

## RESIDUAL VOLTAGE TRANSFORMER

RESIDUAL VOLTAGE TRANSFORMER is used to detect unbalanced voltage in three phase system and to supply voltage to directional earth-fault relay.

For directional earth-fault relay. It is necessary that the voltage applied to voltage coil of the relay corresponds in phase to that of the current in current coil. Such voltage will be the Residual voltage of the system and will be the phasor sum of the three line-to-earth voltages.

Residual voltage can be achieved by connecting secondaries of three single phase V.Ts. connected in three phase in open-delta fashion. It is, however, economical to use three phase V.Ts. instead of Three nos. single phase V.Ts. 'AE' manufactures three phase R.V.Ts. suitable upto 33kV system voltage.

In normal three phase limb V.T. when one phase experiences earth fault, the resultant flux due to two healthy lines returns through transformer limb of faulty line, inducing a heavy short circuit current in the winding on the limb. Also voltage induced in secondary open-delta winding is not true residual voltage. To overcome this difficulty two separate limbs are provided in the magnetic circuit of three phase Voltage Transformer to form Five limb Voltage Transformer as shown in Fig. No. 4

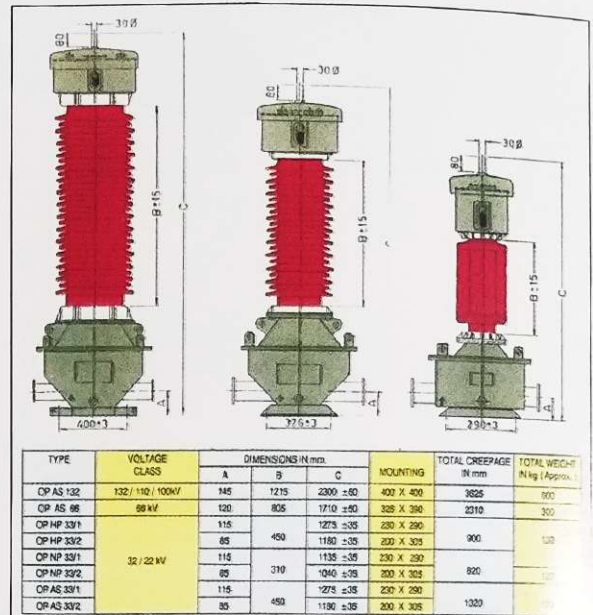
The use of an open-delta connected winding to give true residual voltage in demonstrated in Fig. No. 5 with three cases:

**5A)** Under healthy condition all three phases will be balanced and hence residual voltage  $V_R$  will be zero.

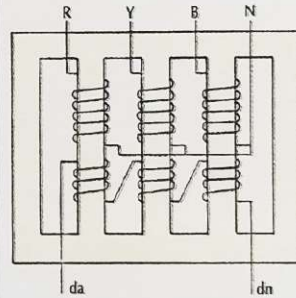
**5B)** In system with unearthed neutral. if here is earth fault on one line, neutral of V.T. will be shifted, such that each healthy phase winding will have line-to-line voltage with  $60^\circ$  phase difference. The resultant open-delta voltage shall be therefore three times phase voltage ( $V_R = 3 V_S$ )

**5C)** In Solidly earthed system, neutral of the V.T. does not get shifted due to earth-fault one line. Therefore, the resultant open-delta residual voltage remains phase voltage only ( $V_R = V_S$ )

Primary winding of R.V.T. is connected in star. The secondary winding is connected in open-delta. Sometimes additional secondary winding is provided in R.V.T. for measuring purpose and is connected in Star. Ratio of R.V.T. is generally specified as line-to-line primary voltage to open-delta residual voltage. It, therefore, becomes necessary to mention system neutral condition so as to select phase voltage of the open-delta winding correctly. When R.V.Ts. are used along with Capacitor Bank capacitor bank gets discharged through primary winding 'AE' make R.V.Ts. are suitable for such applications also.



Principle Dimensions of Oil Cooled Voltage Transformers



5 LIMB CONSTRUCTION OF RVT.



TYPICAL R.V.T.

Fig. No. 4

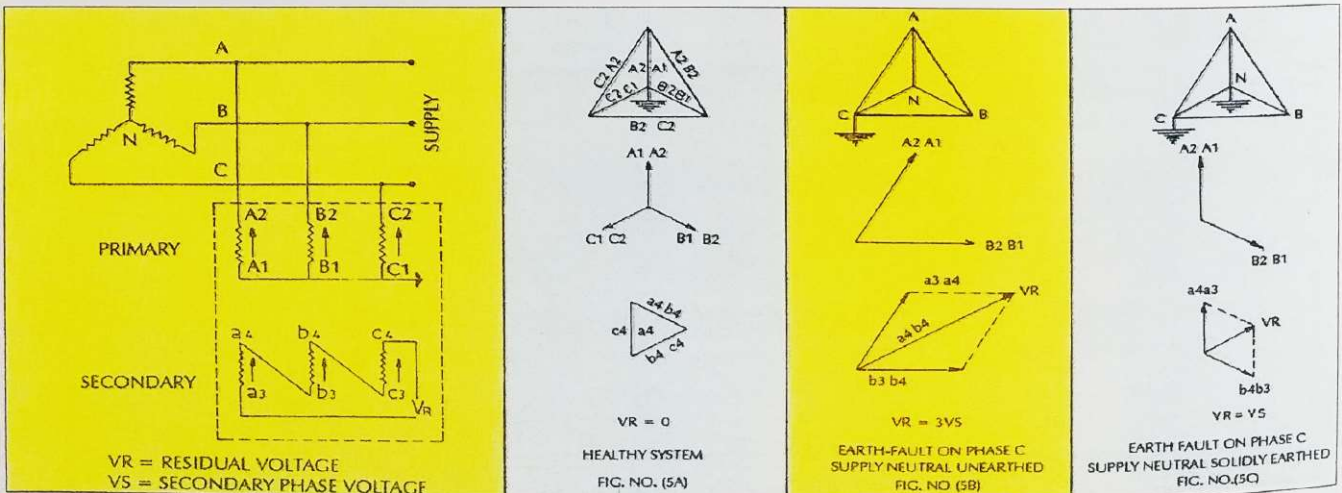


Fig No. 5 Principle of the Residual Voltage Transformer