EXPERIMENT NO. 11

Objective: To find line, phase quantities and power in three phase star load using two wattmeter method.

Apparatus Required:

S/N	Apparatus	Quantity	Range/ Remark
1	Three phase supply	**1**	**(0-440) V**
2	Three Phase Variac	**1**	(i/p-440V,o/p-0-470V,15A)
3	Three bulbs in each	**1**	(……………..) W Each
4	Wattmeter	**2**	**(……….)W, (……….)W**
5	AC Voltmeter	**2**	**(……)V, (……)V**
6	ACAmmeter	**1**	**(………)A**
7	Connecting wires	**--**	**--**

Circuit Diagram:

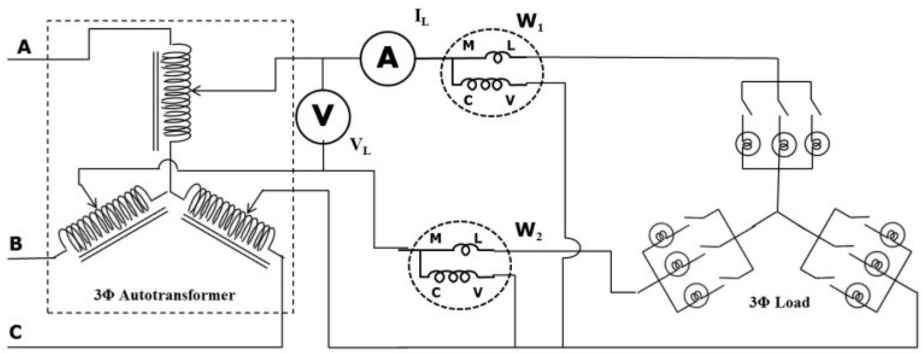


Fig1.

Observation Table:

S.N.	V_l (volt)	V_{ph} (volt)	$I_L = I_{ph}$ (A)	W_1 (Watt)	W_2 (Watts)	$W_1 + W_2$ (Watts)	tanΦ	cosΦ	$W=\sqrt{3}\ V_l I_l \cos\Phi$

Theory:

Measurement of power

The three phase power can be measured by three single Wattmeters having current coils in each line and potential coils connected across the given line and any common junction. Since the common junction is completely arbitrary it may be placed on any one side of the three lines. In which case the wattmeter connected in the line will indicate the zero power because its potential coil has voltage across it. Hence that wattmeter may be dispersed with and the three phase power can measured by means of only two single phase wattmeter having common potential junction on any of the three lines in which there is no current coil. This is known as two wattmeter method, measuring three phase power. In general m phase power can measured by means of m-1 wattmeters. This method is valid for both balanced as well as unbalanced circuits. The total real powers delivered to the load are given by the algebraic sum of the two wattmeter reading.

$$P=W_1+W_2$$

This significance of the algebraic sum will be realized in the paragraph that follow. Two wattmeter can be connected with their current coils in any two lines, while their potential coils are connected to the third, as shown in fig 1.The wattmeter readings are given by

$$W_1=V_{RB}I_R\cos\phi_1$$

Where ϕ_1 is the angle between V_{AB} and I_A and

$W2 = V_{YB}\, I_Y \cos\phi_2$

Where ϕ_2 is the anlge between V_{BY} and I_B

The two wattmeter method when applied to the balanced loads, yield interesting result. Consider either balanced by on delta connected loads, with the aid of the corresponding phase diagram drawn earlier for the phase sequence A-B-C fig 2, it can be seen that the angle between V_{BY} and I_Y is (30°+ ϕ) and that between V_{RB} and IR is (30°- ϕ),where is the load power factor angle associated with the load impedance. Thus,we have

$$W_1=V_L\, I_L\cos(30°+\phi)$$

Where VL and IL are the magnitude of the line voltage and line current, respectively. Simple manipulation yield

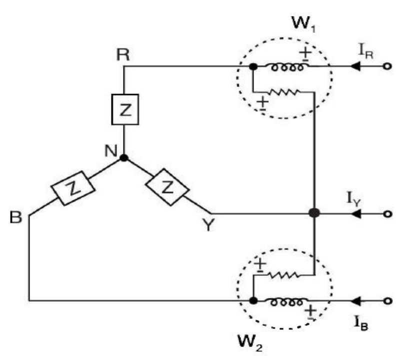
$$W_1+W_2=\sqrt{3}V_L\, I_L\cos(\phi)$$

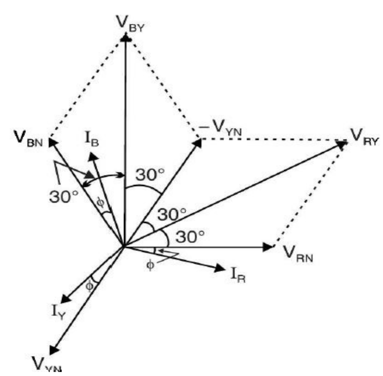
And,

$$W_2-W_1=V_L\, I_L\sin(\phi)$$

From which

$$\tan\phi=\frac{\sqrt{3}(W_2-W_1)}{(W_2+W_1)}$$





Procedure:

1. Make the connections as per the circuit diagram.
2. Keep the three phase variac at its zero position.
3. Make sure all the switches are in off position.
4. Switch on the supply and increase the supply voltage to rated voltage.
5. Switch on one bulb each of all the phases and note the reading of all the meters.
6. Repeat step 5 for two bulbs and three bulbs switched on in each phase.

Result: The line voltage is $\sqrt{3}$ times the phase voltage and the two wattmeter method measure three phase power.

Precaution:

1. All connections should be done tightly.
2. Take the readings carefully, avoid parallax.