Quadrant II – Transcript and Related Materials

Programme	**: Bachelor of Science (First Year)**
Subject	**: Electronics**
Paper Code	**: ELG 102**
Paper Title	**: Repair and Maintenance of Electrical and Electronic Appliances**
Unit	**: II**
Module Name	**: Energy meter: Introduction, working, Connection**
Module No	**: 06**
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Notes:

Introduction:

- An instrument that is used to measure either quantity of electricity or energy, over a period of time is known as **energy meter** or **watt-hour meter**.
- In other words, energy is the total power delivered or consumed over an interval of time t may be expressed as:

$$W = \int_0^t v(t)i(t)dt$$

If $v(t)$ is expressed in volts, $i(t)$ in amperes and t in seconds, the unit of energy is $joule$ or $watt\ second$.

The commercial unit of electrical energy is $kilowatt\ hour\ (KWh)$.

- The meter used works on “electro-magnetic induction” principle. are Hence, known as **induction type instruments**.
- These energy meters are particularly suitable for industrial or domestic use.
- The accuracy of the induction meter is unaffected by the variations of voltage of frequency on supply.

Construction of induction type energy meter:

- Induction type energy meter essentially consists of following components:

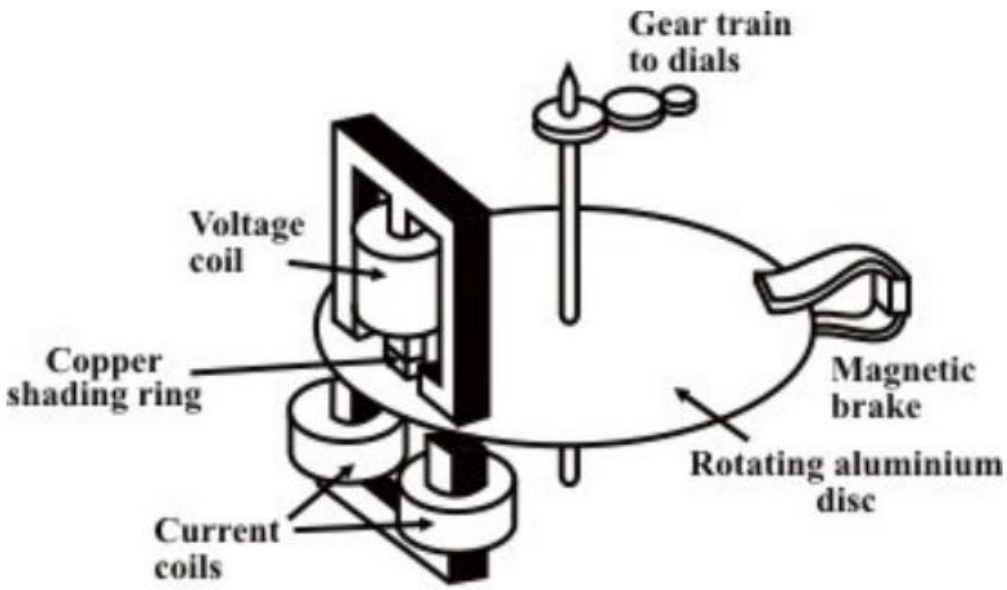
(a) Driving system

(b) Moving system

(c) Braking system

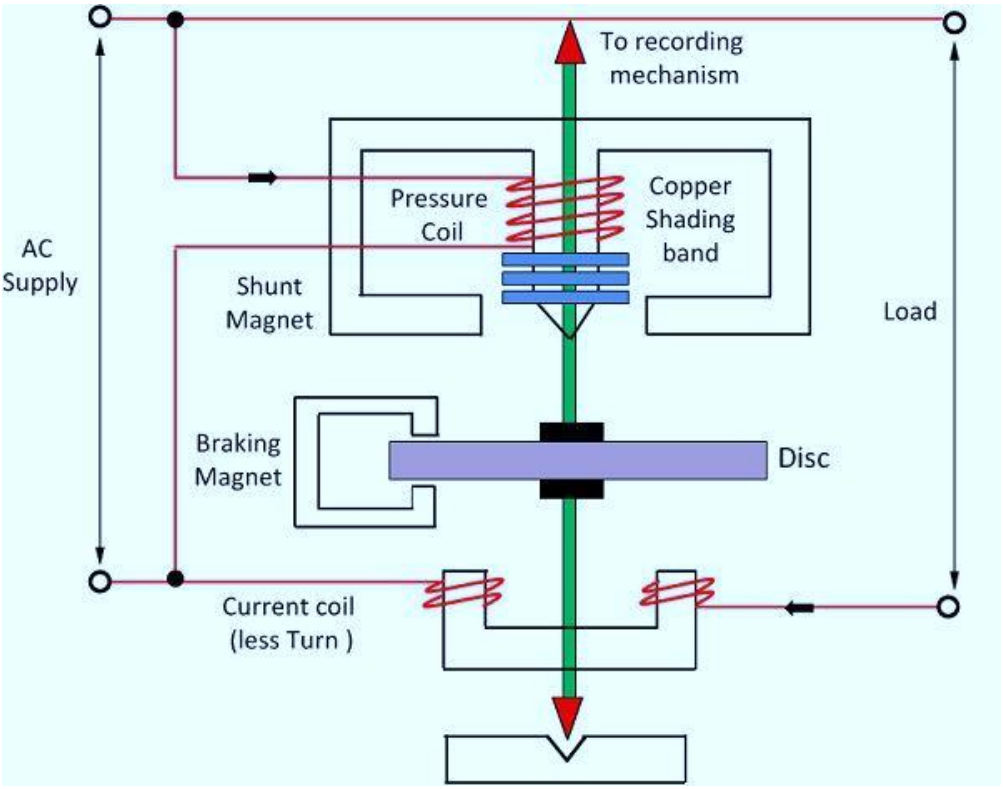
(d) Registering system

a) Driving system:



- The construction of the electro magnet system is shown in Fig. and it consists of two electromagnets, called "**shunt**" magnet and "**series**" magnet, of laminated construction.
- **Voltage/Pressure Coil:** A coil having large number of turns of fine wire is wound on the middle limb of the shunt magnet. This coil is known as "pressure or voltage" coil and is connected across the supply mains. It is highly inductive.
- This causes the current, and therefore the flux, to lag the supply voltage by nearly 90^0 .

- **Adjustable copper shading rings:** are provided on the central limb of the shunt magnet to make the **phase angle displacement between magnetic field set by shunt magnet and supply voltage.**
- The copper shading bands are also called the power factor compensator or compensating loop.
- **Current coil:** The series electromagnet is energized by a coil, known as "current" coil which is connected in series with the load so that it carries the load current.
- The flux produced by this magnet is proportional to, and in phase with the load current.



b) Moving system:

- The moving system essentially consists of a light rotating aluminium disk mounted on a shaft.
- The shaft is connected by a gear arrangement to the clock mechanism on the front of the meter to provide information that consumed energy by the load.
- The time varying (sinusoidal) fluxes produced by shunt and series magnet induce eddy currents in the aluminium disc.
- The interaction between these two magnetic fields and eddy currents set up a **driving torque** in the disc.
- The number of rotations of the disk is therefore proportional to the energy consumed by the load in a certain time interval and is commonly measured in kilowatt hours (KWh).

c) Braking system

- Damping of the disk is provided by a small permanent magnet, located diametrically opposite to the a.c. magnets.
- The disk passes between the magnet gaps.
- The movement of rotating disc through the magnetic field crossing the air gap sets up eddy currents in the disc that reacts with the magnetic field and exerts a braking torque (opposes driving torque).
- By changing the position of the brake magnet or diverting some of the flux there form, the speed of the rotating disc can be controlled.

d) Registering or Counting system

- The registering or counting system essentially consists of gear train, driven either by worm or pinion gear on the disc shaft, which turns pointers that indicate on dials the number of times the disc has turned.
- The energy meter hence, adds together or integrates all the instantaneous power values so that total energy used over a period is thus known.
- Therefore, this type of meter is also called an "integrating" meter.

Basic operation

- The basic working of Single phase induction type Energy Meter is only focused on two mechanisms:
    1. Mechanism of rotation of an aluminum disc which is made to rotate at a speed proportional to the power consumed.
    2. Mechanism of counting and displaying the amount of energy transferred.

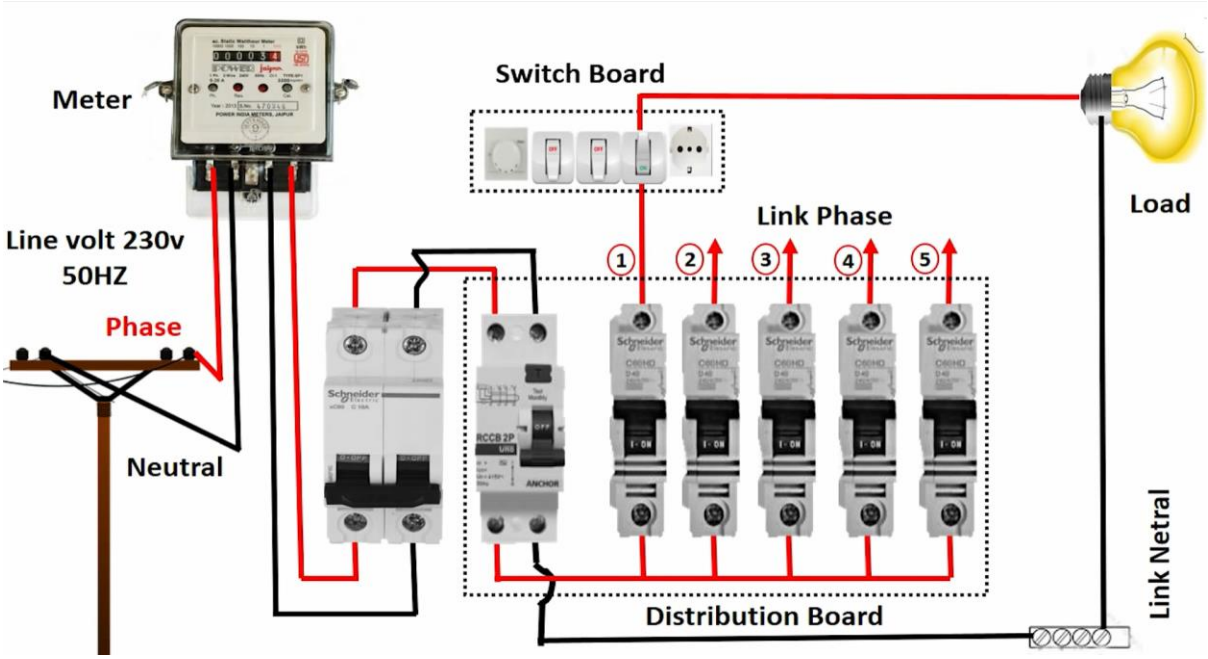
Mechanism of rotation of an aluminum disc

- The metallic disc is acted upon by two coils.
- One coil is connected or arranged in such a way that it produces a magnetic flux in proportion to the voltage and the other produces a magnetic flux in proportion to the current.
- The current and the field of the voltage coil is delayed by 90 degrees using a lag coil.
- A permanent magnet exerts an opposing force, proportional to the speed of rotation of the disc – this acts as a brake which causes the disc to stop spinning when power is no consumed, rather than allowing it to spin faster and faster.
- This causes **the disc to rotate at a speed proportional to the power being used.**

Mechanism of displaying the amount of energy transferred-Registering and counting system

- The registering or counting system essentially consists of gear train, driven either by worm or pinion gear on the disc shaft.
- This turns pointers that indicate on dials the number of times the disc has turned.

Connection


Meter
Switch Board
Load
Link Phase
Line volt 230v
50HZ
Phase
Neutral
1
2
3
4
5
Link Netral
Distribution Board