Experiment No. 6 **Date:**

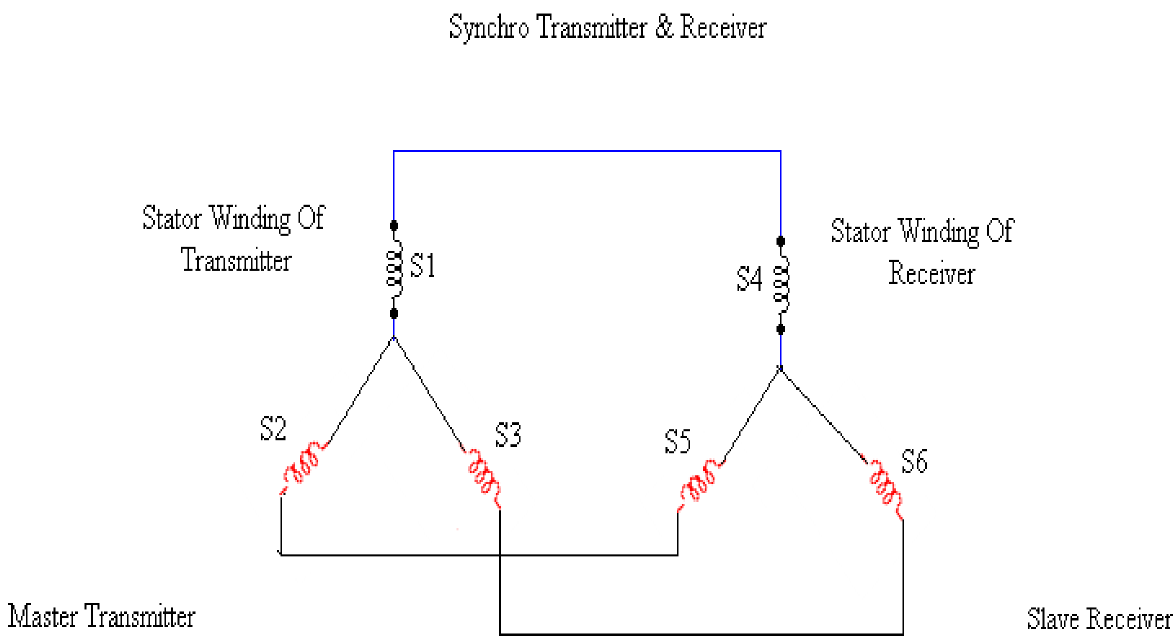
Aim:

Study synchros to observe angular displacement.

Apparatus:

Synchro transmitter –receiver kit, Patch cords, Power supply, etc

Diagram:



Theory

A synchro is an electromagnetic transducer, commonly used to convert an angular position of a shaft into am electric signal. The basic synchro is usually called a synchro transmitter. Its construction is similar to that of a three phase alternator. The stator (stationary member) is of laminated silicon steel & is slotted to accommodate a balance three phase winding which is usually of concentric coil type & is Y connected. The rotor is a dumb bell construction & wound with a concentric coil. An A.C. voltage is applied to the rotor winding through slip rings.

Let an A.C. voltage

$$Vr(t) = Vr \sin Wct \qquad \text{-------(1)}$$

Be supplied to the rotor of the synchro transmitter. This voltage causes a flow of magnetizing current in the rotor coil which produces a time varying flux directed along its axis & distributed nearly in the air gap along stator periphery. Because of transformer action, voltages are induced in each of the stator coil. As the air gap flux is sinusoidaly distributed, the flux linking any stator coil is proportional to the cosine of the angle between rotor & stator coil axis & so is the voltage induced in each stator coil. The stator coil voltages are of course in time phase with each other. Thus we see that synchro transmitter acts like single coils from the secondary.

Synchro Transmitter:

In Synchro transmitter construction is similar to alternator. Here rotor is dumb bell shaped & mounted with concentric coil. The stator is a 3 Φ winding spaced 120 apart on space from each other. See fig (A).

The rotor is given 1 Φ A.C. supply voltage induced on each stator winding is proportional to cos Φ as shown in fig. (B).

Ref. voltage to rotor is

$$Vr = V \sin\omega t$$

Then stator voltage ω. r. t. neutral

$$R = V_1n = K\, V\sin\omega t \cos(\theta + 120)$$

$$= V_2n = K\, V\sin\omega t \cos(\theta)$$

$$= V_3n = K\, V\sin\omega t \cos(\theta + 240)$$

Hence $Vs_1, Vs_2 = V_1n = V_2n$

$$= K\, V\sin\omega t \{\cos(\theta + 120) - \cos(\theta)\}$$

$$Vs_1, Vs_2 = \sqrt{3}\, KV\sin\omega t \sin(\theta + 240)$$

$$Vs_2, Vs_3 = \sqrt{3}\, KV\sin\omega t \sin(\theta + 120)$$

$$Vs_3, Vs_1 = \sqrt{3}\, KV\sin\omega t \sin(\theta)$$

At $\theta = 0$, $Vs_3, s_1 = 0$ & this is electrical 0 of transmitter.

The synchro transmitter is thus single Φ transmitter in time phase but different magnitude depending on Φ. Thus rotor position Φ reflect as voltage on stator side.

Synchro Transmitter, Control Transformer Pair:

The use in error detector is now identical unit to transmitter is synchro control .When connected as shown in fig. error on rotor position i.e. difference between rotor position causes a voltage to be induced at the o/p control transmitter. This voltage is proportional to error between the angular rotor positions of both.Thus,

$$e(t) = K\, V_r \cos(\theta) \sin\omega t, \text{ at } e(t) = 0$$

& this defines electrical zero position.

Synchro Transmitter, Receiver:

When both rotors R excited same i/p both sec. also tied as shown in fig (D), then rotor angular position will be followed by another rotor as per 1st rotor. Here master rotor is rotated by θ & slave also will move by similar angle θ. Here rotor applied voltage rotor angle & sec. voltage are the parameter.

In a control transmitter 1st two are fixed on receiver. Thus rotor will change.

In transmitter-receiver rotor voltage & stator voltage are same on both. Hence rotor position will follow.

Operating Instruction:

Study of Synchro Transmitter.

In this part of the expt. We can see how because of the transformer action the angular position of the rotor of synchro transmitter is transformed into a unique set of stator voltage.

<u>Procedure:</u>

(For Synchro Transmitter)

1. Connect the mains supply to the system with the help of cable provided. Do not connect any patch cords to terminals marked.
2. Switch on mains supply for the unit.
3. Starting fro the zero position, note down the voltage between stator winding terminals i.e. Vs_1s_2, Vs_2s_3 & Vs_3s_1 in a sequential manner. Enter reading in tabular form & plot a graph of angular position of rotor voltages for all three phases.

4. Note that zero position of the stator rotor consider with Vs3s1 voltages equal to zero voltages. Do not disturb this condition.

Procedure (for synchro transmitter & receiver)

1. Connect the mains supply
2. Connect $S_{1,}$ $S_{2,}$ S_3 terminals of transmitter to $S_{1,}$ $S_{2,}$ S_3 of receiver by patch cords
3. Switch on SW1 & SW2
4. Move the pointer i.e. rotor position of synchro transmitter Tx insteps of 30^0& observe the new rotor position. Observe that whenever Tx rotor is rotated, Tr rotor follows it for both the direction of rotation & their position are in good agreement.
5. Enter the I/p angular position & o/p angular position in the tabular form & Plot a graph.

Observation Table:

Sr. No	Angular position in degree (synchro receiver)	Angular position in degree (synchro receiver)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Conclusion:

Remark: