4.2 SUPPLY SYSTEMS

Mainly, there are three supply systems for Electric traction:

- ➔ The direct current system -
- ➔ The single-phase AC system operating at low frequency 162/3 Hz or 25 Hz and at normal frequency 50 Hz
- ➔ The three phase AC system

Direct current system:

The transformation and high voltage generation of dc is very inconvenient to the dc supply used is at normally 600 V and this voltage is almost universal for use in urban and suburban railways. For direct current equipment, the series motor is universally employed as its speed-torque characteristics are best suited to traction requirements. Generally, two or more motors are used in single equipment and these are coupled in series or in parallel to give the different running speeds required. The motors are initially connected in series with starting rheostats across the contact line and rails, the rheostats are then cut out in steps, keeping roughly constant current until the motors are running in full series. After this the motors are rearranged in parallel, again with rheostats, the rheostats are cut out in steps, leaving the motors in full parallel. The power input remains approximately constant during the series notching, then jumps to twice this value during the parallel notching. Thus a 4-motor unit will have three economical speeds when the motors are running in series, series-parallel connections. The rheostats are operated electro magnetically or electro-pneumatically.

AC single phase system:

In this supply is taken from a single overhead conductor with the running rails. A pantograph collector is used for this purpose. The supply is transferred to primary of the transformer through on oil circuit breaker. The secondary of the transformer is connected to the motor through switchgear connected to suitable tapping on the secondary winding of the transformer. The switching equipment may be mechanically operated tapping switch or remote-controlled contractor of group switches. The switching connections are arranged in two groups usually connected to the ends of a double choke coil which lies between the collections to adjacent tapping points on the transformer. Thus, the coil acts

as a preventive coil to enable tapping change to be made without short circuiting sections of the transformer winding and without the necessity of opening the main circuit.

AC three phase system:

In case of 3-phase system, energy can be drawn directly from the existing 3-phase electric network or by using transformer substation in case the network is operating at higher voltage. This system, therefore, has high efficiency as no converting equipment is involved. Here, two trolly wires per track are required and are connected between two phases of the supply. The induction motor is used as the drive which is robust in construction and cheap in first cost. It has high efficiency and it acts as an induction generator when runs at a speed more than its synchronous speed, thus during regenerative braking by changing the number of poles (increase) the synchronous speed can be reduced and hence power can be pumped back into the supply system. Since, it is a constant speed motor, which can be used to limit the speed of the train to a definite value. Three phase main line railways operate at a voltage between 3300 and 3600 and a frequency of 162/3 Hz. Low starting torque, high starting current and constant speed characteristics of induction motors are some reasons why 3-phase systems could not become popular for traction purposes.