PH 102 PROJECT

TELESCOPE

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Introduction

The night sky always attracted people by its charming mystery. Observers had been using naked eyes for their explorations for many centuries. Obviously, they could not achieve a lot due to eyesight limitations. It cannot be estimated, how important the invention of telescopes was for astronomers. It opened an enormous field for visual observations, which had led to many brilliant discoveries. That happened in 1608, when the German-born Dutch eyeglass maker had guessed to combine several lenses and created the first telescope [PRAS]. This occasion is now almost forgotten, because no inventions were made but a Dutchman. His device was not used for astronomical purposes, and it found its application in military use. The event, which remains in people memories, is the Galilean invention of his first telescope in 1609. The first Galilean optical tube was very simple, it could only magnify objects three times. After several modifications, the scientist achieved higher optical power. This helped him to observe the Venusian phases, lunar craters and four Jovian satellites. The main tasks of a telescope are the following:

- Gathering as much light radiation as possible
- Increasing an angular separation between objects
- Creating a focused image of an object

We have now achieved high technical level, which enables us to create colossal telescopes, reaching distant regions of the Universe and making great discoveries.

Telescope components

The main parts of which any telescope consists with are the following:

- Primary lens for refracting telescopes, which is the main component of a device. Bigger the lens, more light a telescope can gather, and fainter objects can be viewed.
- Eyepiece, which magnifies the image.
- Mounting, which supports the tube, enabling it to be rotated.

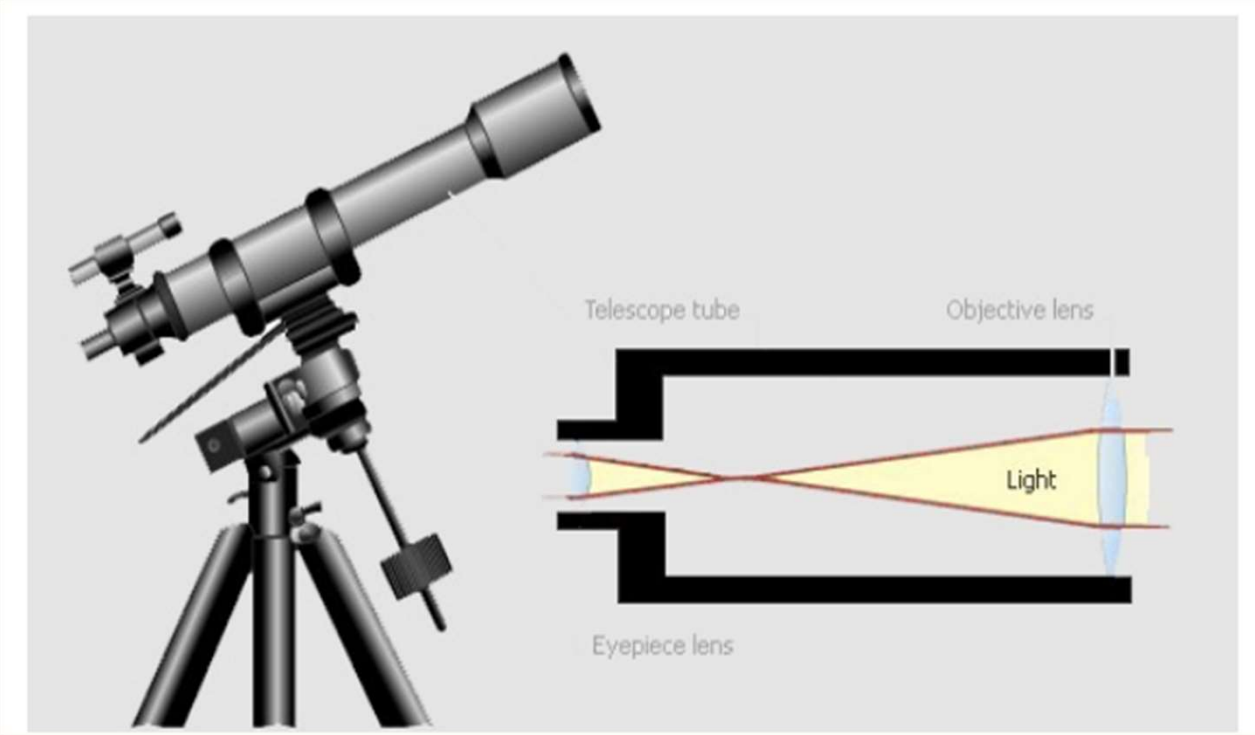
Note: • For reflecting telescopes Primary mirror is used in place of primary lens which carries the same role as the primary lens in a refracting telescopes

Telescopes can be divided into two main categories

- Refracting telescopes
- Reflecting telescope

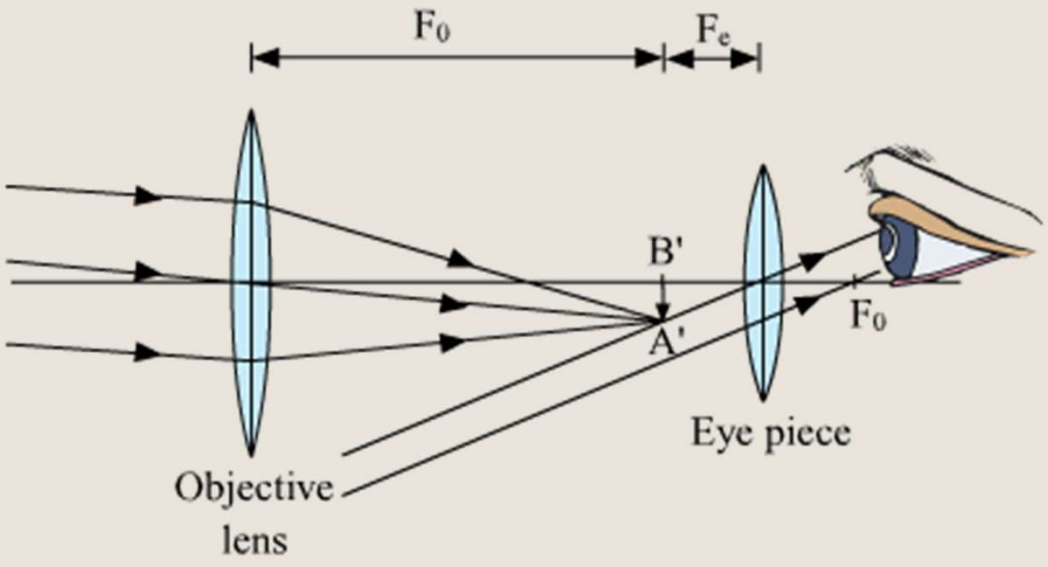
Refracting telescopes

The history of refractor's invention was discussed in the introduction part. Refractor is the simplest type of telescopes, which combines two lenses at the ends of a tube. As mentioned above, the main component of this type of 2 telescope is the primary lens – the objective. A concave lens is used as an objective of a refractor. It defines how faint objects can be viewed. The eyepiece, another concave lens, is placed at the other end of the tube. It defines the magnification of an object observed.



Working of telescope

Telescope consists of two lenses: objective and eyepiece. Objective has larger focal length and diameter to accommodate maximum amount of light coming from the far away (astronomical) objects. A parallel beam of rays from an astronomical object is made to fall on the objective lens of the telescope. It forms a real, inverted and diminished image A'B' of the object. The eyepiece is so adjusted that A'B' lies just at the focus of the eye piece. Therefore, a highly magnified image of the object is formed at infinity. The same has been shown in the figure below.



A telescope's ability to collect light is directly related to the diameter of the lens or mirror -- the aperture -- that is used to gather light. Generally, the larger the aperture, more light the telescope collects and brings to focus, and the brighter the final image. The telescope's magnification, its ability to enlarge an image, depends on the combination of lenses used. The eyepiece performs the magnification. Magnifying Power is a measure of the extent to which an object can be enlarged/magnified through a telescope.

The formula for the **magnifying power** of a telescope is

- $M = f_o/f_e$

Where,

- m is the magnifying power.
- fo is the focal length of the objective.
- fe is the focal length of the eyepiece.

The magnifying power of a telescope can also be given through the formula:

- $M=f_o(1+f_e/D)/f_e$

Here,

- d is the least distance of distinct vision

Resolving power of a telescope is defined as the reciprocal of the smallest angle subtended at the objective lens of the telescope by two-point objects which can be just distinguished as separate.

Resolving power of telescope is given by :

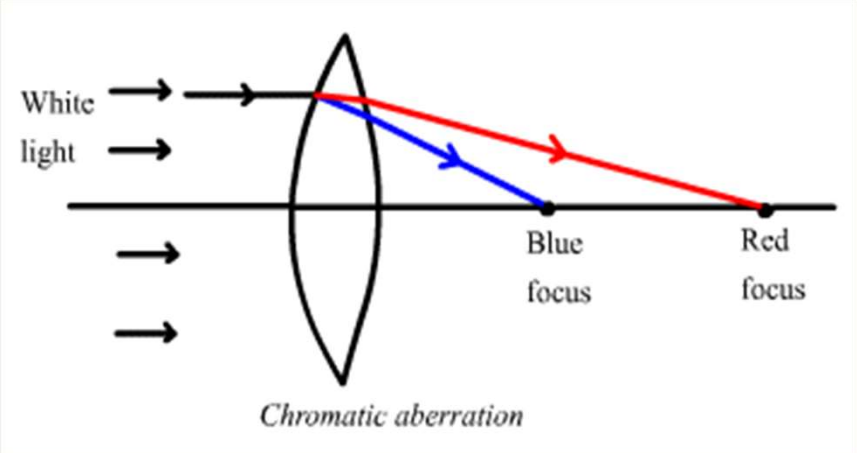
➢Resolving Power = D/d = a / 1.22 λ

Where,

- λ = 589 nm mean wavelength of light used
- D = is distance of the objects from objective of the telescope.
- d - is distance between two consecutive slits or objects
- a - is critical width of the rectangular slit for just resolution of two slits or objects.

limitations

1. Very high initial cost relative to reflector
2. A certain amount of secondary spectrum (chromatic aberration) unavoidable (reflector completely free of this)
The colours cannot focus at one point



Chromatic aberration

3. Long focal ratios can mean that the instrument is cumbersome

Conclusion

- Telescopes are more the achievement of eyeglass makers than the invention of scientists. We can now see, how important opticians' device became for the astronomers. Telescope observations proved that the Earth is not the center of the Universe, and that the Solar System consists of several planets and their satellites. The optics is constantly modified and better telescopes are being produced for better views.

BY:

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(Fixing, Cutting, Design, Report)

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