1	Derive an expression for the generalized A,B,C,D constants for equipment for T representation and show that AD-BC=1.	[10]	CO1	L3
2	Write the schematic diagram and hence get the expressions for voltage at different tapping points of a DC distributor fed at one end with concentrator loads.	[10]	CO3	L3
3	A 50Hz, 3 phase transmission line 280 Km long has a total series impedance of (30+j40)Ω and shunt admittance of 930x10^{-6} mho. It delivers 40MWat 220KV with 90% p.f. lagging. Find the transmission efficiency and ABCD constants by medium line pi approximation.	[10]	CO5	L3
4	A 3 phase transmission line is 400 km long and caters a load of 450 MVA,0.8 p.f. lag at 345 kv. The ABCD constants are A=D=0.8181, 1.3°,B=172.2,84.2°,C=1.933x10^{-3} ,90.4° mho. Sending end current and percentage voltage drop at full load. Also calculate receiving end line to neutral voltage at no load. Calculate the sending end line to neutral voltage.	[10]	CO5	L3
5	What are the advantages and disadvantages of corona? What are the factors affecting the corona.	[10]	CO3	L2
6	A distributor AF is fed at the same voltage of 220V. the length of the distributor is 600m and the loads are tapped off as follows: 50A at 50m from the end A, 50A at 75 m from A, 30A at 100 m from A, and 25A at 150 m from A. calculate a) the minimum potential and b) the voltage at each load point. The resistance per 100m of the conductor for and go return is 0.08Ω.	[10]	CO3	L3
7	What are the requirements of a good distributed system? Write a note on radial distribution system.	[10]	CO4	L1

5. The phenomenon of violet glow, hissing noise and production of ozone gas in an overhead transmission line is known as corona.

Advantages and Disadvantages of Corona have many advantages and disadvantages. In the correct design of a high voltage overhead line, a balance should be struck between the advantages and disadvantages.

Advantages

(i) Due to corona formation, the air surrounding the conductor becomes conducting and hence virtual diameter of the conductor is increased. The increased diameter reduces the electrostatic stresses between the conductors.

(ii) Corona reduces the effects of transients produced by surges.

Disadvantages

(i) Corona is accompanied by a loss of energy. This affects the transmission efficiency of the line.

(ii) Ozone is produced by corona and may cause corrosion of the conductor due to chemical action.

(iii) The current drawn by the line due to corona is non-sinusoidal and hence non-sinusoidal voltage drop occurs in the line. This may cause inductive interference with neighbouring communication lines.

Factors Affecting Corona

The phenomenon of corona is affected by the physical state of the atmosphere as well as by the conditions of the line. The following are the factors upon which corona depends:

(i) Atmosphere. As corona is formed due to ionsiation of air surrounding the conductors, therefore, it is affected by the physical state of atmosphere. In the stormy weather, the number of ions is more than normal and as such corona occurs at much less voltage as compared with fair weather.

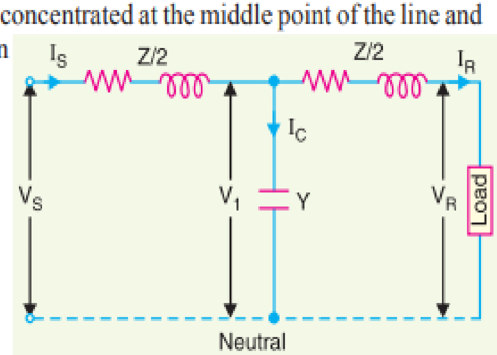
(ii) Conductor size. The corona effect depends upon the shape and conditions of the conductors. The rough and irregular surface will give rise to more corona because unevenness of the surface decreases the value of breakdown voltage. Thus a stranded conductor has irregular surface and hence gives rise to more corona that a solid conductor.

(iii) Spacing between conductors. If the spacing between the conductors is made very large as compared to their diameters, there may not be any corona effect. It is because larger distance between conductors reduces the electro-static stresses at the conductor surface, thus avoiding corona formation.

(iv) Line voltage. The line voltage greatly affects corona. If it is low, there is no change in the condition of air surrounding the conductors and hence no corona is formed. However, if the line voltage has such a value that electrostatic stresses developed at the conductor surface make the air around the conductor conducting, then corona is formed.

1. Generalized ABCD constants for T representation and show that AD-BC=1

the whole line to neutral capacitance is assumed to be concentrated at the middle point of the line and half the line resistance and reactance are lumped on either side as shown in Fig. 10.24.



Here, $\vec{V_S} - \vec{V_1} + \vec{I_S}\,\vec{Z}/2$ ...(v)

and $\vec{V_1} = \vec{V_R} + \vec{I_R}\,\vec{Z}/2$

Now, $\vec{I_C} = \vec{I_S} - \vec{I_R}$

$$= \vec{V_1}\,\vec{Y} \quad \text{where } Y = \text{shunt admittance}$$

$$= \vec{Y}\left(\vec{V_R} + \frac{\vec{I_R}\,\vec{Z}}{2}\right)$$

$$\therefore \qquad \vec{I_S} = \vec{I_R} + \vec{Y}\,\vec{V_R} + \vec{Y}\,\frac{\vec{I_R}\,\vec{Z}}{2}$$

$$= \vec{Y}\,\vec{V_R} + \vec{I_R}\left(1 + \frac{\vec{Y}\,\vec{Z}}{2}\right) \qquad \text{...}(vi)$$

Substituting the value of V_1 in eq. (v), we get,

$$\vec{V_S} = \vec{V_R} + \frac{\vec{I_R}\,\vec{Z}}{2} + \frac{\vec{I_S}\,\vec{Z}}{2}$$

Substituing the value of I_S, we get,

$$\vec{V_S} = \left(1 + \frac{\vec{Y}\,\vec{Z}}{2}\right)\vec{V_R} + \left(\vec{Z} + \frac{\vec{Y}\,\vec{Z}^2}{4}\right)\vec{I_R} \qquad \text{...}(vii)$$

Comparing eqs. (vii) and (vi) with those of (i) and (ii), we have,

$$\vec{A} = \vec{D} = 1 + \frac{\vec{Y}\,\vec{Z}}{2}\,; \quad \vec{B} = \vec{Z}\left(1 + \frac{\vec{Y}\,\vec{Z}}{4}\right); \; \vec{C} = \vec{Y}$$

Incidentally :

$$\vec{A}\,\vec{D} - \vec{B}\,\vec{C} = \left(1 + \frac{YZ}{2}\right)^2 - Z\left(1 + \frac{YZ}{4}\right)Y$$

$$= 1 + \frac{Y^2Z^2}{4} + YZ - ZY - \frac{Z^2Y^2}{4} = 1$$

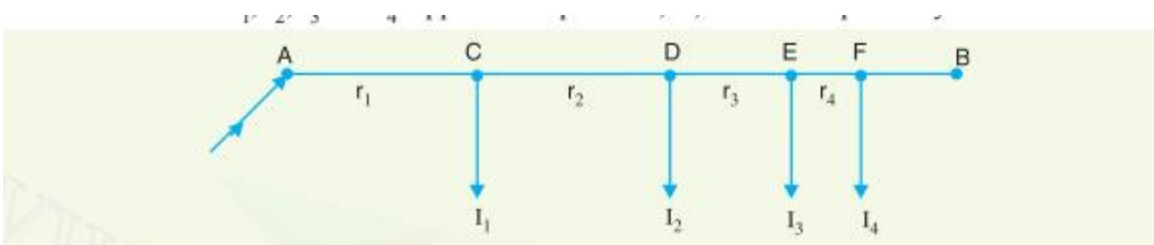


Fig. 13.5

Let r_1, r_2, r_3 and r_4 be the resistances of both wires (go and return) of the sections AC, CD, DE and EF of the distributor respectively.

Current fed from point A	$= I_1 + I_2 + I_3 + I_4$
Current in section AC	$= I_1 + I_2 + I_3 + I_4$
Current in section CD	$= I_2 + I_3 + I_4$
Current in section DE	$= I_3 + I_4$
Current in section EF	$= I_4$
Voltage drop in section AC	$= r_1 (I_1 + I_2 + I_3 + I_4)$
Voltage drop in section CD	$= r_2 (I_2 + I_3 + I_4)$
Voltage drop in section DE	$= r_3 (I_3 + I_4)$
Voltage drop in section EF	$= r_4 I_4$

$\therefore$ Total voltage drop in the distributor

$$= r_1 (I_1 + I_2 + I_3 + I_4) + r_2 (I_2 + I_3 + I_4) + r_3 (I_3 + I_4) + r_4 I_4$$

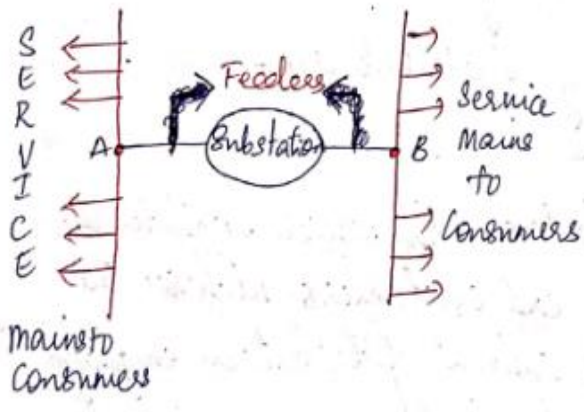
It is easy to see that the minimum potential will occur at point F which is farthest from the feeding point A.

7.

Requirements of a good distribution s/m. :-

1. The continuity in the power supply must be ensured. Thus s/m should be reliable.
2. The η of the lines must be high as possible.
3. The s/m should be safe from consumer point of view. There should be leakage.
4. The lines should be overloaded.
5. The layout should not affect the appearance of the site or locality.
6. The s/m should be economical.
7. The specified consumer vlg must not vary more than the prescribed limits. As per Indian Electricity rules, the variation must not be beyond ±5% of the specified vlg.

Radial distribution S/m :-



→ When the distributor is connected to substation on one end with the help of feeders. The system is called radial distribution system.

→ The feeders, distributors & service mains are radiating away from the substation hence named as radial system.

→ One distributor is connected only at one end to substation through a feeder A as shown in fig.

→ At the other end distributor will be connected to substation through feeder B as shown in fig.

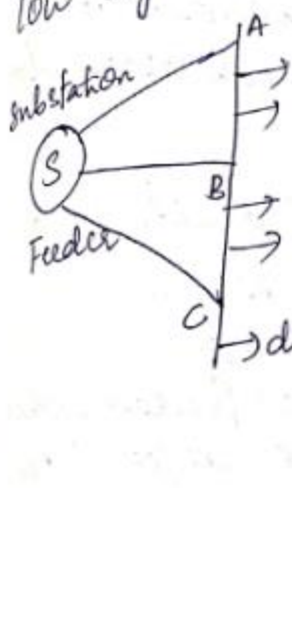
Page 5 / 28

→ with such arrangement, if fault occurs either on feeder or distributor, all the consumers connected to that distributor will be affected.

→ The end of the distributor nearer to the substation will get heavily loaded than the end which is too far away from the substation.

→ The consumers at the distinct end of the distributor would be subjected to the vlg variations & fluctuation, as the load on the distributor changes.

→ The s/m is advantages only when the generation is at low vlg level & the substation at the centre of the load.



→ The distributor is fed at no of points with the help of feeders

→ The fault on a feeder or distributor causes interruption to all the consumers connected to the distributors can be avoided with such arrangement as shown in fig.

Advantages

→ Simplest as is fed at only one end.

→ The initial cost is low.

→ It is useful when the generation is at low Vlg

→ Preferred when the station is located at the centre of the load.

Disadvantages

→ The end of distributor near to the substation gets heavily loaded.

→ The consumers at the distant end of the distributor face serious Vlg fluctuations due to change in load on the distributor.

→ A fault on either feeder & distributor causes interruption to all consumers → @

6.

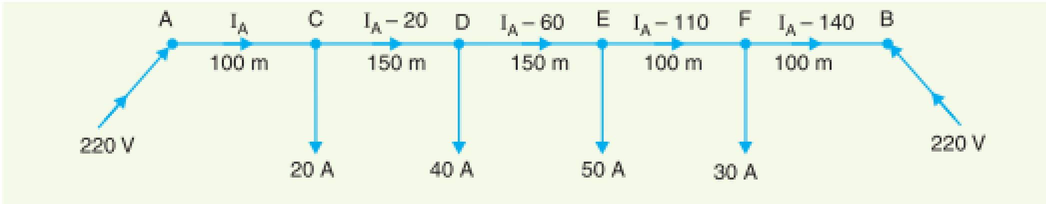


Fig. 13.17

Resistance of 1 m length of distributor

$$= 2 \times \frac{1 \cdot 7 \times 10^{-6} \times 100}{1} = 3 \cdot 4 \times 10^{-4}\ \Omega$$

Resistance of section AC, R_{AC} $= (3 \cdot 4 \times 10^{-4}) \times 100 = 0 \cdot 034\ \Omega$

Resistance of section CD, R_{CD} $= (3 \cdot 4 \times 10^{-4}) \times 150 = 0 \cdot 051\ \Omega$

Resistance of section DE, R_{DE} $= (3 \cdot 4 \times 10^{-4}) \times 150 = 0 \cdot 051\ \Omega$

Resistance of section EF, R_{EF} $= (3 \cdot 4 \times 10^{-4}) \times 100 = 0 \cdot 034\ \Omega$

Resistance of section FB, R_{FB} $= (3 \cdot 4 \times 10^{-4}) \times 100 = 0 \cdot 034\ \Omega$

Voltage at B = Voltage at A – Drop over length AB

or $$V_B = V_A - [I_A R_{AC} + (I_A - 20) R_{CD} + (I_A - 60) R_{DE} + (I_A - 110) R_{EF} + (I_A - 140) R_{FB}]$$

or $$220 = 220 - [0 \cdot 034 I_A + 0 \cdot 051 (I_A - 20) + 0 \cdot 051 (I_A - 60) + 0 \cdot 034 (I_A - 110) + 0 \cdot 034 (I_A - 140)]$$

$$= 220 - [0 \cdot 204 I_A - 12 \cdot 58]$$

or $$0 \cdot 204 I_A = 12 \cdot 58$$

$\therefore$ $$I_A = 12 \cdot 58 / 0 \cdot 204 = 61 \cdot 7 \text{ A}$$

The *actual distribution of currents in the various sections of the distributor is shown in Fig. 13.18. It is clear that currents are coming to load point E from both sides *i.e.* from point D and point F. Hence, E is the point of minimum potential.

$\therefore$ Minimum consumer voltage,

$$V_E = V_A - [I_{AC} R_{AC} + I_{CD} R_{CD} + I_{DE} R_{DE}]$$