ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS INSTITUTION
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VII Semester

AU3008 Sensors and Actuators

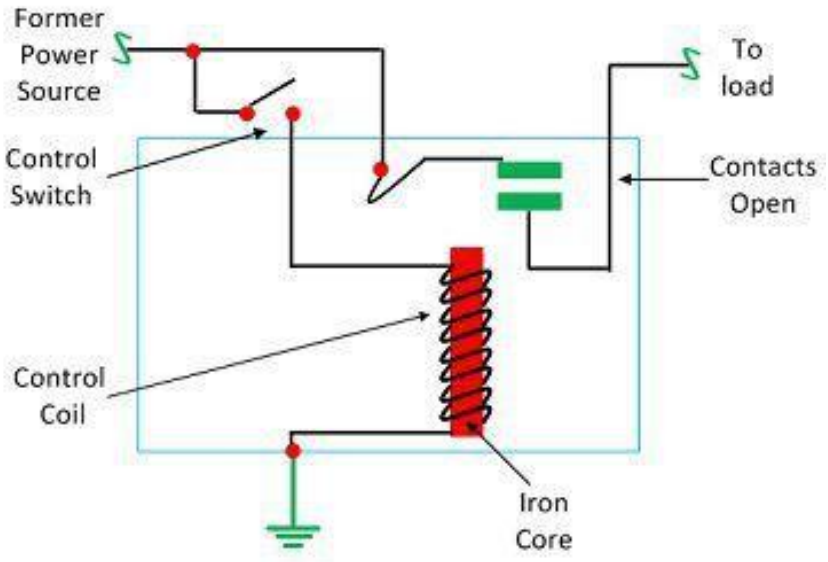
UNIT – 4 - AUTOMOTIVE ACTUATORS

4.6 Working principles, construction of Relays

- A **relay** is an electromechanical or electronic switching device used to control circuits. It allows a low-power control circuit to operate a high-power load. Relays are widely used in automation, protection, and control systems.

- **Working Principle of Relay**

  It works on the principle of an electromagnetic attraction. When the circuit of the relay senses the fault current, it energises the electromagnetic field which produces the temporary magnetic field.



Relay

1. Power Supply:

- The relay is connected to a power source (battery or AC supply).

2. Control Switch:

- This is the switch that activates the relay. When the switch is closed, it completes the circuit to the control coil.

3. Control Coil:

- This coil is wound around an iron core. When current flows through the coil, it generates a magnetic field.

4. Armature:

- This is a movable piece of metal attached to the iron core. When the magnetic field is strong enough, it attracts the armature.

5. Contacts:

- The contacts are connected to the armature. They are usually in one of two states:

❒ **Normally Open (NO):** The contacts are open when the coil is not energized.

❒ **Normally Closed (NC):** The contacts are closed when the coil is not energized.

Working:

1. When the control switch is closed, current flows through the control coil.
2. This creates a magnetic field around the iron core.
3. The magnetic field attracts the armature.
4. As the armature moves, it opens the normally closed contacts and closes the normally open contacts.

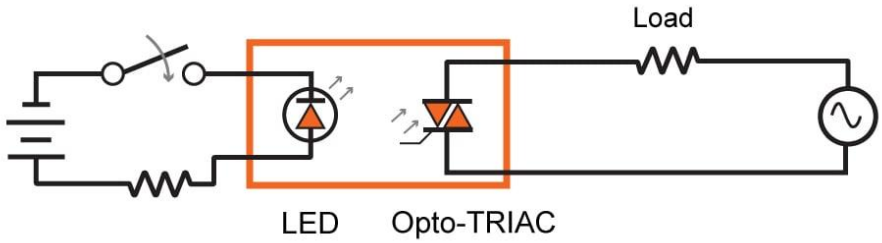
5. This action completes the circuit to the load, allowing current to flow through it.

4.6.2 Types of Relays:

Types of Relays (Based on Operation)

1. **Electromechanical Relays:**
   - ❒ Operate using a physical armature and contacts.
   - ❒ Example: General-purpose relays.
2. **Solid-State Relays (SSRs):**
   - ❒ No moving parts; rely on electronic components.
   - ❒ Suitable for high-speed switching and longer life.
3. **Reed Relays:**
   - ❒ Use magnetic reeds inside a sealed tube.
   - ❒ Compact and used in low-power applications.

Working of Solid- State Relays



1. Input Circuit:

- The input circuit consists of a switch and an LED (Light Emitting Diode).

- When the switch is closed, current flows through the LED, causing it to emit light.

2. Optocoupler:

- The optocoupler is a device that isolates the input and output circuits.
- It consists of two components:
- **LED:** The same LED from the input circuit.
- **Phototransistor:** A light-sensitive transistor that receives the light emitted by the LED.

3. Output Circuit:

- The output circuit contains an Opto-TRIAC, which is a type of thyristor (a semiconductor device with three layers).
- The phototransistor in the optocoupler controls the gate of the Opto-TRIAC.

Working:

1. **Input:** When the switch is closed, the LED emits light.
2. **Optocoupler:** The light from the LED strikes the phototransistor in the optocoupler, causing it to conduct.
3. **Output:** The conducting phototransistor triggers the gate of the Opto-TRIAC.
4. **Load Activation:** The Opto-TRIAC turns on, allowing current to flow through the load.

Applications of SSRs :

- **Industrial Automation**: Conveyor belts, robotic arms, and PLC systems.
- **Heating Systems**: Control of electric heaters in furnaces and ovens.
- **Lighting Control**: Switching LED and incandescent lighting systems.
- **Motor Drives**: Control of small DC or AC motors in fans, pumps, and compressors.
- **HVAC Systems**: Precise control of cooling and heating elements.
- **Medical Equipment**: Noise-sensitive equipment requiring silent operation.

Working of Reed Relays:

A **reed relay** is a type of relay that uses a magnetic reed switch as the switching element. Reed relays are compact, fast, and reliable, often used in low-power, high-speed switching applications.

1. Components of a Reed Relay

a. Reed Switch:

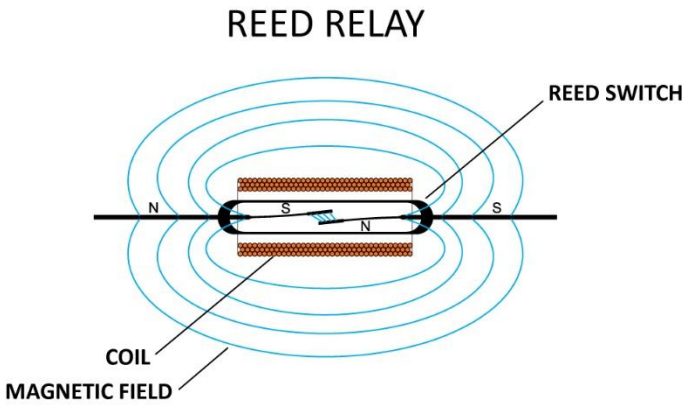
- A reed switch consists of two thin, flexible magnetic metal reeds sealed in a glass envelope. These reeds are positioned very close to each other but do not touch.
- The reeds are made of ferromagnetic materials such as nickel-iron, coated with a non-stick material to prevent sticking during operation.

b. Coil:

- A coil is wound around the reed switch to generate a magnetic field when energized.

c. Encapsulation:

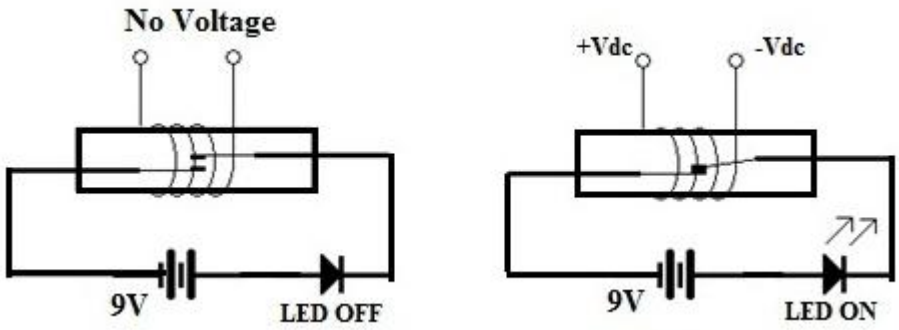
- The reed switch and coil are enclosed together in a protective casing, ensuring durability and insulation.



Working:

1. **Coil Activation:** When current flows through the coil, it creates a magnetic field around the core.

2. **Reed Switch Activation:** The magnetic field from the coil penetrates the glass tube and magnetizes the two reeds.
3. **Reed Contact:** The magnetized reeds are attracted to each other and make contact, completing the circuit.
4. **Circuit Completion:** Once the reeds make contact, current can flow through the circuit connected to the reed switch.



❒ The circuit diagram of the reed relay is shown below. This relay includes a switch with magnetic contacts that move in an external magnetic influence otherwise the induced field from its solenoid.

❒ These relays have quick switching speed as compared to the electromechanical ones however their switching voltage & current is lower due to the thickness of their contacts.

❒ In the above first circuit diagram when no voltage is provided to the coil, the reed switch will be opened & the LED is not activated.

❒ In the second circuit, if we provide a DC voltage to the coil then a magnetic field is generated & the contacts will be closed by allowing the flow of current from the battery so that the LED will be turned ON.

❒ Reed Relay Vs Electromechanical Relay

The difference between the reed relay Vs electromechanical relay includes the following.

Reed Relay	Electromechanical Relay
A reed relay uses an electromagnet for controlling one or more reed switches.	An electromechanical relay works by using a magnetic field generated by an electromagnetic coil once a control signal is applied to it.
This relay normally has a high contact resistance.	EMRs normally have less contact resistance because they utilize larger contacts & normally utilize lower resistivity materials as compared to the nickel-iron utilized within a reed switch.
These relays have lower ratings as compared to electromechanical relays.	These relays have higher ratings as compared to reed relays.
Generally, these relays exhibit much faster operation than EMRs which ranges between a factor of 5 & 10.	This relay exhibits not much faster operation as compared to the relay.
These relays contain hermetically-sealed contacts, which lead to more reliable switching characteristics at low signal levels & higher insulation values within the open condition.	These relays are frequently enclosed within plastic packages that provide a certain amount of protection; however, the contacts are exposed over time to outside pollutants and emissions from the plastic body.
The mechanical life of these relays has longer in light load conditions than EMRs.	The mechanical life of these relays has not longer as compared to reed relays.
The power consumption of these relays is low than EMRs.	The power consumption of these relays is high than reed relays.
Its operating speed is fast.	Its operating speed is slow.
This relay has small in size.	This relay has a large size.
It is expensive.	It is not expensive.

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