# UNIT-2
# Pilot wire schemes for feeder protection

## 2.2 Pilot wire schemes for feeder protection

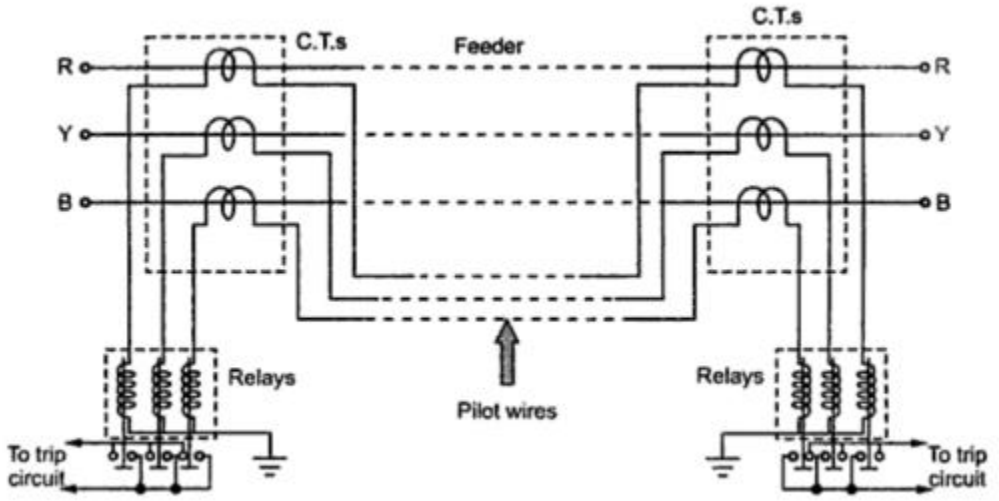
In differential protection scheme, the current entering at one end of the line and leaving from other end of the line is compared. The pilot wires are used to connect the relays. Under normal working condition, the two currents at both ends are equal and pilot wires do not carry any current, keeping relays inoperative. Under an internal fault condition, the two currents at both the ends are no longer same, this causes circulating current flow through pilot wires and makes the relay to trip.

The various schemes used with this method of protection are,

1. Merz-Price Voltage Balance System
2. Translay Scheme

### 2.2.1 *Merz-Price Voltage Balance System*

The figure below shows Merz-Price voltage balance system used for the three phase feeders.




Under normal condition, current entering the line at one end is equal to current leaving from the other end. Therefore, equal and opposite voltages are induced in the secondaries of C.T.s. at the two ends resulting in no current flow, through the relay.

Under fault condition, two currents at the two ends are different. Thus the secondary voltages of both the end C.T.s differ from each other. This circulates a circulating current through the pilot wires and the relays. Thus the relays trip the circuit breakers to isolate the faulty section.

The **advantages** of this method are as follows

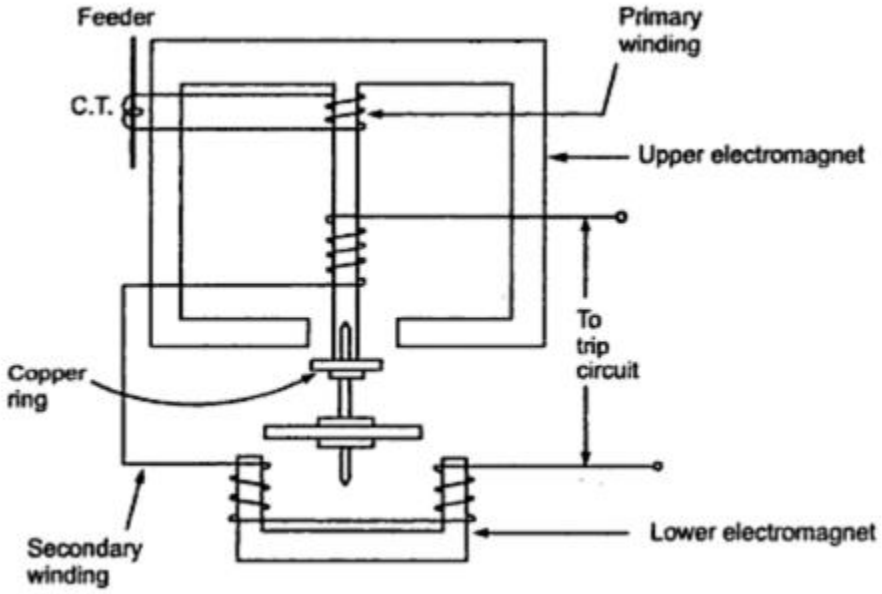
1. It can be used for parallel as well as ring main system.
2. It provides instantaneous protection to ground faults.

The **limitations** of this method are as follows

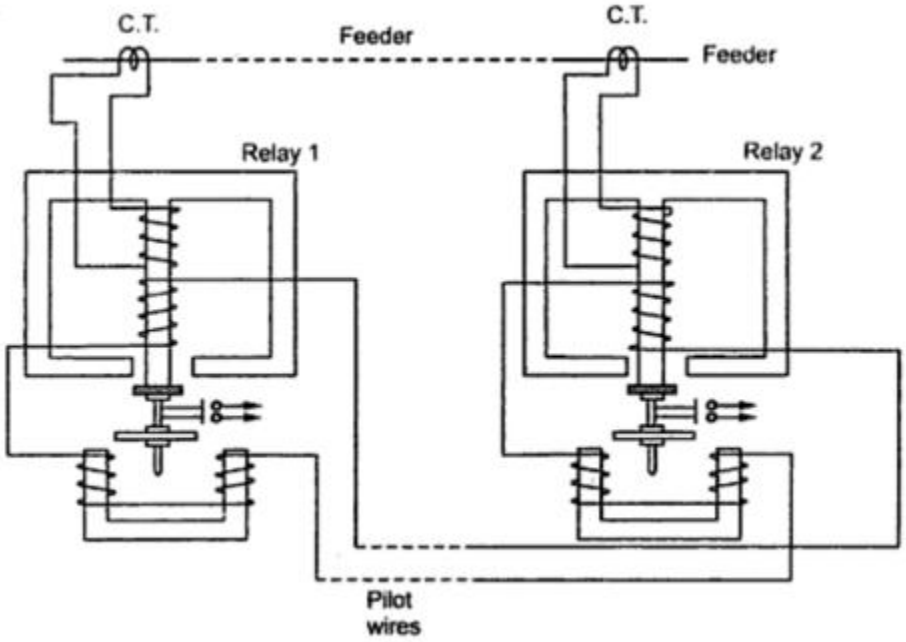
1. The C.T.s used must match accurately.
2. The pilot wires must be healthy without discontinuity.
3. Economically not suitable as the cost is high due to long pilot wires.
4. Due to long pilot wires, capacitive effects adversely bias the operation of the relays.
5. The large voltage drop in the pilot wires requiring better insulation.

### 2.2.2 *Translay Scheme*

The translay relay is another type of differential relay. The arrangement is similar to overcurrent relay but the secondary winding is not closed on itself. Additionally copper ring or copper shading bands are provided on the central limb as shown in the figure below.




In this scheme, two such relays are employed at the two ends of feeder as shown in the figure below.




The secondaries of the two relays are connected to each other using pilot wires. The connection is such that the voltages induced in the two secondaries oppose each other. The copper coils are used to compensate the effect of pilot wire capacitance currents and unbalance between two currents transformers.

Under normal operating conditions, the current at the two ends of the feeder is same. The primaries of the two relays carry the same currents inducing the same voltage in the secondaries. As these two voltages are in opposition, no current flows through the two secondaries circuits and no torque is exerted on the discs of both the relays.

When the fault occurs, the currents at the two ends of the feeder are different. Hence unequal voltages are induced in the secondaries. Hence the circulating current flows in the secondary circuit causing torque to be exerted on the disc of each relay. But as the secondaries are in opposition, hence torque in one relay operates so as to close the trip circuit while in other relay the torque restricts the operation. Care must be taken so that, at least one relay operates under the fault condition.

**Role of copper ring**: Mainly relays may operate because of unbalance in the current transformers. The copper rings are so adjusted that the torque due to current induced in the copper ring due to primary winding of relay is restraining and do not allow the disc to rotate. It is adjusted just to neutralize the effect of unbalance existing between the current transformers. The copper rings also neutralize the effect of pilot capacitive currents. Though the feeder current is same at two ends, a capacitive current may flow in the pilots. This current leads the secondary voltage by $90^{o}$. The copper rings are adjusted such that no torque is exerted on the disc, due to such capacitive pilot currents. Therefore in this scheme the demerits of pilot relaying scheme is somewhat taken care of.

The **advantages** of this scheme are,

1. Only two pilot wires are required.
2. The cost is very low.
3. The current transformers with normal design can be employed.
4. The capacitive effects of pilot wire currents do not affect the operation of the relays.