Unit-3
Automotive Accessories & Lighting Systems

By,
Mr. A J Bhosale
Asst. Professor
Dept. of Automobile Engineering
Govt. College of Engineering and Research, Avsari (Kd)

Syllabus:

- Vehicle lighting System: Head& Side lamps/Indicators, Fog lamps, Brake lights, High Intensity Discharge headlamps, LED lighting ,Advanced front lighting system (AFS), Headlamp leveling & Adjustments, Dash board Indicators: Fuel gauge, oil pressure gauge, Temperature gauges, Speedometer, Warning Lights, Electric horn, Horn relay, Wind shield wipers, Power window, Head-up display (HUD)

Introduction

- Vehicle lighting systems are very important, particularly where road safety is concerned. If headlights were suddenly to fail at night and at high speed, the result could be catastrophic.
- Many techniques have been used, ranging from automatic changeover circuits to thermal circuit breakers, which pulse the lights rather than putting them out as a blown fuse would.
- Modern wiring systems fuse each bulb filament separately and even if the main supply to the headlights failed, it is likely that dim-dip would still work.
- We have come a long way since lights such as the Lucas 'King of the road' were in use. These were acetylene lamps!

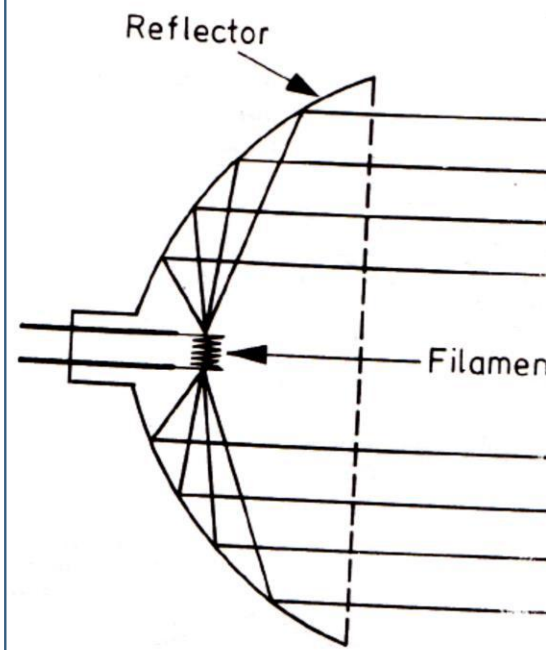
- A key point to remember with vehicle lights is that they must allow the driver to:
  - **See in the dark.**
  - **Be seen in the dark (or conditions of poor visibility).**
- Sidelights, tail lights, brake lights and others are relatively straightforward. Headlights present the most problems, namely that, on dipped beam they must provide adequate light for the driver but without dazzling other road users.
- Many techniques have been tried over the years and great advances have been made, but the conflict between seeing and dazzling is very difficult to overcome. One of the latest developments, ultra-violet (UV) lighting, which is discussed later, shows some promise.

Energy Demand:

- In modern vehicles the demand for the battery current has increased because of widespread use of electric bulbs and other equipment for various purposes.
- In an average car, the lighting system consumes about 70-75% of electrical energy when driven at night.
- In terms of amperage, the consumption may be from 24-40 A at night for all purposes including the radio, heater and transmission controls.

❑ Headlights:

- The headlights are composed of three elements:
  1. The light filament that gives off light when a current flows through it;
  2. The parabolic reflector that reflects the light in front;
  3. The lens that refracts or distorts the light beam into an illuminating pattern.
- The present day headlights are the outcome of a lot of research and development.
- Earlier a single electric bulb of the carbon filament type was employed.
- The bulb was placed at the focus of a parabolic silvered reflector in order to give a parallel beam of light.



ig. 12.1 The parabolic reflector showing light rays en ted from the filament of the bulb.

- Figure shows a parabolic reflector with the bulb, the lines showing light rays emitted from the filament of the bulb in all directions.
- This type of headlight gives a parallel light beam which gives greater illumination nearer the axis. A small amount of light is blocked by bulb itself and the intensity of light falls of towards the outer portion of the beam.
- From figure above, it may be seen that if the bulb filament is moved from position **d**, the focus of reflector to position a, the light beam **dbe** will no longer be a parallel one but will become divergent (**abc**)

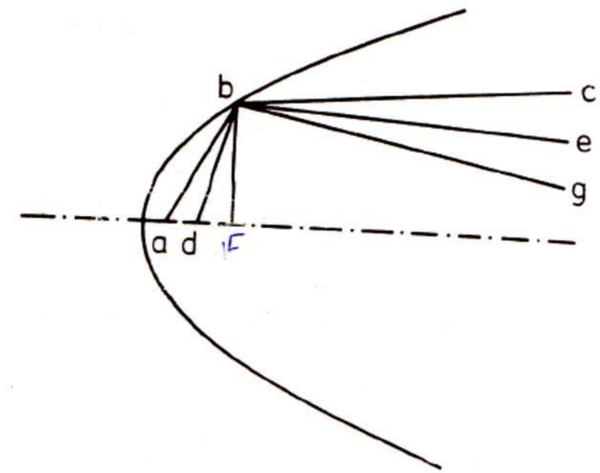


Fig. 12.2 The effect of changing position of filament on the nature of the light beam.

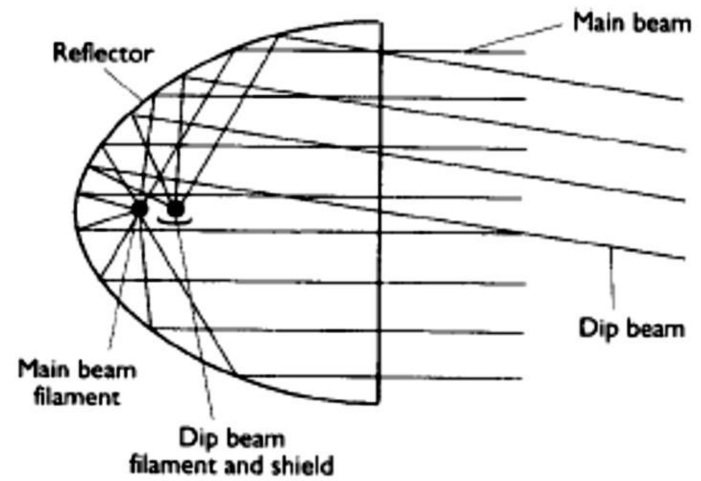


Figure 11.6 Creating a dip beam with a twin filament shielded bulb

- On the contrary, if the filament is moved to position **f** the beam will take the course as shown by **fbg** and will meet at a point on the axis of the bulb.
- By a suitable adjustment of the bulb, the beam can be concentrated at a predetermined distance ahead of the vehicle in order to give a spotlight effect.
- The earlier headlights were provided with certain means of adjusting the bulb-holder with respect to the reflector along the bulb axis in order to focus it. It had to be done up every time the bulb was changed. This was essential, otherwise it would cause increased dazzle to the other motorists.

- The filament is encased in an airtight bulb in order to prevent burning up of the white hot filament because of oxygen in the air.
- The reflector is generally of polished metal and it throws all the light rays into a cylindrical beam.
- The lens is made up of a number glass prisms molded together and they bend the beam of light into an oval pattern which is aimed ahead of the vehicle and somewhat in the downward direction.
- A part of the light is spread out in front of the vehicle for providing local illumination, whereas the rest of it is focused into a hot spot that provides distant illumination.

Sealed-beam Headlights

- Sealed-beam headlights were first introduced in 1940 in the USA. In a sealed-beam head-light, the filament and the reflector along wit the lens are sealed in an airtight unit.

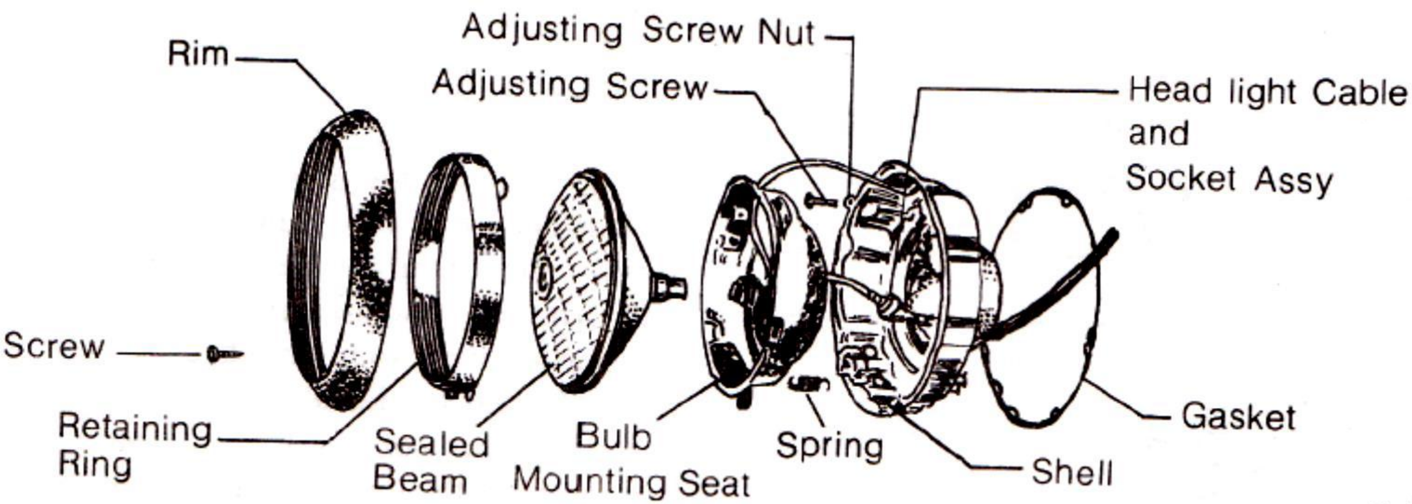


Fig. 12.3 Various components of sealed beam head-light.

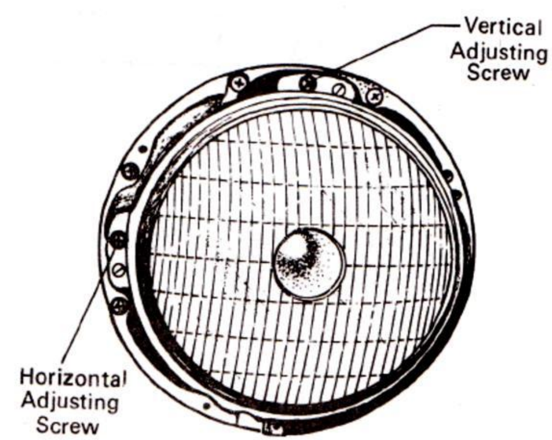


Fig. 12.4 Method of adjusting headlight beam.

- The front face of the sealed beam unit is a lens which is fused to a reflector after the two filament units have been inserted through the centre of the reflector and sealed in position.
- The complete unit is then evacuated and filled with an inert gas. With these units, the only service required is to aim them.

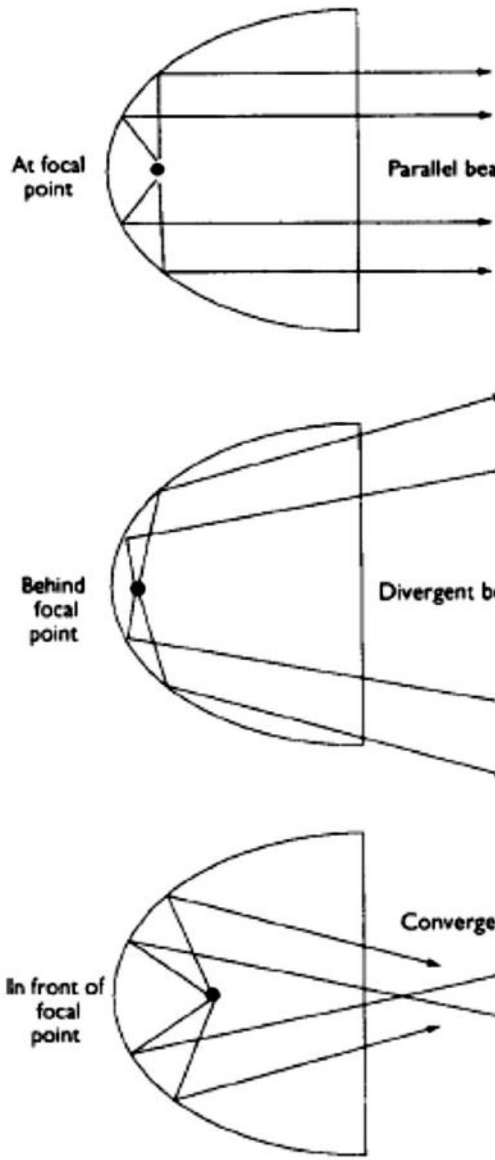
Sealed-beam headlights have the following advantages:

1. The glass unit is self-contained with accurately focused filaments;
2. Dust, moisture, etc. are prevented from entering from the back of the lens and the reflector;
3. A greater amount of light is provided in the beam because of the absence of a filament bulb; and
4. The beam of light obtained is greatly improved due to the pre-focused filament and permanently bright reflector.

❑ Reflectors:

1. Parabolic Reflector

- A parabola is a curve similar in shape to the curved path of a stone thrown forward in the air.
- A parabolic reflector (Figure 11.5(a)) has the property of reflecting rays parallel to the principal axis when a light source is placed at its focal point, no matter where the rays fall on the reflector.
- It therefore produces a bright parallel reflected beam of constant light intensity.
- With a parabolic reflector, most of the light rays from the light-bulb are reflected and only a small amount of direct rays disperses as stray light.



- The intensity of reflected light is strongest near the beam axis, except for light cut-off by the bulb itself. The intensity drops off towards the outer edges of the beam.
- A common type of reflector and bulb arrangement is shown in Figure 11.6 where the dip filament is shielded.
- This gives a nice sharp cut-off line when on dip beam and is used mostly with asymmetric headlights.

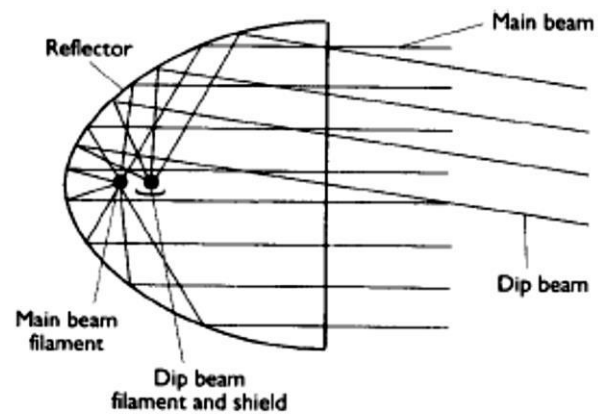
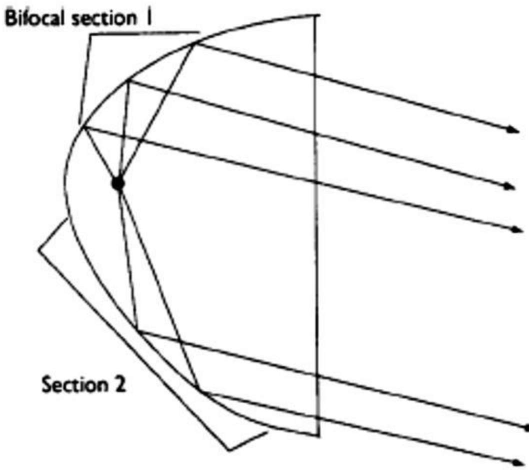


Figure 11.6 Creating a dip beam with a twin filament shielded bulb

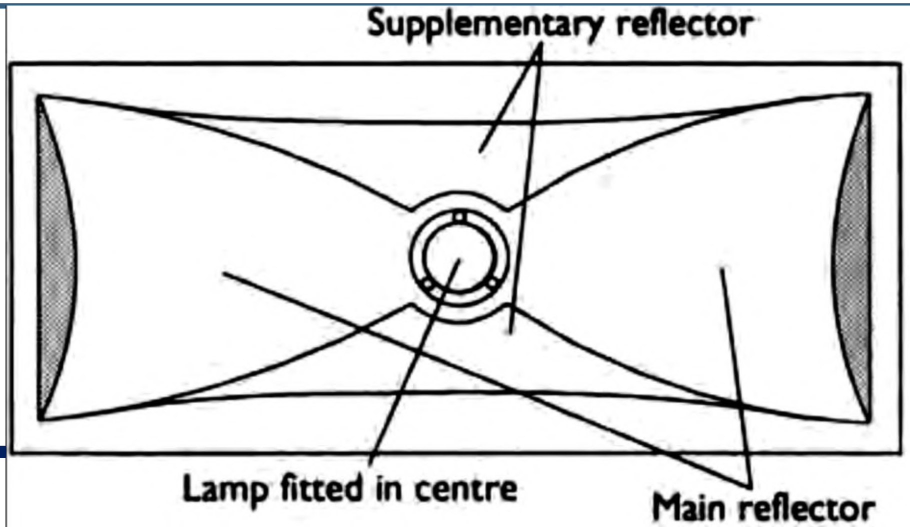
2. Bifocal Reflector

- The bifocal reflector (Figure 11.5(c)) as its name suggests has two reflector sections with different focal points.
- This helps to take advantage of the light striking the lower reflector area.
- The parabolic section in the lower area is designed to reflect light down to improve the near field area just in front of the vehicle.
- This technique is not suitable for twin filament bulbs, it is therefore only used on vehicles with a four-headlight system.
- With the aid of powerful CAD programs, variable focus reflectors can be made with non-parabolic sections to produce a smooth transition between each area.



3. Homifocal reflector

- A homifocal reflector (Figure 11.5(d)) is made up of a number of sections each with a common focal point. This design allows a shorter focal length and hence, overall, the light unit will have less depth.
- The effective luminous flux is also increased. It can be used with a twin filament bulb to provide dip and main beam.
- The light from the main reflector section provides the normal long range lighting and the auxiliary reflectors improve near field and lateral lighting.



4. Poly-ellipsoidal headlight system (PES)

- The poly-ellipsoidal system (PES) as shown in Figure 11.7 was introduced by Bosch in 1983.
- It allows the light produced to be as good, or in some cases better than conventional lights, but with a light-opening area of less than 30cm^2.
- This is achieved by using a CAD designed elliptical reflector and projection optics. A shield is used to ensure a suitable beam pattern.
- This can be for a clearly defined cut-off line or even an intentional lack of sharpness. The newer PES Plus system, which is intended for larger vehicles, further improves the near-field illumination.
- These lights are only used with single filament bulbs and must form part of a four-headlamp system.

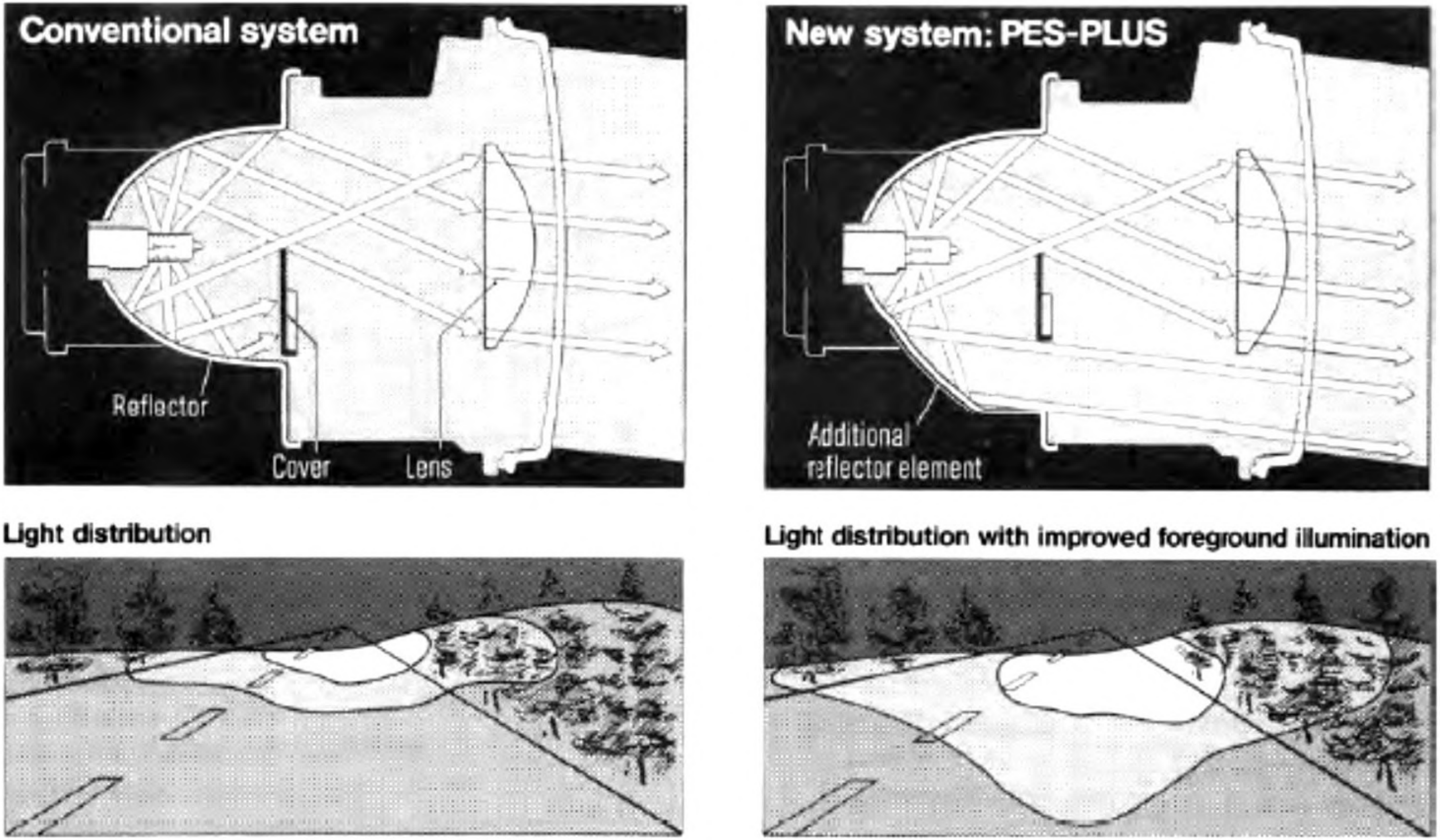


Figure 11.7 Improved poly-ellipsoid low beam

- **Headlight Levelling**
- The principle of headlight levelling is very simple, the position of the lights must change depending on the load in the vehicle. Figure 11.8 shows a simple manual aiming device operated by the driver.
- An automatic system can be operated from sensors positioned on the vehicle suspension. This will allow automatic compensation for whatever the load distribution on the vehicle. Figure 11.9 shows the layout of this system. The actuators, which actually move the lights, can vary from hydraulic devices to stepper motors.
- The practicality of headlight aiming is represented by Figure 11.10. Adjustment is by moving two screws positioned on the headlights, such that one will cause the light to move up and down the other will cause side-to-side movement.

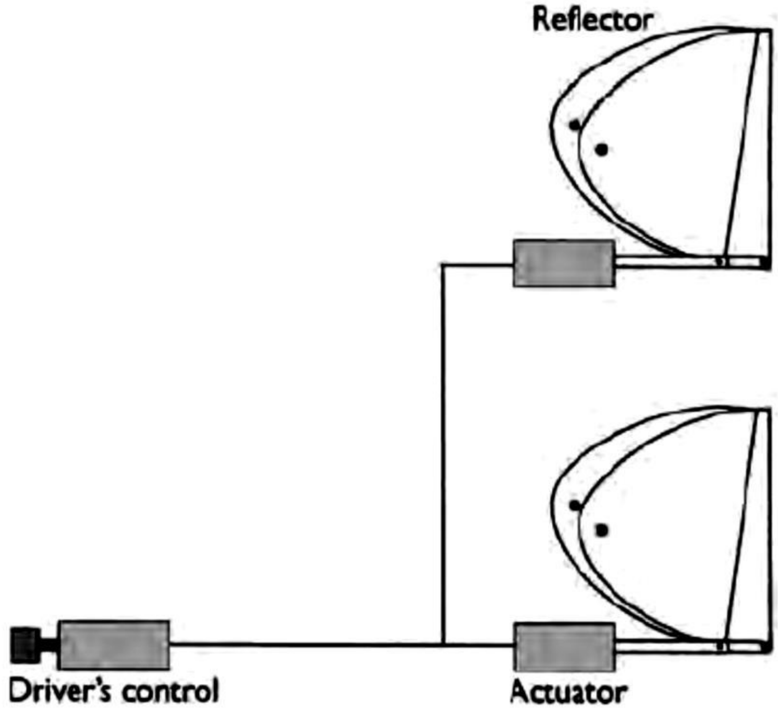


Figure 11.8 Manual headlight levelling

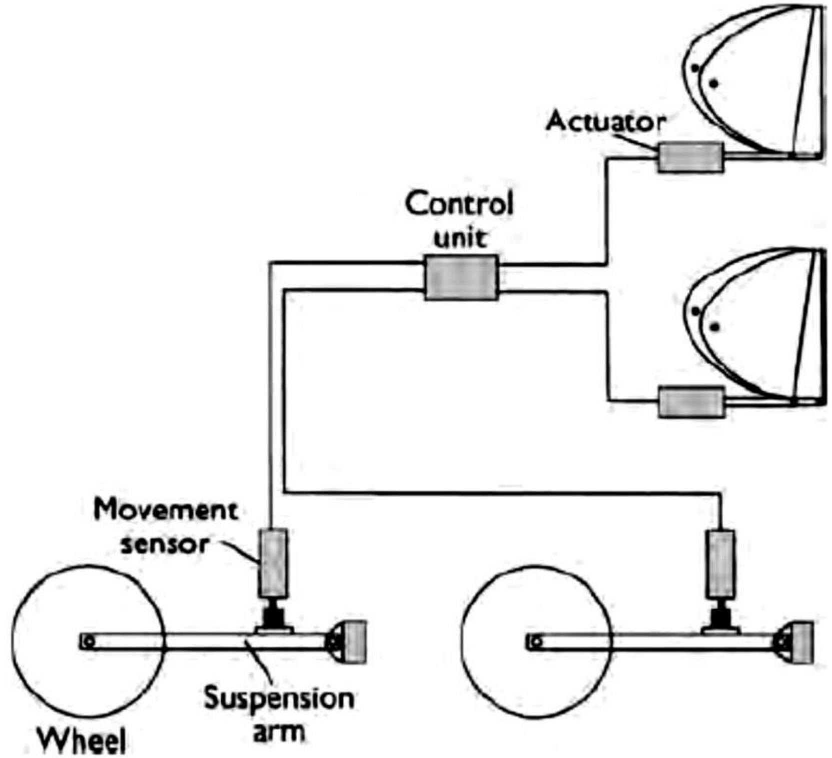


Figure 11.9 Automatic headlight adjustment

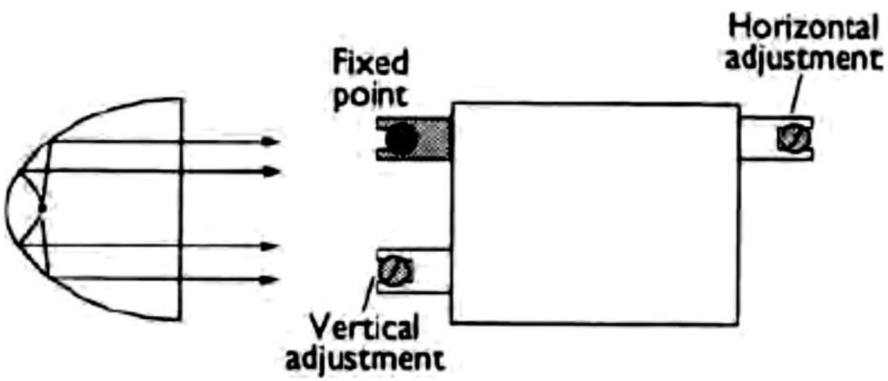


Figure 11.10 Principle of headlight aiming