كلية المأمون الجامعة

قسم هندسة تقنيات القدرة الكهربائية

المرحلة الرابعة

Working Principle of relays

أنظمة النقل والتوزيع

محاضرة رقم (16)

Most of the relays in service on electric power system today are of electro-mechanical type. They work on the following two main operating principles :

(i) Electromagnetic attraction

(ii) Electromagnetic induction

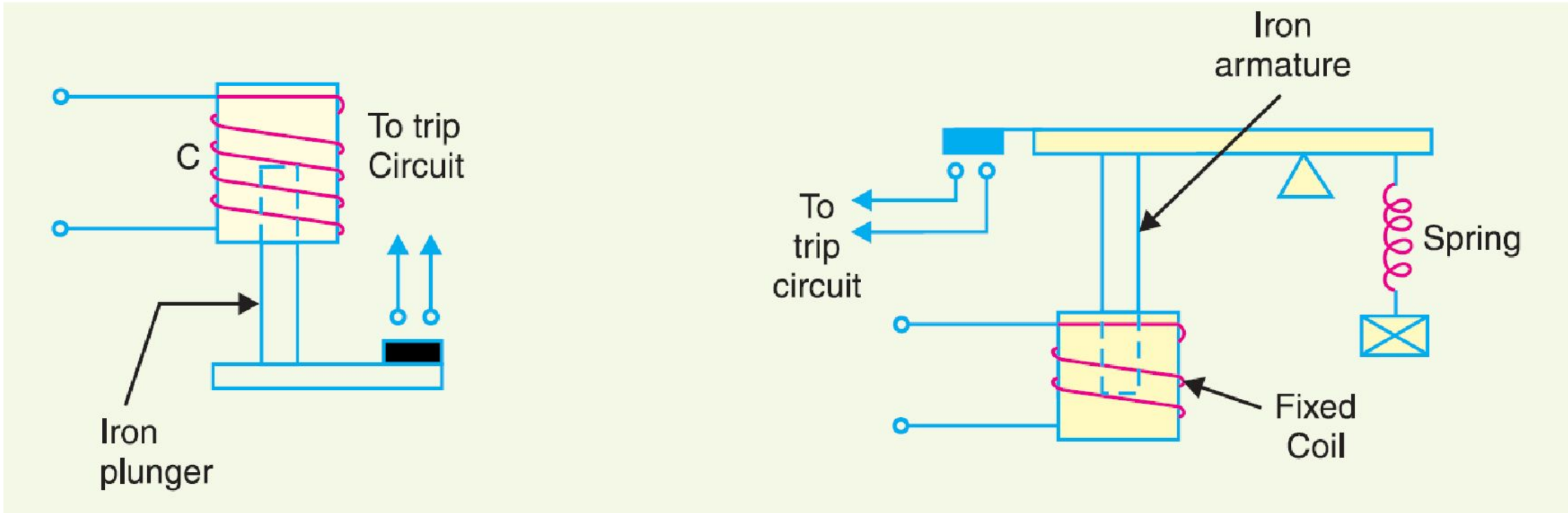
Electromagnetic Attraction Relays

Electromagnetic attraction relays operate by virtue of an armature being attracted to the poles of an electromagnet or a plunger being drawn into a solenoid. Such relays may be actuated by d.c. or a.c. quantities.

(i) Attracted armature type relay.

(ii) Solenoid type relay.

(iii) Balanced beam type relay.


C
To trip
Circuit
Iron
plunger
Iron
armature
To
trip
circuit
Spring
Fixed
Coil

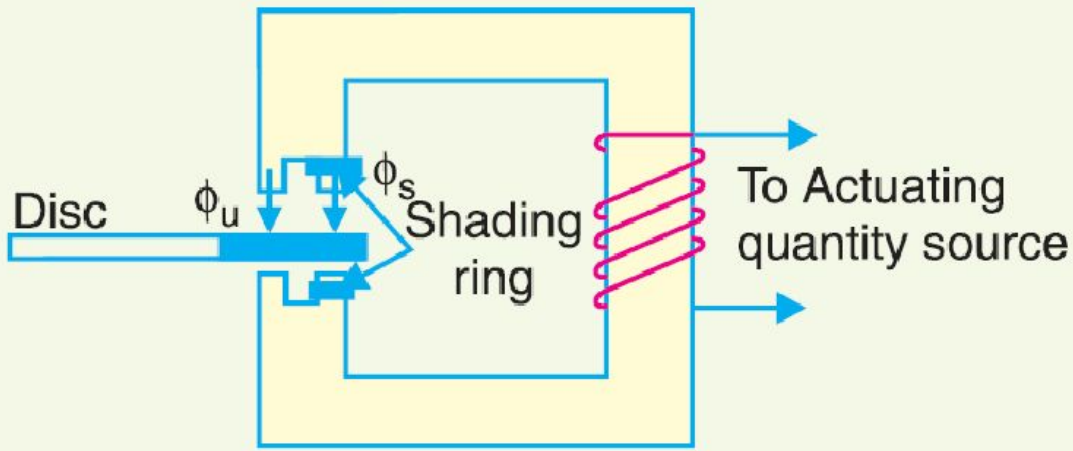
Electromagnetic induction relays

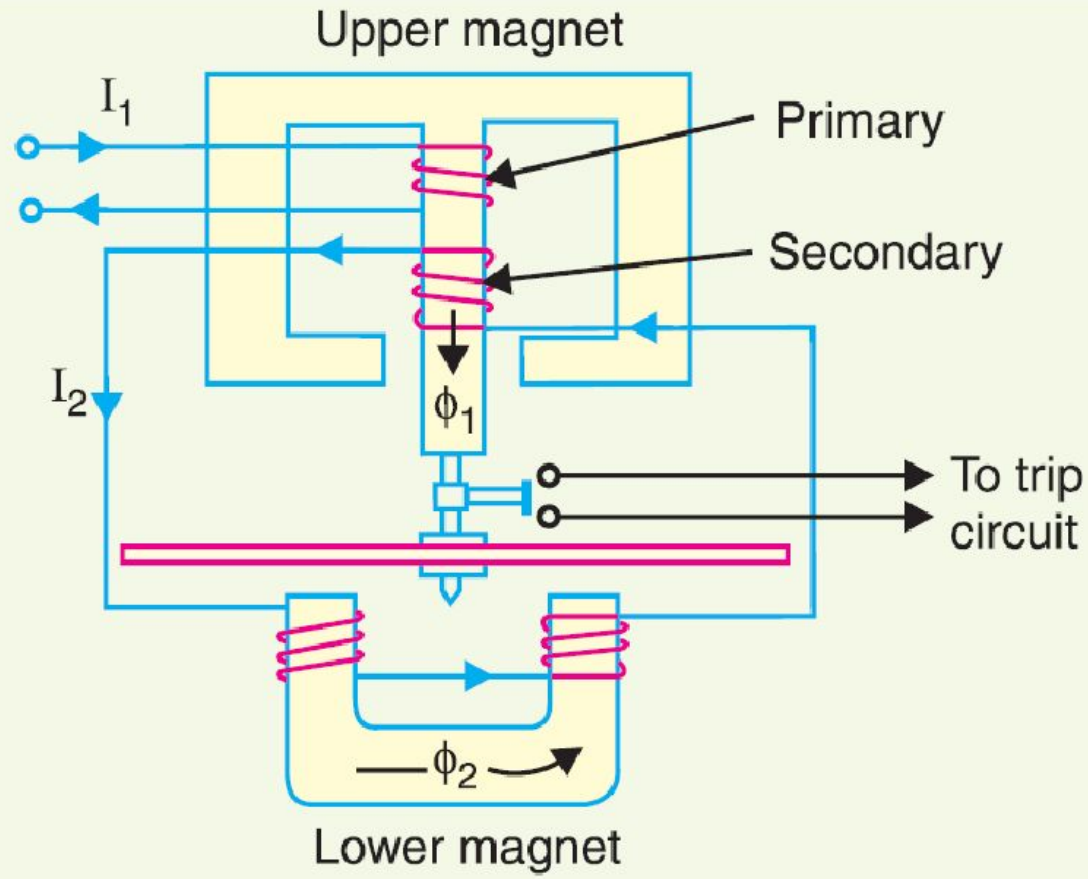
Electromagnetic induction relays operate on the principle of induction motor and are widely used for protective relaying purposes involving a.c. quantities. They are not used with d.c. quantities owing to the principle of operation. An induction relay essentially consists of a pivoted aluminium disc placed in two alternating magnetic fields of the same frequency but displaced in time and space. The torque is produced in the disc by the interaction of one of the magnetic fields with the currents induced in the disc by the other.

(*i*) shaded-pole structure

(*ii*) watthour-meter or double winding structure

(*iii*) induction cup structure


Disc
ϕ_u
ϕ_s
Shading ring
To Actuating quantity source


Upper magnet
I_1
Primary
Secondary
I_2
ϕ_1
To trip circuit
ϕ_2
Lower magnet

Relay Timing

(*i*) Instantaneous relay. An instantaneous relay is one in which no intentional time delay is provided. In this case, the relay contacts are closed immediately after current in the relay coil exceeds the minimum calibrated value.

(*ii*) Inverse-time relay. An inverse-time relay is one in which the operating time is approximately inversely proportional to the magnitude of the actuating quantity.

(*iii*) Definite time lag relay. In this type of relay, there is a definite time elapse between the instant of pickup and the closing of relay contacts. This particular time setting is independent of the amount of current through the relay coil ; being the same for all values of current in excess of the pickup value.

Important Terms

(i) Pick-up current. It is the minimum current in the relay coil at which the relay starts to operate. So long as the current in the relay is less than the pick-up value, the relay does not operate and the breaker controlled by it remains in the closed position. However, when the relay coil current is equal to or greater than the pickup value, the relay operates to energies the trip coil which opens the circuit breaker.

(*ii*) Current setting. It is often desirable to adjust the pick-up current to any required value. This is known as current setting and is usually achieved by the use of tappings on the relay operating coil.

$$\text{Pick-up current} = \text{Rated secondary current of C.T.} \times \text{Current setting}$$

(*iii*) Plug-setting multiplier (P.S.M.). It is the ratio of fault current in relay coil to the pick-up current *i.e.*

$$\text{P.S.M.} = \frac{\text{Fault current in relay coil}}{\text{Pick - up current}}$$

(*iv*) Time-setting multiplier. A relay is generally provided with control to adjust the time of operation. This adjustment is known as time-setting multiplier. The time-setting dial is calibrated from 0 to 1 in steps of 0.05 sec (see Fig. 21.15). These figures are multipliers to be used to convert the time derived from time/P.S.M. curve into the actual operating time.