Object: - To study the construction and working of single phase energy meter and to find out energy consumed in 30 minutes.

Apparatus: - One single phase energy meter, one single phase load, Stop watch and connecting wires.

Theory: - Energy meter is an instrument which measures electrical energy. It is also known as watt-hour (Wh) meter. It is an integrating device. There are several types of energy meters single phase induction type energy meter are very commonly used to measure electrical energy consumed in domestic and commercial installation. Electrical energy is measured in kilo watt-hours (kWh) by this energy meter.

Construction: - A single phase induction type energy meter consists of driving system, moving system, braking system and registering system. Each of the systems is briefly explained below.

Driving system: - This system of the energy meter consists of two silicon steel laminated electromagnets. M1 & M2 as shown in fig.1The electromagnet M1 is called the series magnet and the electromagnet M2 is called the shunt magnet. The series magnet M1 carries a coil consisting of a few turns of thick wire. This coil is called the current coil (CC) and it is connected in series with the circuit. The load current flows through this coil. The shunt magnet M2 carries a coil consisting many turns of thin wire. This coil is called the voltage coil (VC) and is connected across the supply it consist of current proportional to the supply voltage. Short circuited copper bands are provided on the lower part of the central limb of the shunt magnet. By adjusting the position of these loops the shunt magnet flux can be made to lag behind the supply voltage exactly 90° . These copper bands are called power factor compensator (PFC). A copper shading band is provided on each outer limb of the shunt magnet (fc1 &fc2) these band provides frictional compensation.

Moving system: - The moving system consists of a thin aluminum disc mounted on a spindle and is placed in the air gap between the series and the shunt magnets. It cuts the flux of both the magnet forces are produced by the fluxes of each of the magnets with the eddy current induced in the disc by the flux of the other magnets. Both these forces act on the disc. These two forces constitute a deflecting torque.

Braking system: - The braking system consists of a permanent magnet called brake magnet. It is placed near the edge of the disc as the disc rotates in the field of brake magnet eddy current are induced in it. These eddies current react with the flux and exert a torque. This torque acts in direction so that it opposes the motion of disc. The braking torque is proportional to the speed of the disc.

Registering system: - the disc spindle is connected to a counting mechanism this mechanism records a number which is proportional to the number of revolutions of the disc the counter is calibrated to indicate the energy consumed directly in kilo watts-hour (kWh)

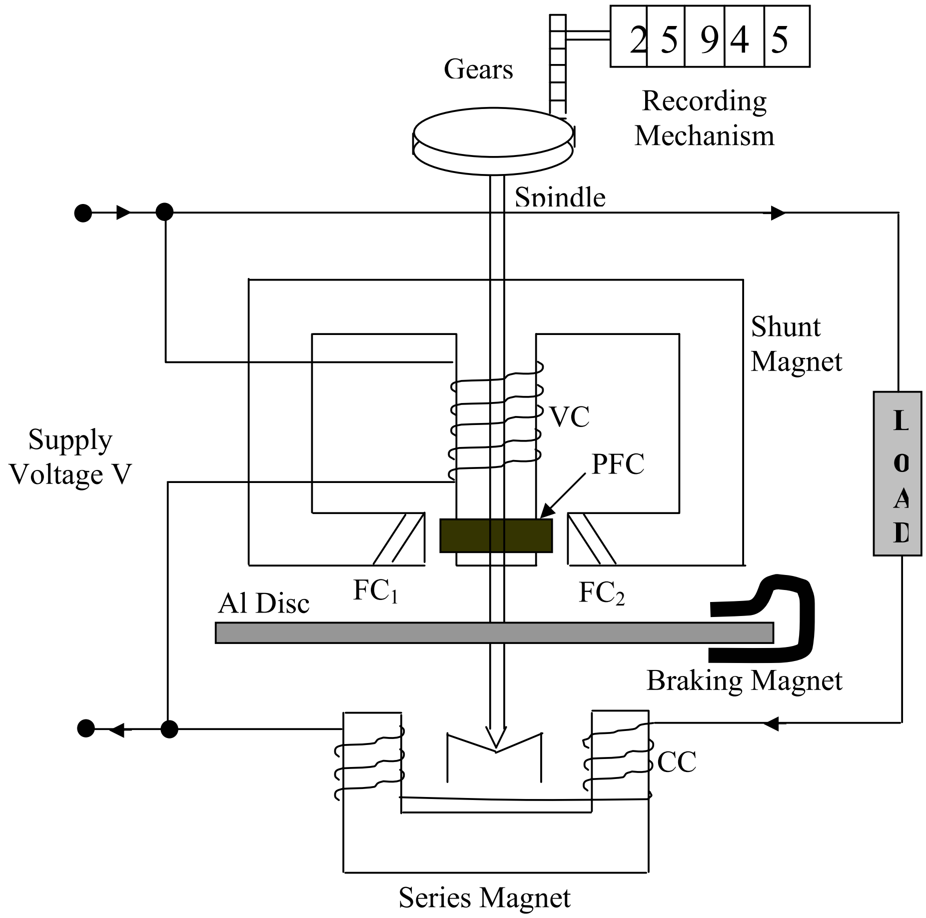
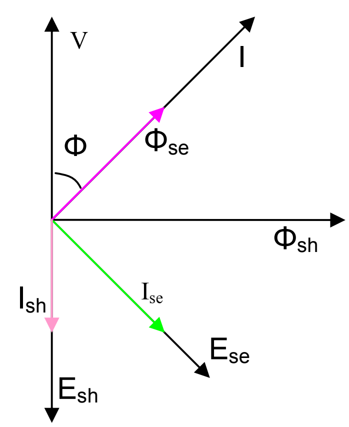


Fig.1

Fc1 = Friction Compensators
PFC = Power factor compensator
CC = Current coil
VC = Voltage coil

Working:-

Let V=Supply voltage
I=Load current lagging behind V by Φ
Cos Φ = Load Power Factor (Lagging)
I_{sh}= Current setup by Φ_{sh} in disc
I_{se}= Current setup by Φ_{se} in disc



Phase diagram will be as follows

Instantaneous deflecting torque

$\tau_d \propto (\psi_{sh} i_{se} - \psi_{se} i_{sh})$ where ψ & i are instantaneous values

Average deflecting toque

$T_d \propto [\Phi_{sh} I_{se} \cos\Phi - \Phi_{se} I_{sh} \cos(180-\Phi)]$ where Φ & I are RMS values

$T_d \propto [\Phi_{sh} I_{se} \cos\Phi + \Phi_{se} I_{sh} \cos\Phi]$

$T_d \propto [\Phi_{sh} I_{se} + \Phi_{se} I_{sh}] \cos\Phi$

We know $\Phi_{sh} \propto V$, $I_{se} \propto I$, $\Phi_{se} \propto I$, $I_{sh} \propto V$

So

$T_d \propto [VI+VI] \cos\Phi$

$T_d \propto VI\cos\Phi$

$\propto$ Power

No of revolution made in t sec

$\int_0^t N dt \propto \int_0^t p dt \propto$ Energy consumed in t sec

Meter Constant

$$K = \frac{No \quad of \quad Revolution \quad made}{KWh}$$

Observation Table:-

Time period of Observation (T) = 30 min

S.No.	No. of Revolutions	Previous Reading (x)	Reading After Exp (y)	No of Units = x-y	Energy		% Error
					Measured M = No of units x 1 (Kwh)	Calculated C = N / K (Kwh)	$= \frac{(M-C)*100}{C}$

Calculations:-

Meter constant K=

Energy Calculated = $\frac{N}{K}$ Kwh

= Kwh

= Kwh

Results: - Study has been done on 1 phase energy meter and verification of energy is done as shown in the above observation table.

Precautions:-

(i) Connection should be tight.

(ii) Voltage and current should not exceed the rated one.