1

Module - 2

CONTROL SYSTEM COMPONENTS

Lecture - 4

RELAYS

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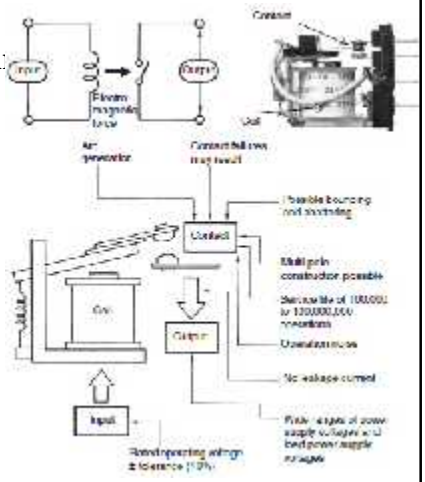
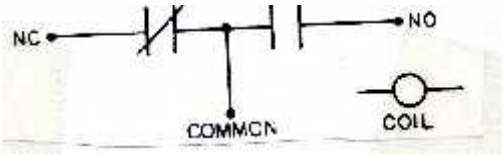
Introduction

- Relays are generally used to accept information from some form of sensing device and convert it into proper power level, number of varied circuits or other amplification factor which will achieve the desired results in control circuit.
- There are many types of relays used i
  - Control Relays
  - Timing Relays
  - DC Series Relay
  - Voltage-Sensitive Relay
  - Field Accelerating Relay
  - Field Failure Relay
  - Overload Relays
  - Instantaneous Trip Current Relays



Control Relay

- Control Relays are used as auxiliary devices to switch control circuits and large motor starter and contactor coils, and to control small loads such as small motors, solenoids, electric heaters, pilot lights, audible signal devices and other relays.
- relays are used in control circuits
- Magnetic relays do not provide motor overload protection
- available in single- or double-throw arrangements with various combinations of normally open (NO) and normally closed (NC) contact circuits

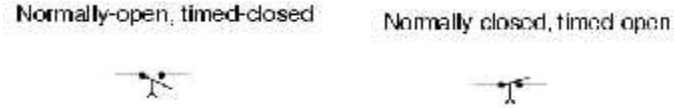


- Relays are used more often to open and close control circuits than to operate power circuits.
- Typical applications include
  - control of motor starter and contactor coils
  - the switching of solenoids
  - control of other relays.
- Low voltage relay systems are used extensively in
  - switching residential and commercial lighting circuits
  - individual lighting fixtures.

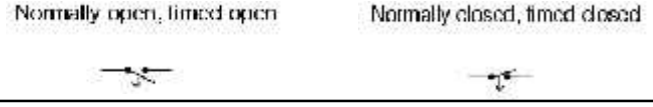
- **pickup voltage -** voltage at which the relay coil is energized, resulting in the contacts switching
- **dropout voltage -** voltage on the relay coil at which the contacts return to their un-operated condition
  - designed to not drop out until the voltage drops to a minimum of approximately 85 percent of the rated voltage.
  - will not pick up (energize) until the voltage rises to 90 percent of the rated voltage.
  - will operate continuously at 110 percent of the rated voltage without damage to the coil.
- **Inrush current** – current in the coil at the time of closing
  - Because of air gap in the magnetic path
- **Sealed current** - current after closing of contacts
  - Inrush current 6 times the sealed current

Timing Relay

- A timing relay is similar to a control relay, except that certain of its contacts are designed to operate at a preset time interval, or time lag, after the coil is energized, or de-energized.
- There are different types:
  - Fluid Dashpot
  - Pneumatic
  - Electronic
  - Motor Driven
- Another classification:
  - On-delay - means the relay provides a delay when energized.



  - Off-delay - means the relay provides a delay when de-energized.



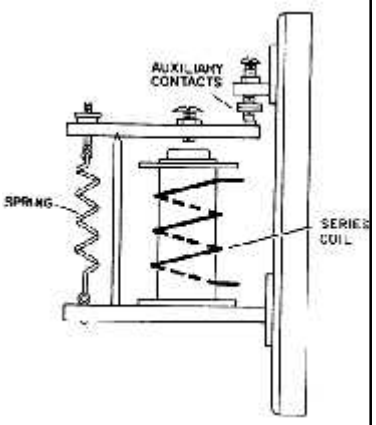
Types of Timing Relays

- Fluid Dashpot
  - The contacts are operated by the movement of an iron core.
  - The magnetic field of a solenoid coil lifts the iron core against the retarding force of a piston moving in an oil-filled dashpot.
  - not very accurate
  - provides only on-delay
  - contact may be normally open or normally closed
  - Uses:
    - To control the accelerating contactors of motor starters
    - To time the closing or opening of valves on refrigeration equipment.
    - Multi-contact dashpot timing relays are used for dc motor starting.
- Pneumatic Timer
  - accomplish a time delay with a pneumatic timing mechanism.
  - adjustable over a wide timing range
  - have a good repeat accuracy.
  - provide on and oft time delay.

- Motor Driven Timer
  - normally used when a process has a definite on and off operation, or a sequence of successive operations, as in washing machines.
  - consists of a small synchronous motor driving a cam dial assembly on a common shaft.
- Electronic Timer
  - employs CMOS IC control circuitry.
  - more compact
  - available with a wider timing range
  - offer increased stability, accuracy, and reliability.

DC Series Relay

- A common application of dc series relays is to time the acceleration of dc motors
- coil of the dc series relay is connected in series with the starting resistance
- The armature is light and constructed so that it is very fast in operation.
- As the starting current passes through the coil, the armature is pulled down causing the contacts to open.
- When the current in the coil has decreased to a predetermined value, the spring pulls the armature back and the contacts close



Voltage-Sensitive Relay

- commonly used to sense the dc motor armature voltage – as indication of speed
- used in:
  - hoist controllers
  - reversing-plugging to stop
  - applying armature shunt contactors on multi-step slowdown and acceleration circuits.

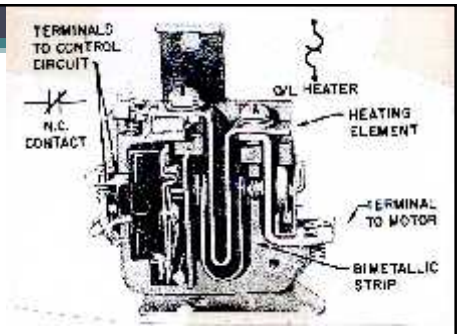
Field Accelerating Relay

- used with starters
- provides the full field during the starting period and limits the armature current during sudden speed changes
- connected in series with the motor armature
- when a sudden speed increase causes excessive armature currents, the coil closes the relay contacts.

Field Failure Relay

- is a single-pole control relay
- The coil is connected in series with the shunt field
- If the shunt field fails, the relay coil is de-energized and the relay contact opens the circuit to the motor starter,
- disconnecting the motor from the line.

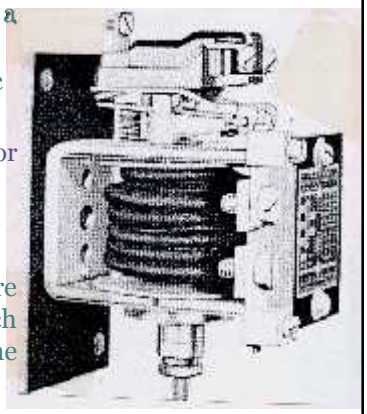
Overload Relays



- Types:
  - Thermal
  - Magnetic
  - Time Limit
  - Instantaneous
- Thermal
  - A thermal-overload relay uses a heater connected in series with the motor supply .
  - The amount of heat produced increases with supply current. If an overload occurs, the heat produced causes a set of contacts to open, interrupting the circuit.
  - relay contacts, after tripping, will automatically re-close after the relay has cooled down
  - There are two common types:
    - Bimetallic type – use bimetallic strip
    - Melting alloy type – use principle of heating solder to its melting point

- Magnetic
  - coil is connected in series with the motor
  - operate on the magnetic action of the load current that is flowing through a coil
  - When the load current rises to a certain value, a plunger is pulled up and contact will be opened, interrupting the circuit.
  - used to protect large motor windings against continued over-current.
- Time Limit Overload Relays
  - Time delay overload relay make use of the oil dashpot principle.
  - As the current increases in the relay coil, so does the magnetic flux.
  - The force of gravity is overcome and the plunger and piston move upward.
  - During this upward movement, oil is forced through bypass holes in the piston.
  - As a result, the operation of the contacts is delayed
    - Inverse time characteristics - As the line current increases the relay tripping time decreases.

- Instantaneous Trip Current Relays
  - used to take a motor off the line as soon as a predetermined load condition is reached.
  - does not have the inverse time characteristic
  - consists of
    - a solenoid coil through which the motor current flow
    - a moveable iron core within the coil
    - and a snap-action precision switch
  - If an over-current condition causes the core to be lifted, the snap-action precision switch is operated to trip the control contact of the relay.
  - The tripping value of the relay can be set over a wide range of current ratings by moving the plunger core up and down on the threaded stem



Thank You

- Next Lecture:
- MOTOR STARTER