## 3.4 Protection of Generator:

The generating units, especially the larger ones, are relatively few in number and higher in individual cost than most other equipments. Therefore, it is desirable and necessary to provide protection.

### i) Failure of prime-mover:

When input to the prime-mover fails, the alternator runs as a synchronous motor and draws some current from the supply system. the machine can be safely isolated by the control room attendant. Therefore, automatic (protection is not required.

### (ii) Failure of field

The chances of field failure of alternators are undoubtedly very rare. not to provide automatic protection against this contingency.

### (iii) Over current

Due to overload on the supply system. On the occurrence of an overload, the alternators can be disconnected manually .

### (iv) Over speed

This is due to sudden loss of all or the major part of load on the alternator. Modern alternators are usually provided with mechanical centrifugal devices mounted on their driving shafts to trip the main valve of the prime-mover when a dangerous over speed occurs.

### v) Overvoltage

overvoltage in an alternator occurs when speed of the prime-mover increases due to sudden loss of the alternator load.

### (vi) Stator winding faults

These faults occur mainly due to the insulation failure of the stator windings. The main types of stator winding faults are (a) fault between phase and ground (b) fault between phases (c) inter-turn fault involving turns of the same phase winding differential method of protection (also knows as Merz-Price system) is most commonly employed.

### (vii) Unbalanced loading

Unbalanced loading arises from faults to earth or faults between phases on the circuit external to the alternator

- Under normal operating conditions, equal currents flow through the different phases of the alternator and their algebraic sum is zero.
- Therefore, the sum of the currents flowing in the secondaries is also zero and no current flows through the operating coil of the relay.
- However, if unbalancing occurs, the currents induced in the secondaries will be different and the resultant of these currents will flow through the relay.

## 3.4.1 Differential Protection of Alternators:

The most common system used for the protection of stator winding faults employs circulating- current principle .(Merz-Price circulating current scheme)

## Schematic arrangement:

- Identical current transformer pairs $CT_1$ and $CT_2$ are placed on either side of each phase of the stator windings.
- The secondaries of each set of current transformers are connected in star.
- The two neutral points and the corresponding terminals of the two star groups being connected together by means of a four-core pilot cable

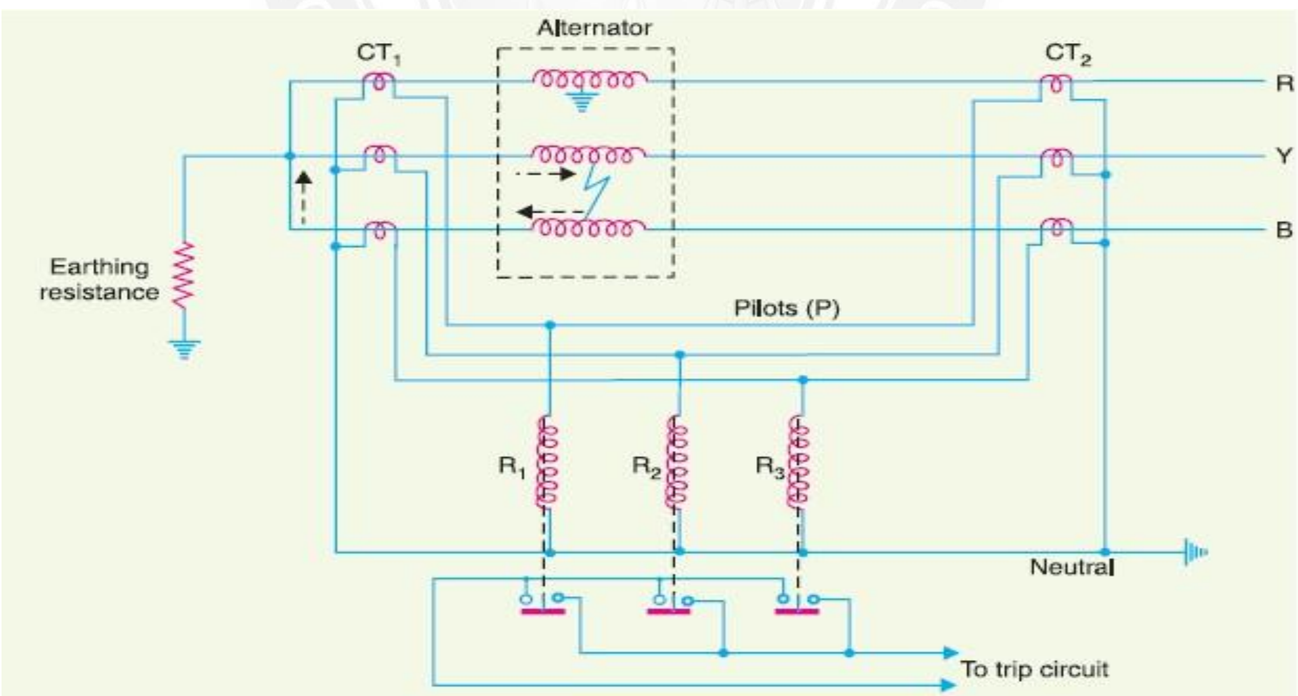


Figure: 3.4.1 Differential Protection of Alternators

*[Source: "Principles of Powersystem" by V.K.Mehta, Page: 311]*

## Under earth fault:

- ✓ Suppose an earth fault occurs on phase R due to breakdown of its insulation to earth as shown in Fig.
- ✓ The current in the affected phase winding will flow through the core and frame of the machine to earth, the circuit being completed through the neutral earthling resistance.
- ✓ The currents in the secondaries of the two CTs in phase R will become unequal and the difference of the two currents will flow through the corresponding relay coil (i.e. R1), returning via the neutral pilot. Consequently, the relay operates to trip the circuit breaker.

## Under short circuit:

- The short-circuit current circulates via the neutral end connection through the two windings and through the fault as shown by the dotted arrows
- The currents in the secondaries of two CTs in each affected phase will become unequal and the differential current will flow through the operating coils of the relays. (*i.e. R2 and R3) connected* in these phases.
- The relay then closes its contacts to trip the circuit breaker.