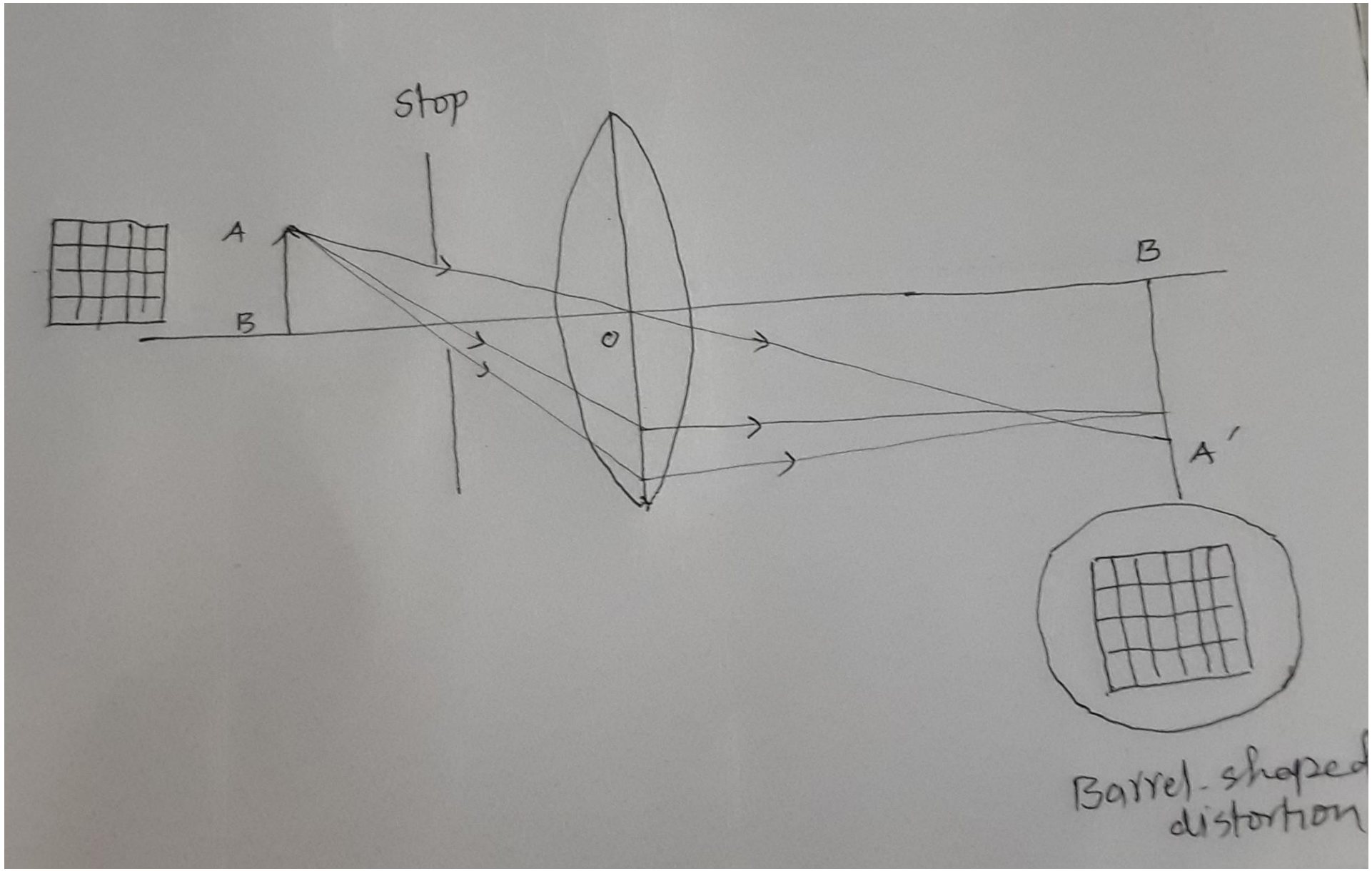


Pin-cushion distortion

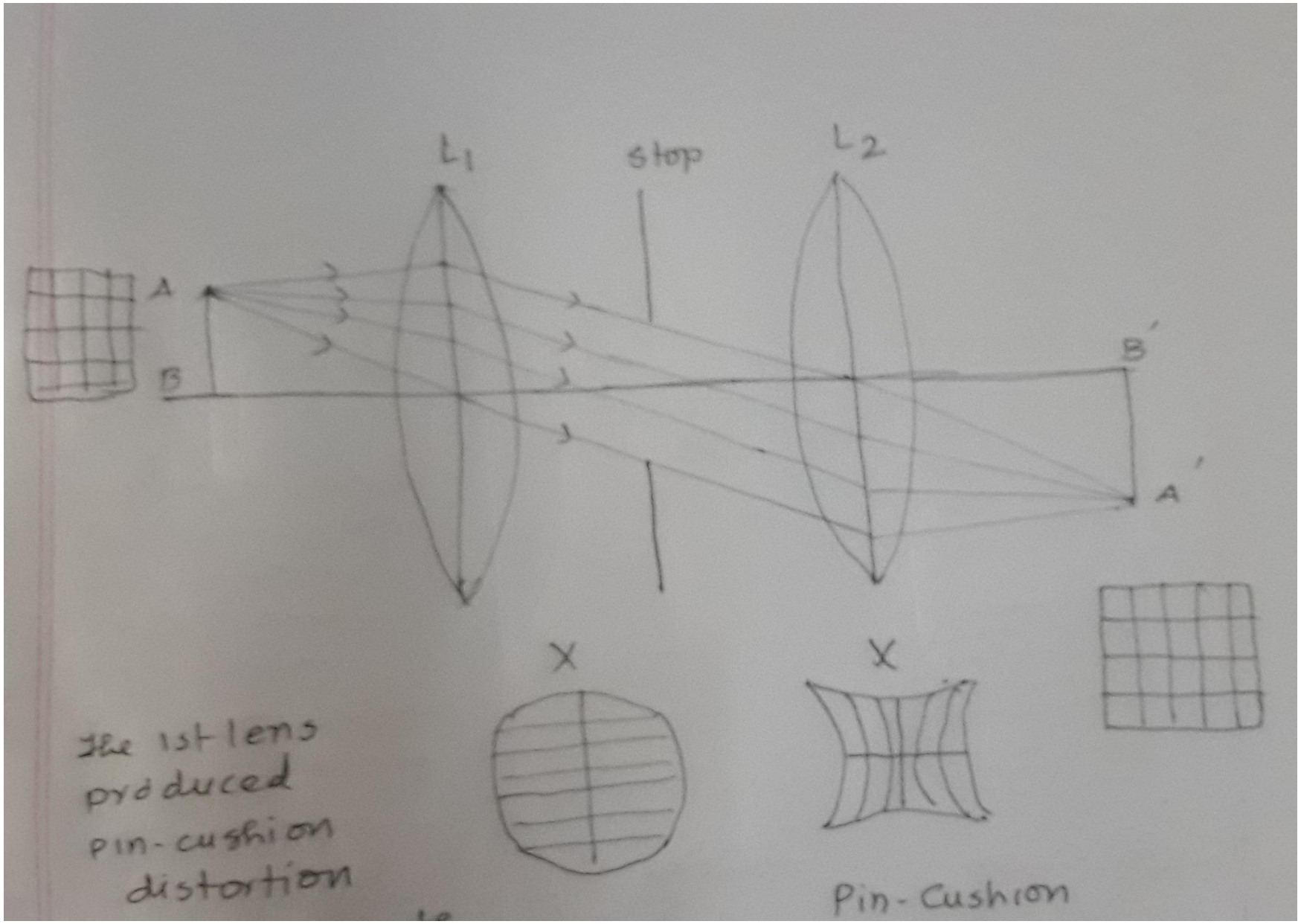
Barrel-shaped distortion

When stop is placed towards the object side (Fig.1), the magnification of the outer regions of the plane square object is smaller than its magnification of the central portion and, consequently, image gets the shape of barrel.




Stop
A
B
O
B
A'
Barrel-shaped distortion

Removal of distortion



Removal of distortion

To remove distortion, the two meniscus lenses are placed such that the concave surfaces of two lenses face each other. Now place an aperture stop between the two lenses as shown in Fig. 3