

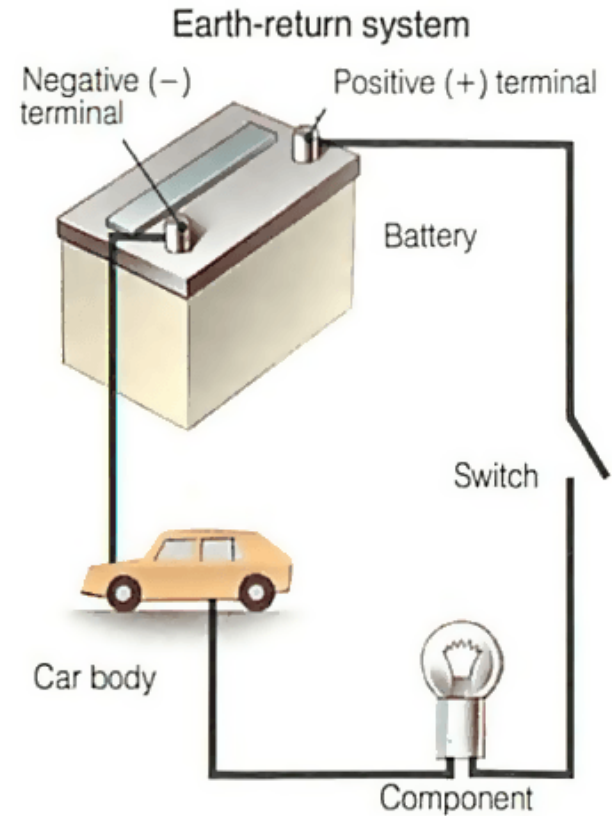
Fourth module

AEES

Automotive wiring technology

- The electrical system of an automobile is a closed circuit with an independent power source the battery .
- Apart from the main charging, starting and ignition circuits, there are other circuits that power lights, electric motors, the sensors and gauges of electrical instruments, heating elements, etc...
- All Circuits are opened and closed either by switches or by relays

- Current flows along a single cable from the battery to the component being powered, and back to the battery through the car's metal body.
- The body is connected to the earth terminal of the battery by a thick cable.
- This type of circuit is called an earth-return system, any part of it connected to the car body is said to be earthed.
- Modern cars have a 12 volt battery. Its capacity is measured in amp/hours.
- A 56 amp/hour battery should be able to deliver a current of 1 amp for 56 hours, or 2 amps for 28 hours.
- If the battery voltage drops, less current flows, and eventually there is not enough to make the components work



Ground wires and Battery cable

1. Ground Wires:

- **Ground wires are conductors that provide a path for electrical current to return to the ground or chassis of the vehicle.**
- **They are typically black or brown in color and are essential for completing electrical circuits and ensuring safety.**

2. Battery Cable:

- **Battery cables are heavy-gauge wires that connect the vehicle's battery to the starter motor, alternator, and other electrical components.**
- **They are usually color-coded, with red indicating the positive (+) cable and black for the negative (-) cable.**

Fuses and Circuit Protection Devices

- Fuses are protective devices that interrupt the flow of electrical current when a circuit is overloaded or short-circuited, preventing damage to the wiring and components.
- Circuit breakers are another form of circuit protection devices that can be reset after tripping.
- They come in various amperage ratings and are often found in fuse boxes or panels.

Terminals, connectors and relays

1. Terminals and Connectors:

1. Terminals are used to connect wires to electrical components. They come in various shapes and sizes, including spade, ring, and bullet terminals.
2. Connectors are devices used to join two or more wires together, enabling easy disconnection for maintenance or repairs.

2. Relays:

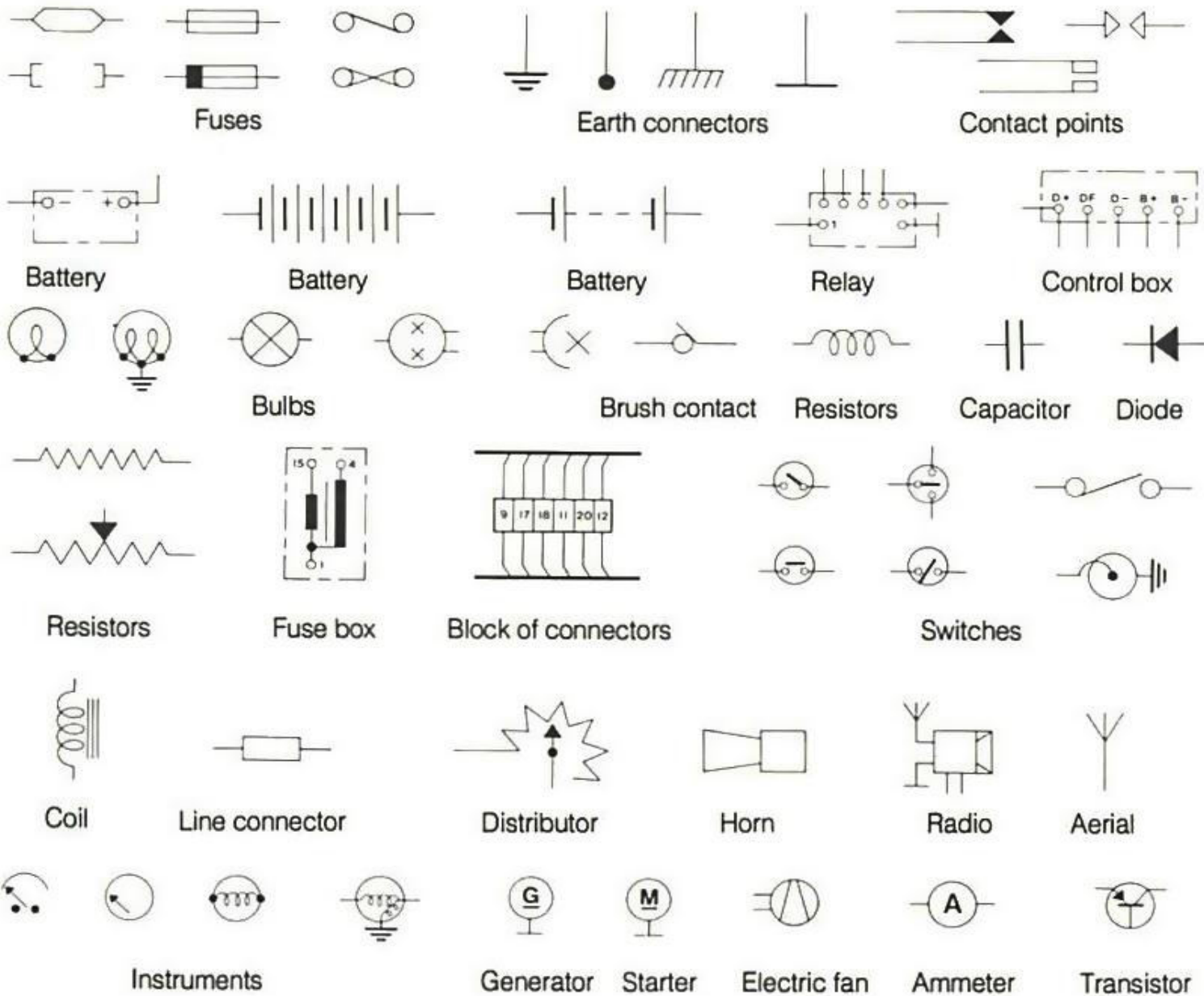
1. Relays are electromagnetic switches used to control high-current circuits with a low-current signal.
2. They are often used to control functions like headlights, horns, and power windows.

Wiring Schematics and Symbols:

- Wiring schematics are diagrams that represent the electrical system of a vehicle, showing the connections between components and the flow of electricity.
- Symbols are used in schematics to represent various components, wires, and connections. Common symbols include lines, arrows, switches, resistors, and more.

AUTO ELECTRICAL WIRING

SYMBOLS



Head light switch control

- The headlight switch is a critical component in a vehicle's electrical system that allows the driver to control the headlights and other lighting functions of the vehicle. The specific functions and features of a headlight switch may vary depending on the make and model of the vehicle, but here are some common aspects of headlight switch control:

1. Headlight Modes:

- The primary function of the headlight switch is to control the headlights. It typically has multiple positions or modes, such as:
 - Off: Turning the switch to the "Off" position will turn off all exterior headlights and running lights.
 - Parking Lights: This position activates the vehicle's parking lights, also known as running lights or marker lights. These are the lights that are on when you park your car.
 - Headlights: Turning the switch to this position activates the headlights at their full brightness.

2. High Beam and Low Beam Control:

- Most headlight switches have a mechanism for controlling the high beam and low beam headlights. Typically, pulling or pushing the switch can toggle between high beams (for better visibility at night on dark roads) and low beams (for normal driving conditions).

3. Fog Lights and Auxiliary Lighting:

1. Some headlight switches have additional positions for controlling fog lights, auxiliary lights, or other custom lighting added to the vehicle.

4. Headlight Dimmer Switch:

1. In older vehicles, a separate dimmer switch on the floor or steering column is used to toggle between high and low beams.

Lighting system

- There are 2 kinds of light sources ,namely one that one emit light and other reflects light
- In case of the head lamp used in automobiles, both things are combined
- The filament of electric lamp is the primary source while reflector is the secondary source

Head lights

- The head light are composed of three elements
 - 1.The filament that gives light when a current flows through it
 - 2.The parabolic reflector that reflects light in front
 - 3.The lens that refracts the light beam into illuminating pattern

- Reflector:

Here the first figure shows the bulb is placed in the focus of parabolic reflector in order to give a parallel beam of light

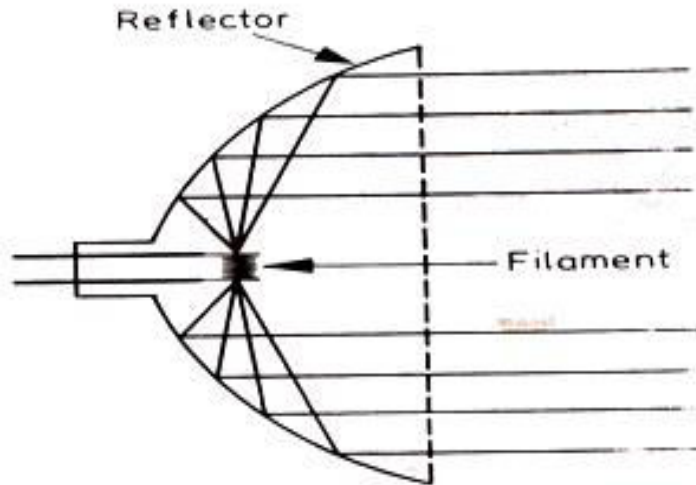


Fig. 12.1 The parabolic reflector showing light rays emitted from the filament of the bulb.

- If the bulb filament is moved from the focus of reflector, to position a, then light beam will not be parallel one but will become divergent
- If the filament is moved to position d then also direction of light beam changed
- It may be mentioned that by a suitable adjustment of the bulb, the beam can be concentrated at determined place

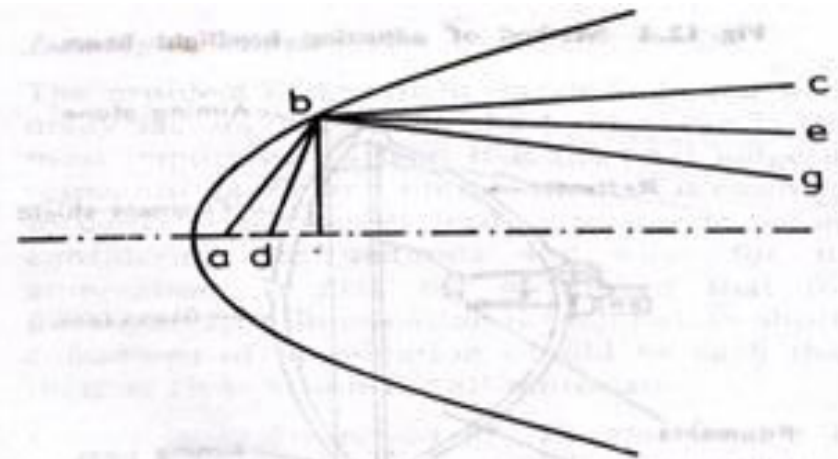


Fig. 12.2 The effect of changing position of filament on the nature of the light beam.

Sealed-beam headlight

- In a sealed beam head light ,the filament and reflector along with the lens are sealed in an airtight unit
- The front face of the sealed beam unit is a lens which is fused to the reflector
- After two filament units have been inserted through the centre of the reflector and sealed in position
- Then the complete unit is evacuated and filled with an inert gas.

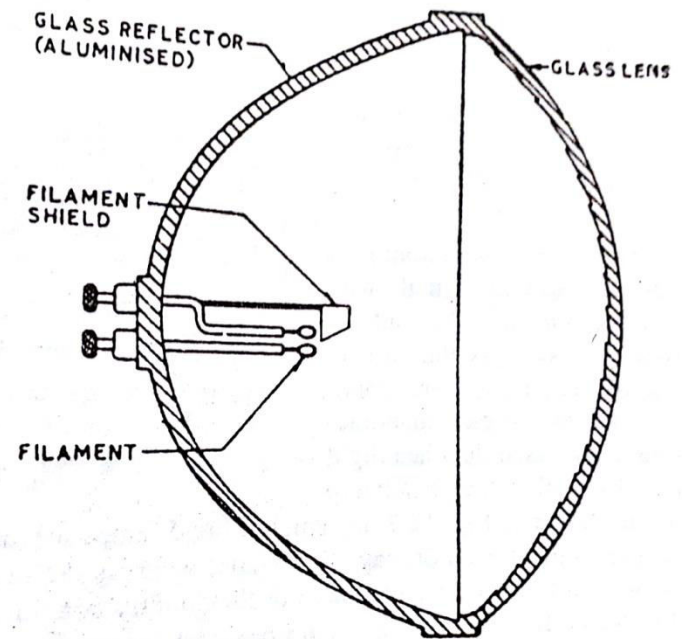


Fig. 12.6. Sealed beam headlight unit.

Advantages of sealed beam head light

- The glass unit is self-contained with accurately focused filaments
- Dust ,moisture etc are prevented from entering back of lens and reflector
- The greater amount of light is provided in the beam
- The beam of light is greatly improved due to pre focused filament and permanently bright reflector.

Head light dazzle

- Dazzle is nothing but brightness which causes interference with vision
- The brightness ,contrast and the angle subtended on the eye are dependent

Anti dazzle devices

- Anti dazzling devices redirect the light rays
- It will be achieved by various ways by lenses ,specially designed reflectors, by bulbs of special design
- A dipping reflector was used as one of the anti dazzling device. In this case the headlight beam is dipped by the movement of the reflector within the headlight casing
- The solenoid mounted on the back of the reflector controlled the movement of reflector

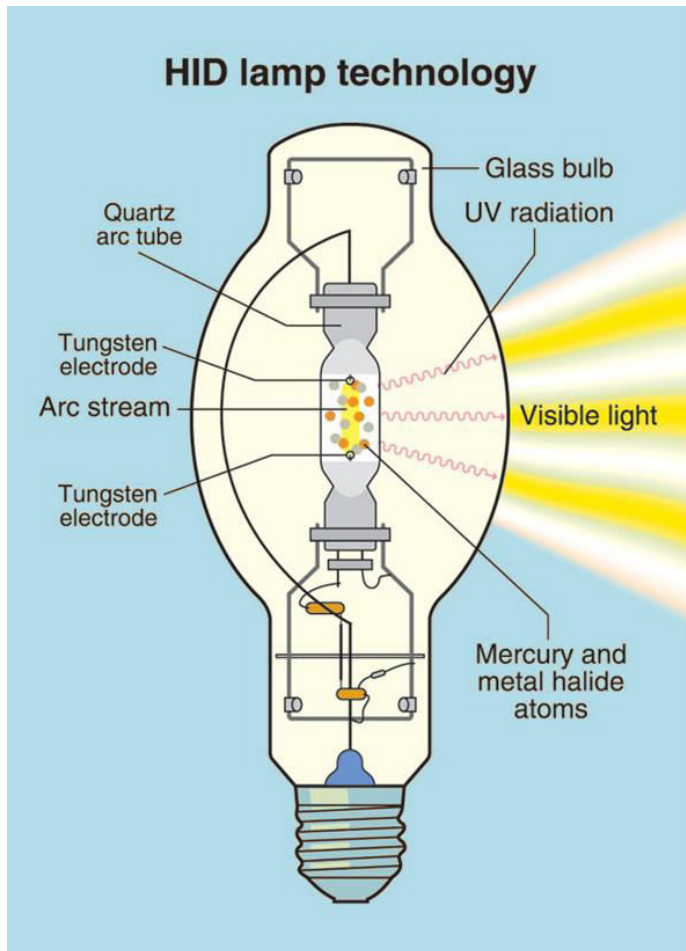
Halogen Head Lights

- A halogen headlight consists of a thin tungsten filament surrounded by a halogen gas in a glass filament capsule which is extremely resistant to high temperatures.
- It works by sending electricity through the tungsten filament inside the glass capsule
- A halogen lamp, also known as a tungsten halogen, quartz-halogen or quartz iodine lamp, is an incandescent lamp consisting of a tungsten filament sealed into a compact transparent envelope that is filled with a mixture of an inert gas and a small amount of a halogen such as iodine or bromine.

Composite Head lights

- All of today's headlights are composite headlights. Whereas sealed beam headlights are all one-piece, composite headlights consist of multiple pieces that you can disassemble.
- When a sealed beam headlight bulb fails, you have to replace the entire assembly.
- When a composite headlight bulb fails, you can replace just the bulb.
- Still, in addition to aesthetics, sealed beam headlights appeal to auto enthusiasts because their hermetic sealing makes them completely impervious to Freeman, SD weather, debris, and wear.

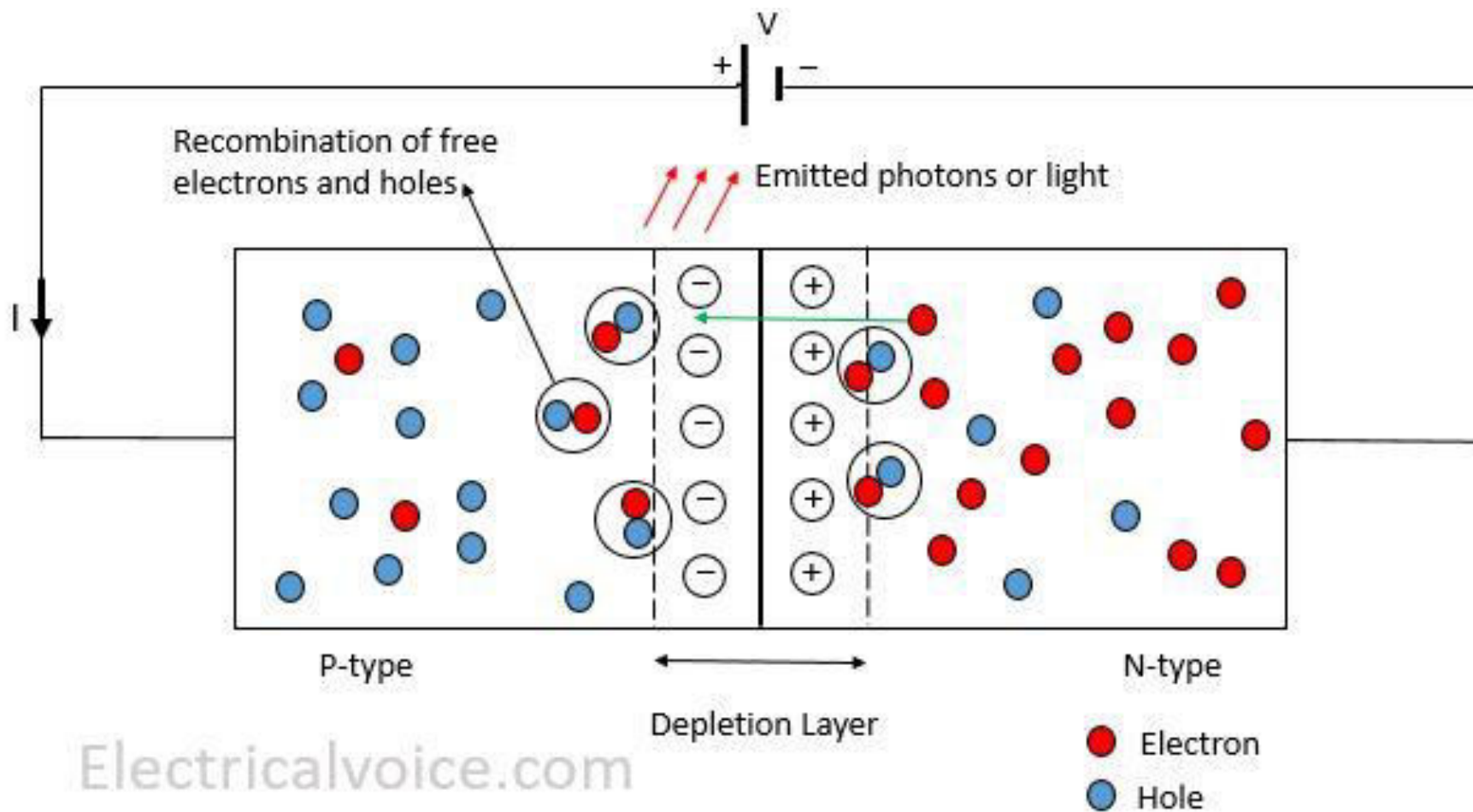
High Intensity Discharge bulb



- **High-intensity discharge lamps (HID lamps)** are a type of electrical gas-discharge lamp which produces light by means of an electric arc between tungsten electrodes housed inside a translucent or transparent fused quartz or fused alumina arc tube.

LED Lamp

- An optoelectronic device which emits light based on the **principle of electroluminescence** is known as **LED (Light Emitting Diode) lamp**.
- Electroluminescence is the emission of light due to the interaction of an electric field with a suitable solid. It was noticed in 1962 that a forward biased gallium-arsenide junction was found to be an efficient emitter of radiation
- In order to construct an LED lamp, a layer of P-type semiconductor material is placed above the N-type semiconductor layer.
- A metal film is used on the P-type layer to provide anode connection to the device. Similarly, a gold-film is formed on the N-type layer to provide cathode connection.
- The gold-film also provides reflection of light from the bottom surface of the device. This increases the efficiency of the LED lamp. The above figure shows the basic construction of an LED lamp.



Working of LED Lamp

- When a DC power supply is applied to an LED lamp in forward bias, the majority charge carriers start drifting, i.e., electrons towards the positive terminal and holes towards the negative terminal of the source. At the PN junction, the recombination of electrons and holes takes place, due to the recombination of these charge carriers, the energy is released either in the form of heat or light.
- The semiconductor materials such as gallium phosphide (GaP), gallium Arsenide Phosphide (GaAsP), gallium nitride (GaN), etc. emit light on the recombination of electrons and holes at the PN junction.
- The electrons in these semiconductor materials lose their energy by the emission of light photons. If the semiconductor material is translucent, the emitted light at the PN junction will be transferred outside. In this way, an LED lamp emits light.

Head light aiming

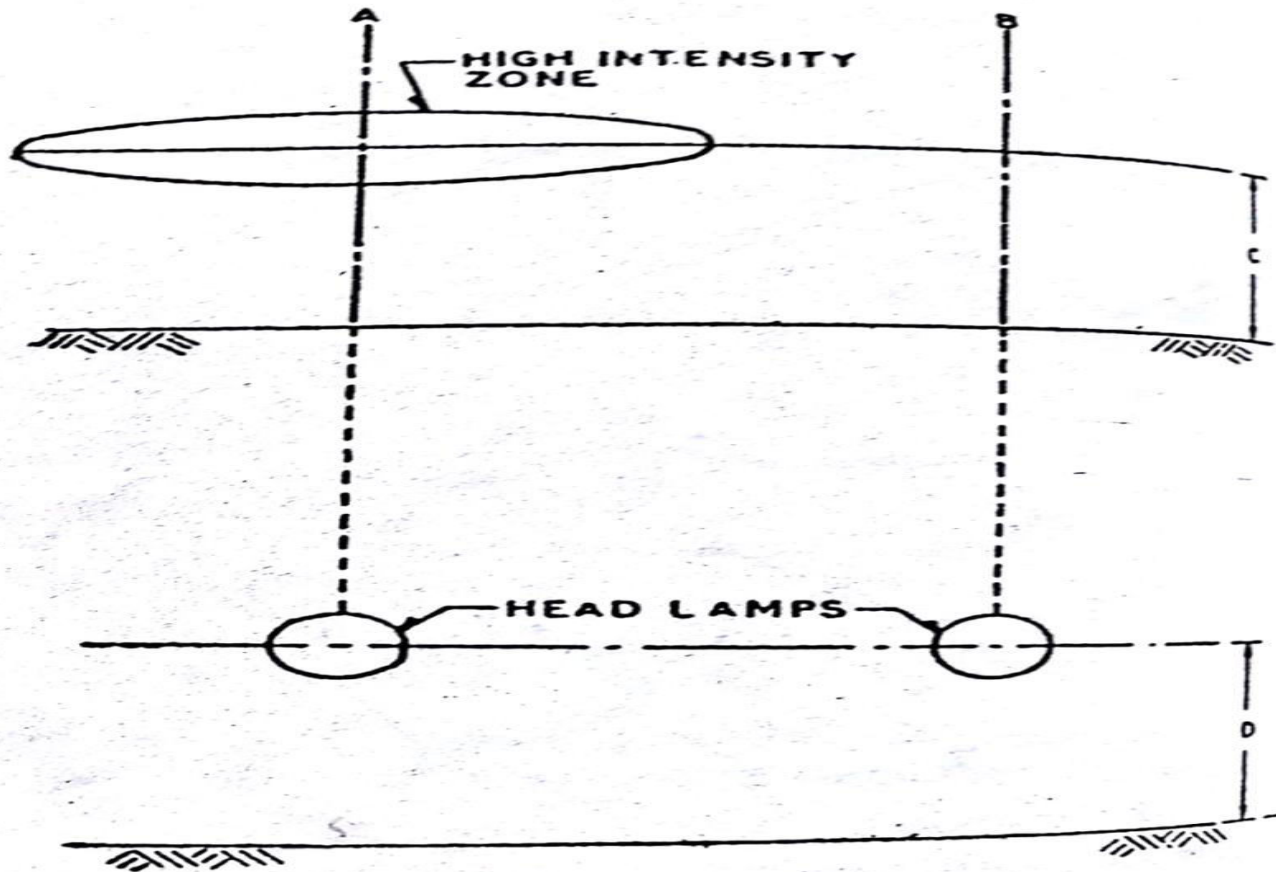


Fig. 12.12. Aiming of headlights.

- Place the vehicle in front of a screen at a distance of 25 feet(7.62 m) from it
The ground must be perfectly level and the vehicle loaded as it will be driven most of the time.
- Mark a line on the screen at a distance C from the ground as shown in figure such that $C=D-2$ inch(51 mm) in case of bus, C equal to D in case of Ambassador car for other vehicles C is known from respective manual.
- Mark on the screen vertical lines a and b which are in line with the headlights the distance between them being equal to the distance between headlights
- Cover one headlights while aiming the other
- on the headlights ,the adjustment screws are provided as shown in figure
With the help of these adjustment the headlight so that the hot-spot(high intensity zone) falls on the screen as shown in figure
- The headlights is aimed correctly now
- similarly aim the other headlight

Other lights

- **Parking light:** Lights for parking in night, in front and rear side
- **Tail lamp:** A red light at the rear of a vehicle for night visibility
- **Roof lamp:** a small interior light on the underside of the roof of a motor vehicle.
- **Fog lamp:** a bright light on a motor vehicle, used in foggy conditions to improve road visibility or warn other drivers of one's presence
- **Brake light:** Red Light in rear side bright when applying brake
- **Dashboard light:** Usually warning lights and night vision lights
- **Daytime running lights:** The purpose of DRLs is not to illuminate the view in front of your car. Instead, they make your car more visible to the drivers and pedestrians you're approaching.
- **Courtesy lights:**

A small light in a car that is automatically switched on when one of the doors is opened

Indicator circuit

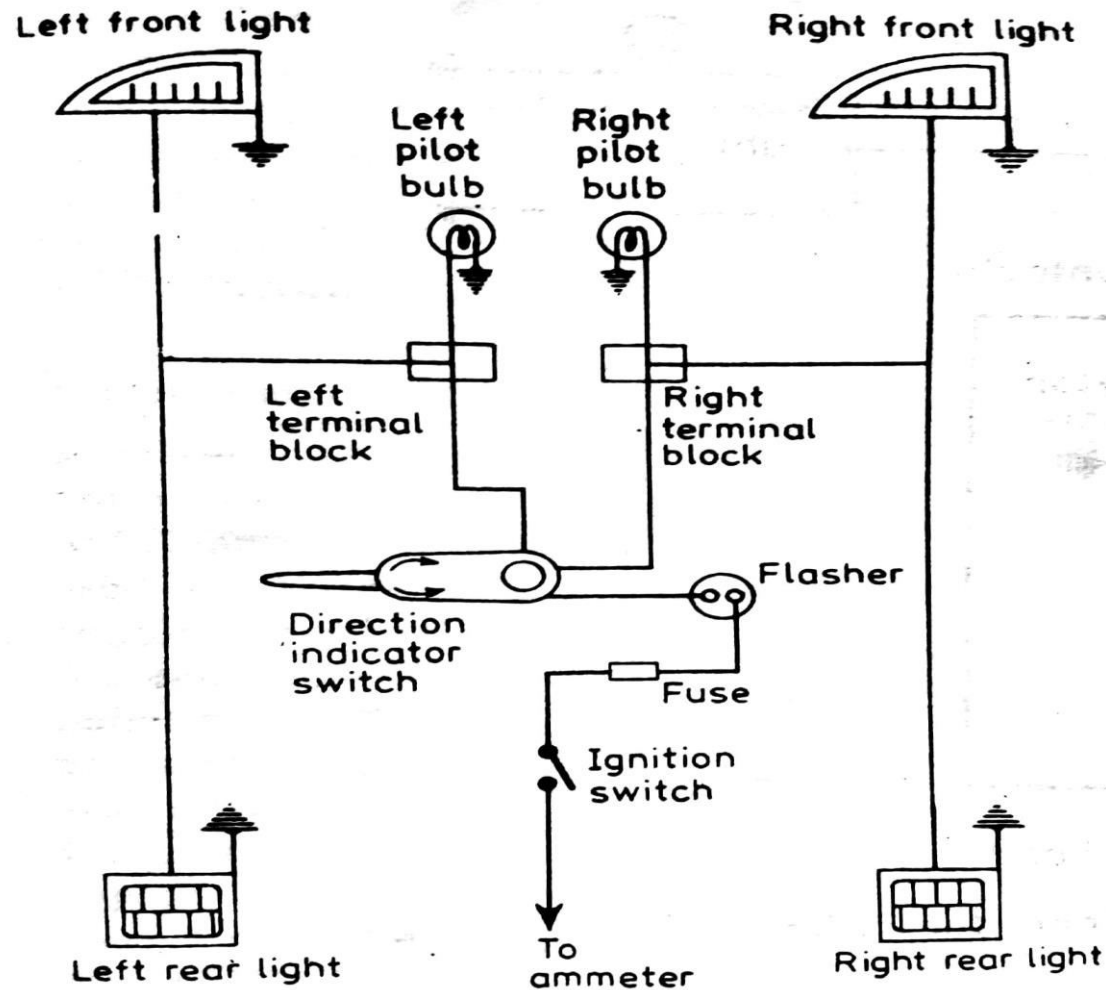


Fig. 12.15 Circuit diagram of a flashing type direction indicator.

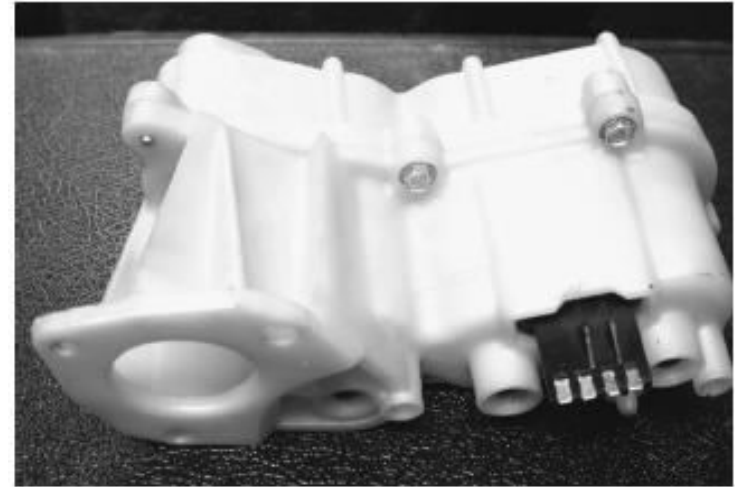
- Figure shows the circuit diagram for a flashing type of direction indicator
- when the signal lever is moved by the driver one or the other way the circuit is closed between the battery and proper indicating lights on the front and rear of the vehicle as well as on the dashboard
- The circuit is completed through a flasher unit which is a device that closes and opens the circuit about 70 to 80 times per minute this gives a flashing signal which is more noticeable than a steady light

Electric seat or Power seat

- A **power seat** in an automobile is a front seat which can be adjusted by using a switch or joystick and a set of small electric motors.
- Most cars with this feature have controls for the driver's seat only, though almost all luxury cars also have power controls for the front passenger seat.
- In addition to fore and aft adjustments, power seats can be raised or lowered and tilted to suit the comfort of the driver and/or passenger. Many power seats allow occupants to adjust the seat lumbar or seatback recline, all at the push of a button or flick of a switch.

Power seat operation

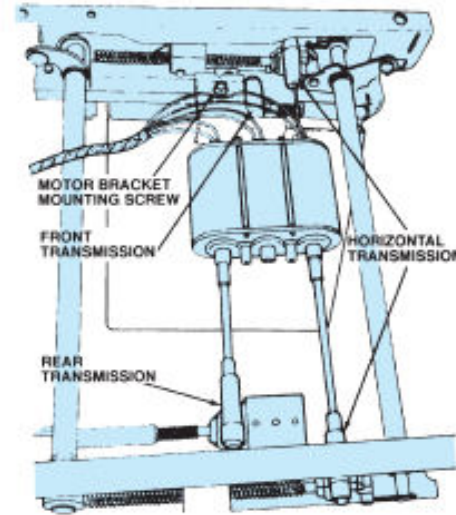
- A typical power-operated seat includes a reversible electric motor and a transmission assembly that has three solenoids and six *drive cables* that turn the six seat adjusters.



A typical power seat transmission assembly. Even though many of these units can be disassembled, they are designed to be replaced as an assembly if any part inside is defective.

Power seats Operation (continues)

- A **screw jack assembly** is often called a *gear nut* and is used to move the front or back of the seat cushion up and down.
- Most power seats use a permanent magnet motor that can be reversed by simply reversing the polarity of the current sent to the motor by the seat switch.



This power seat motor assembly houses three armatures to provide six way adjustment. Many power seats use one motor and a transmission assembly to operate the various gear nuts needed to move the seat.

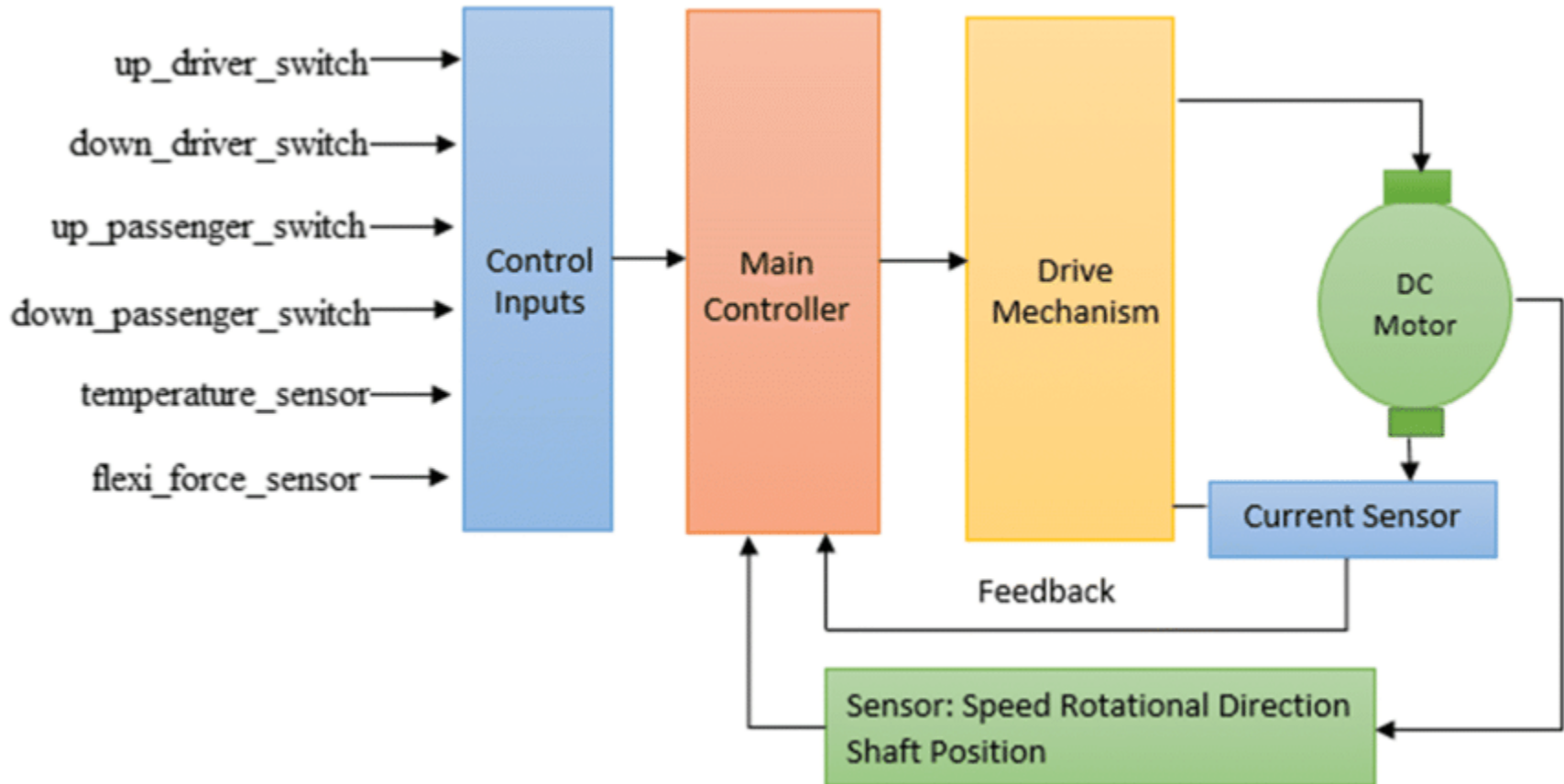
Power window

- Electric windows are essentially the same as a manual window-winding mechanism, except that the manual winder handle is replaced by a motor.
- The system usually consists of a two-way control switch wired by two circuits to a motor in each door. One switch position and circuit drive the motor one way to wind the window up; the other switch position and circuit wind the window down. The switch is wired to the battery the vehicles electrical system.

The Lifting Mechanism

- The window lift on most cars uses a linkage to lift the window glass while keeping it level. A small electric motor is attached to a worm gear and several other spur gears to create a large gear reduction, giving it enough torque to lift and lower the window.
- An important feature of power windows is that they cannot be forced open. Worm gears have a self-locking feature because of the angle of contact between the worm and the gear. The worm can spin the gear, but the gear cannot spin the worm — friction between the teeth causes the gears to bind preventing it from moving.
- The linkage has a long arm or cable, which attaches to a bar that holds the bottom of the window. The end of the arm or cable can slide in a groove in the bar as the window rises. On the other end of the bar is a large plate that has gear teeth cut into and the motor turns a gear that engages these teeth.
- The same linkage is often used on cars with manual windows but instead of a motor turning the gear the handle turns it.

Power Window Operation Diagram



Electric mirror

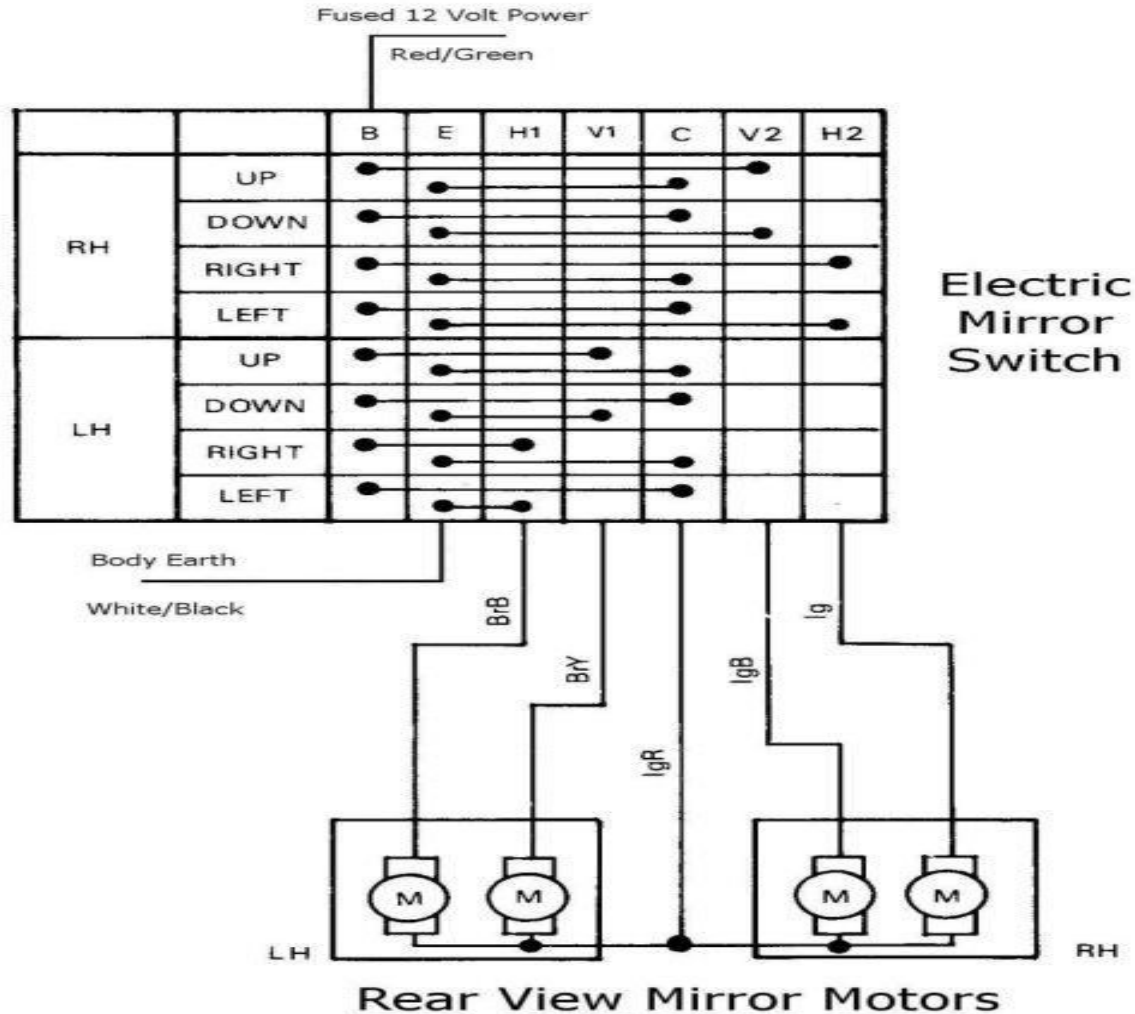
- A **power side-view mirror** or simply **Electrically Controlled power mirrors** allow the driver to position the outside mirrors by use of a switch .
- The mirror assembly will use built-in dual drive, reversible permanent magnet (PM) motors..



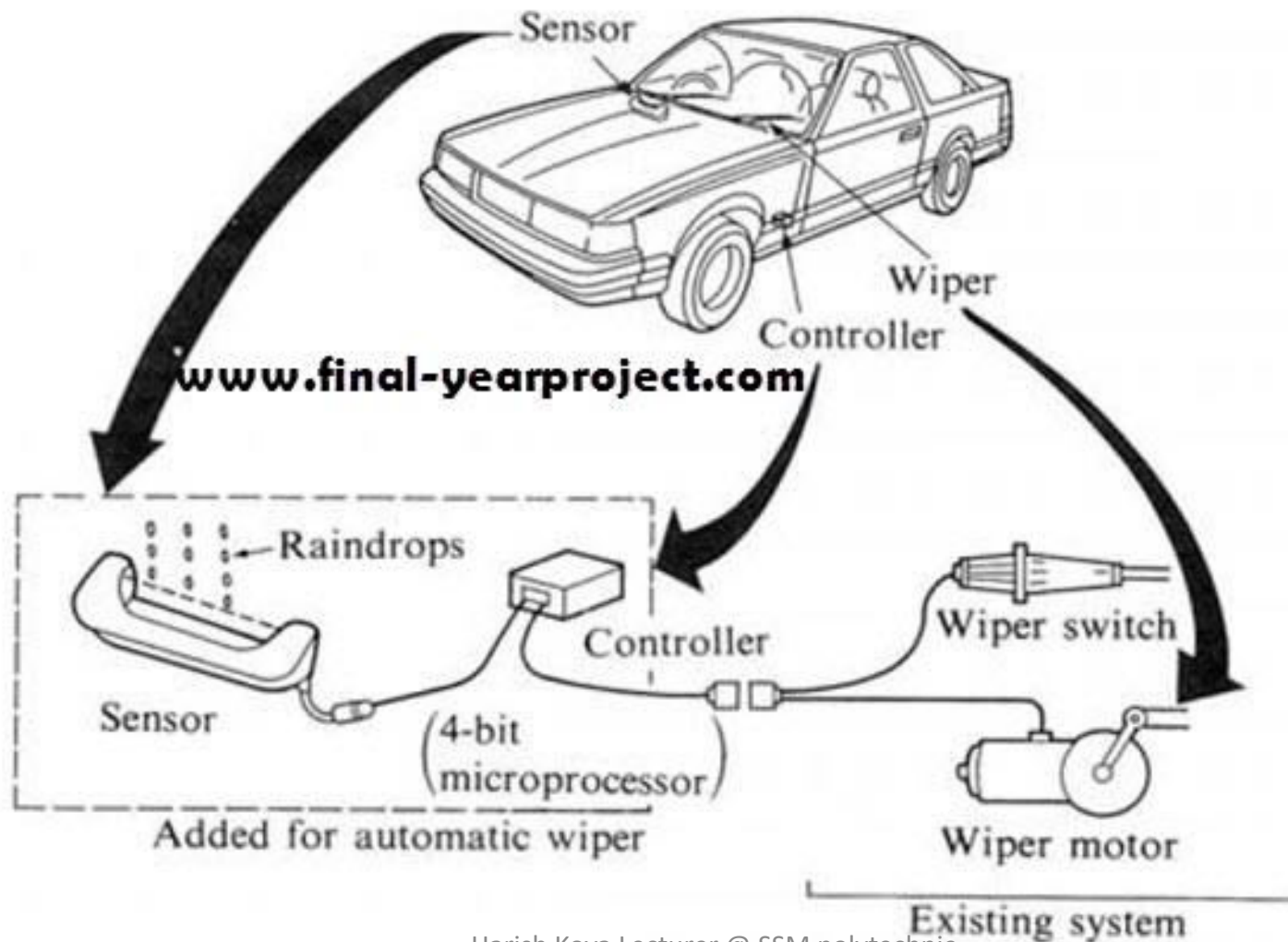
Operation

- A single switch for controlling both the left and right side mirrors is used.
- On many systems, selection of the mirror to be adjusted is by rotating the knob counterclockwise for the left mirror and clockwise for the right mirror.
- The mirror selector usually has a neutral position with none mirrors selected, to prevent accidental changes of the view.
- After the mirror is selected, movement of the joystick (up, down, left, or right) moves the mirror in the corresponding direction.
- Some vehicles use set position memories for automatic repositioning of electric mirror, when the mirror position has been changed

Wiring diagram of Electric mirror



Intelligent windscreen wipers



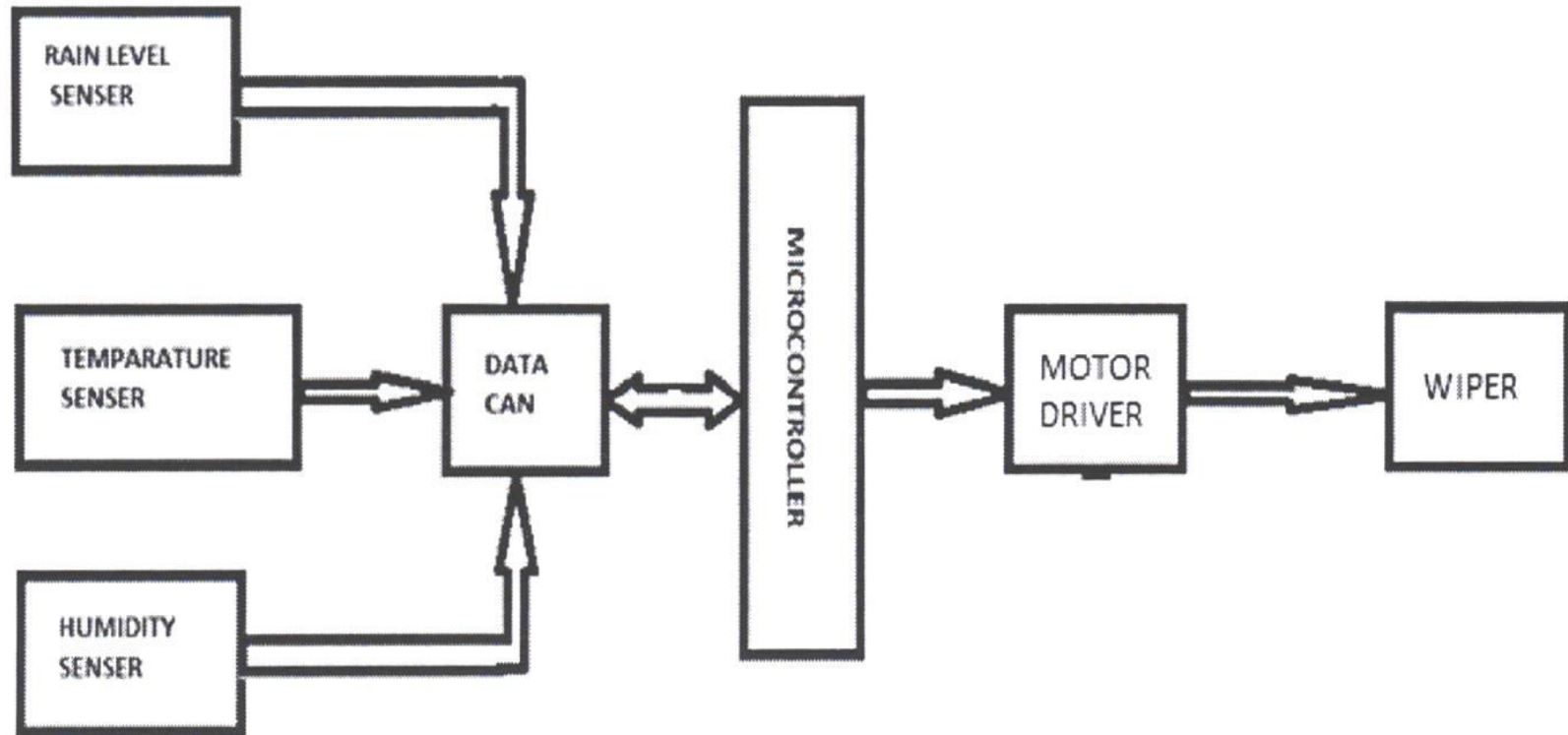
Automated Windshield Wiper System

- Improve safety by decreasing driver distraction
- Detect rainfall on windshield
- Detect intensity of rainfall
- Automatically activate windshield wipers once rainfall is detected

Intelligent Wind Screen Wiper

In intelligent wind Screen wiper, adjust the speed of wiper automatically according to the amount of water on the wind shield. The term "rain-sensing wipers" is commonly used for a system designed to clear the windshield of rain, snow, without driver intervention. The system is programmed to automatically activate and alter the speed and rate of the wiper blades to keep outward visibility unobstructed at all times. A rain-sensing wiper system simply monitors outward visibility and automatically activates the wipers.

Simple Layout of Intelligent windscreen wipers



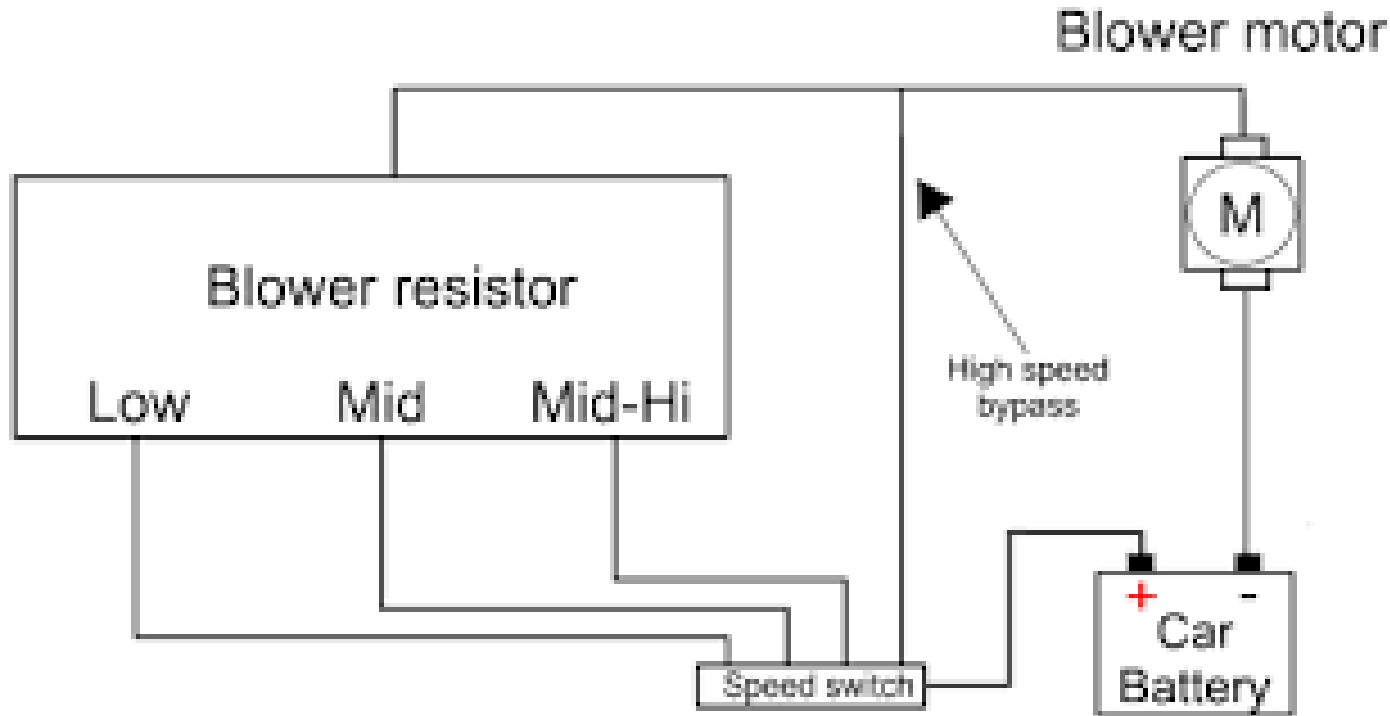
MAIN COMPONENTS

1. Rain level sensor
2. Temperature sensor
3. Humidity sensor
4. CAN(Controller Area Network) (It defines a standard for efficient and reliable communication between sensors, actuator, controller in real time application)
5. Motor Driver (Motor driver actuates the motor to run at high speed or low speed based on the amount of the rain level detector)
6. Microcontroller

WORKING

- The CAN collect the information about amount of rain, temperature, moisture from sensors and from various other units.
- This information sends towards the microcontroller for further processing.
- The microcontroller sends the signal to the motor driver circuit. Then the motor driver actuates the motor to run at high speed or low speed based on the amount of the rain level detected.

Blower Motor Circuit



- The blower motor is **the fan that pushes heated or cooled air through dashboard vents based on the climate system settings and the fan speed selected.**
- Adjusting the fan speed sends a signal through a resistor to the blower motor to either pick up the pace or slow it down.

ANTI THEFT SYSTEMS

Systems used to Prevent vehicle from being theft

- KEY less entry
- Vehicle Immobilizer

Keyless entry

- Keyless entry is a way of accessing a car without using a traditional key. Many use it as a convenience, as they are able to unlock all the doors at the touch of a button.
- This allows others, like children who are old enough to get in on their own, to enter the car quicker
- Using a keyless entry is seen as both a convenience and a safety feature.
- The term keyless entry system originally meant a lock controlled by a keypad located at or near the driver's door, which required entering a predetermined (or self-programmed) numeric code.
- Keyless entry systems allow you to unlock and lock the doors to your vehicle without using a key.
- Keyless remotes contain a short-range radio transmitter, and must be within a certain range, usually 5-20 meters, of the car to work.
- When a button is pushed, it sends a coded signal by radio waves to a receiver unit in the car, which locks or unlocks the door

KEYLESS ENTRY

- Even though some vehicles use a keypad located on the outside of the door, most keyless entry systems use a wireless transmitter built into the key or key fob.
- The transmitter broadcasts a signal that is received by the electronic control module, which is generally mounted in the trunk or under the instrument panel.



FIGURE 25-20 A typical keyless remote fob. A fob is a term used to describe a key ring.

Key less entry system layout

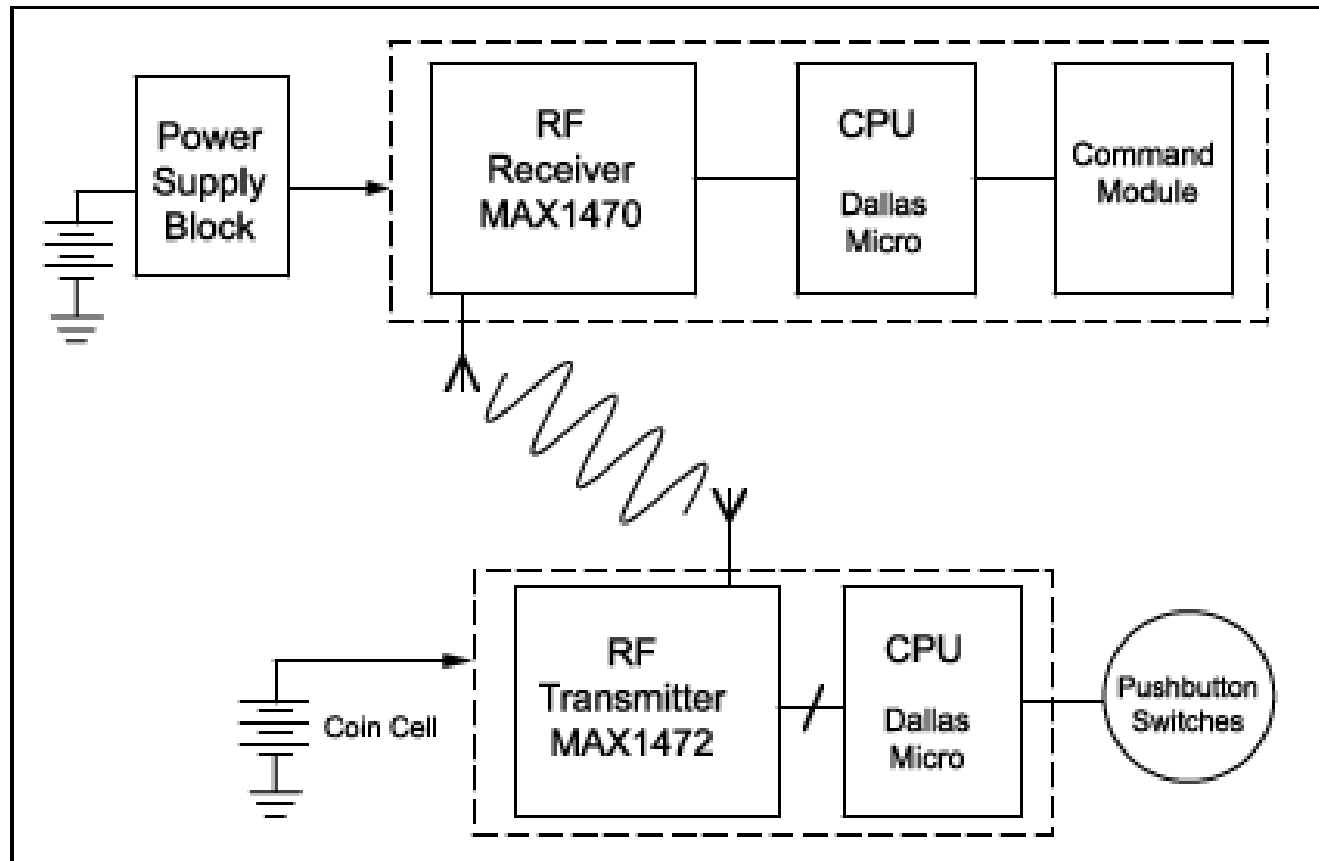


Figure 1. Block diagram for remote keyless entry (RKE) systems.

Vehicle Immobilizer

- An **immobilizer** is an electronic security device fitted to an automobile that prevents the engine from running unless the correct key is present.
- This prevents the car from being hot wired after entry has been achieved and thus reduces motor vehicle theft.
- The microcircuit inside the key is activated by a small electromagnetic field which induces current to flow inside the key body, which in turn broadcasts a unique binary code which is read by the automobile's ECU.
- When the ECU determines that the coded key is both current and valid, the ECU activates the fuel-injection sequence.

Vehicle immobilizer system layout

1. Fungsi set/unset engine immobilizer

