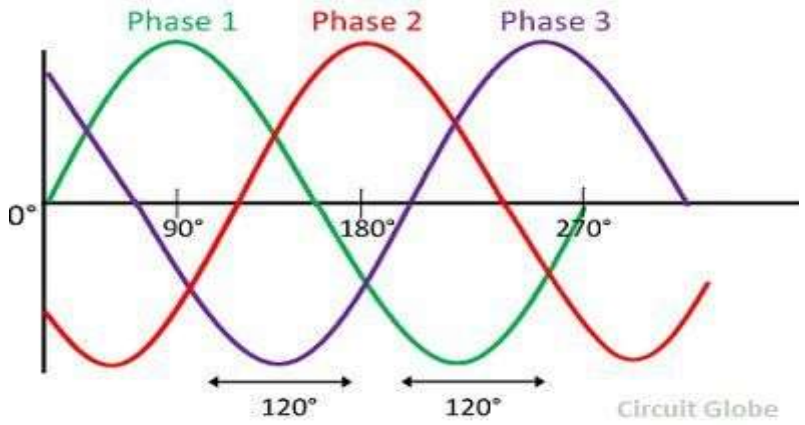
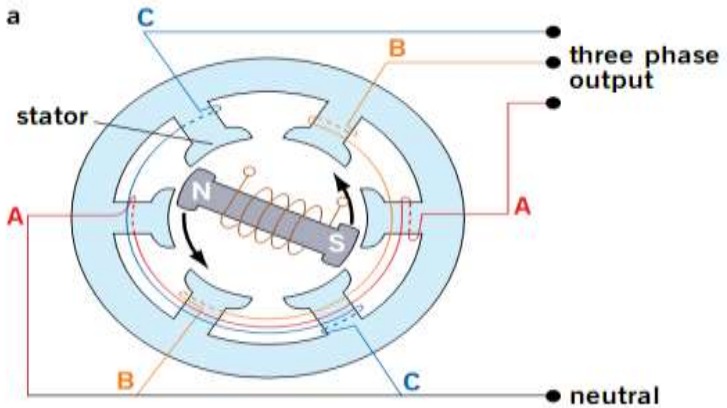
Three phase circuits

Definition: The system which has three phases, i.e., the current will pass through the three wires, and there will be one neutral wire for passing the fault current to the earth is known as the three phase system. The three phase system is also used as a single phase system if one of their phase and the neutral wire is taken out from it. The sum of the line currents in the 3-phase system is equal to zero, and their phases are differentiated at an angle of 120°

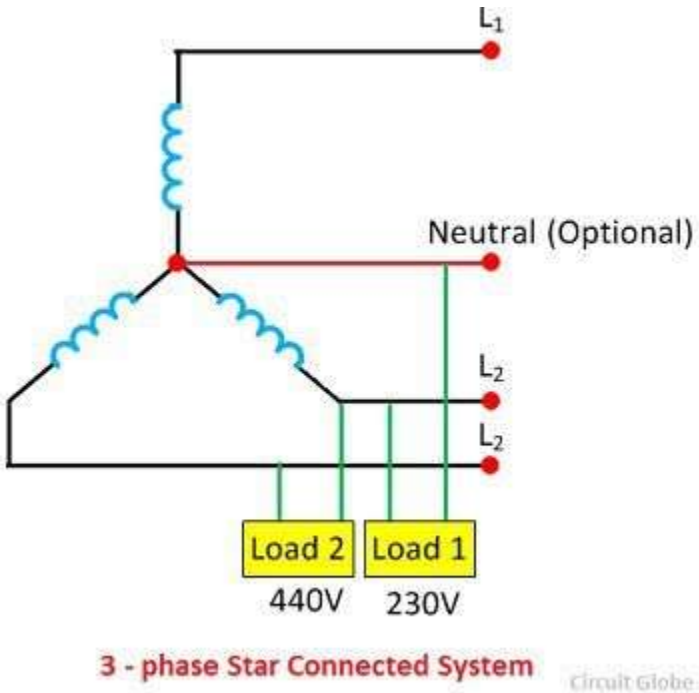


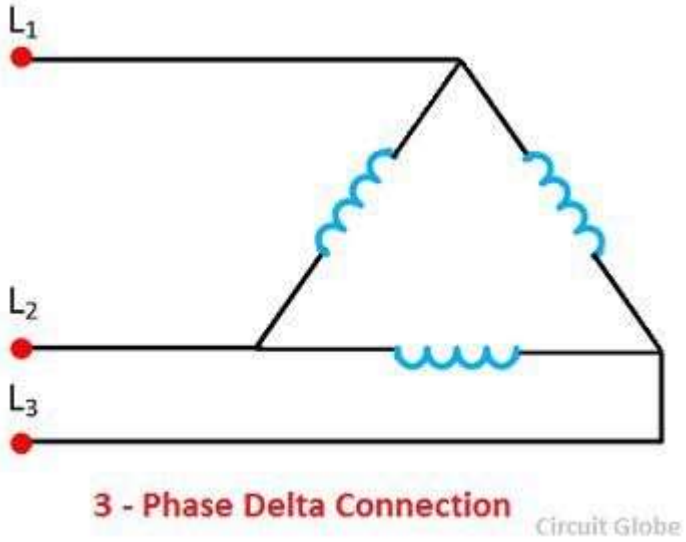


Three phase circuits

Types of Connections in Three-Phase System

The three-phase systems are connected in two ways, i.e., the **star connection and the delta connection**





Three phase circuits

Three Phase Voltage can be generated in a stationary armature with a rotating field structure, or in a rotating armature with a stationary field as shown in Fig

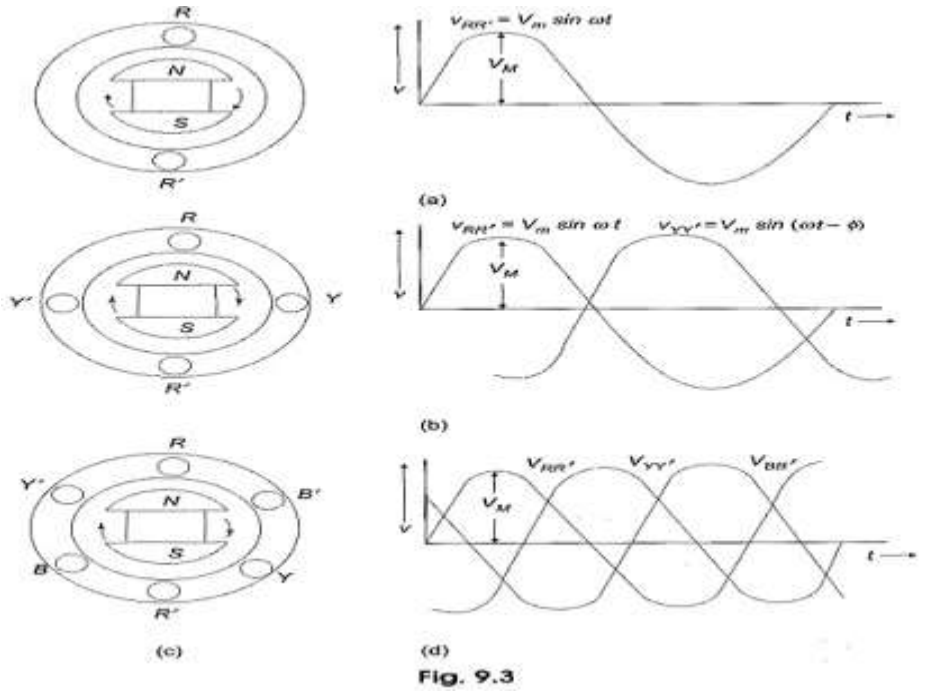


Fig. 9.3

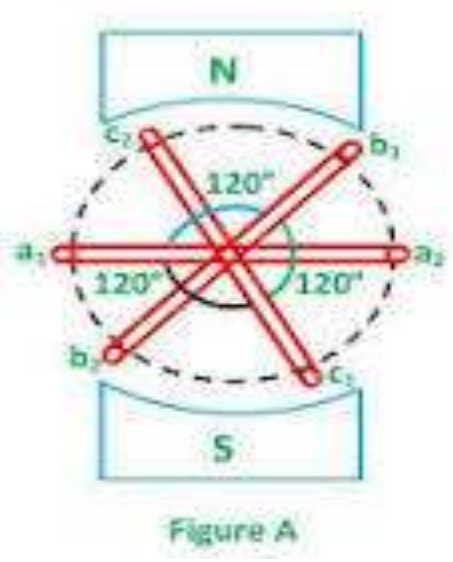


Figure A

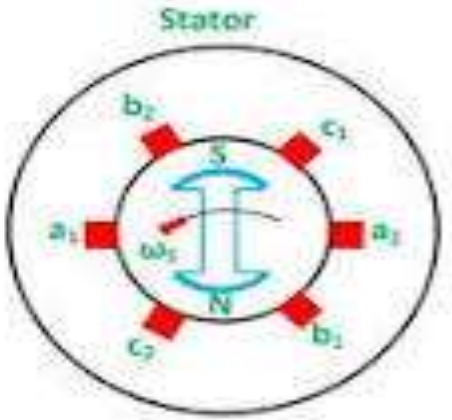


Figure B

Three phase circuits

Single phase voltages and currents are generated by single phase generators as shown in Fig. 9.2(a). The armature (here a stationary armature) of such a generator has only one winding, or one set of coils. In a two-phase generator the armature has two distinct windings, or two sets of coils that are displaced 90° (electrical degrees) apart, so that the generated voltages in the two phases have 90 degrees phase displacement as shown in Fig. 9.3(b).

Similarly, Three **Phase Voltage are generated in three separate but identical sets of windings or coils** that are displaced by 120 electrical degrees in the armature, so that the voltages generated in them are 120° apart in time phase. This arrangement is shown in Fig. 9.3(c). Here RR' constitutes one coil (R-phase); YY' another coil (Y-phase), and BB' constitutes the third phase (B-phase). The field magnets are assumed in clockwise rotation.

Three phase circuits

The voltages generated by a three-phase alternator is shown in Fig. 9.3(d). The Three Phase Voltage are of the same magnitude and frequency; but are displaced from one another by 120°. Assuming the voltages to be sinusoidal, we can write the equations for the instantaneous values of the voltages of the three phases. Counting the time from the instant when the voltage in phase R is zero. The equations are

$$v_{RR'} = V_m \sin \omega t$$
$$v_{YY'} = V_m \sin (\omega t - 120°)$$
$$v_{BB'} = V_m \sin (\omega t - 240°)$$

Generation of Three Phase Voltage

At any given instant, the algebraic sum of the three voltages must be zero.

Advantages Three phase circuits

•In the 3-phase system**, a rotating magnetic field can** be created in stationary windings, whereas this cannot be done in a single phase system.
•For the same rating, three phase machines (like motors, generators etc.) are smaller and simpler in **constructio**n as compared to single phase machines. Therefore, the **overall cost of a three phase machine is less** than that of a 1-phase machine.
•To transmit the same amount of power over certain distance at a given voltage, the three phase **system requires less (or 3/4) of the weight of copper** (conductor material) than that required by the single phase system.
•The **voltage regulation** of three phase transmission lines is better than that of 1-phase line.
•A single phase load can by supplied by a three phase system but, the converse is not true.