



# Shroff S.R. Rotary Institute of Chemical and Technology


## Electrical Engineering Department

# Switchgear And Protection (2170908)

### Chapter No. 6

### Carrier aided protection of transmission line

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# -: Topic :-

# Carrier-aided Distance Scheme for Acceleration of Zone II

# Transfer Trip or Inter-trip

- As we know that the faults in the end 40% (20% on each side) of the transmission line, only about 60% of the mid-length of the line, gets high-speed distance protection. For fault in the 40%, the nearest distance protection trips instantaneously but the remote end protection is delayed one.

➢ **How to speed up the remote end distance protection?**

- Consider a fault in the second zone of distance protection, bit not beyond end B, as seen from end A. We can make use of first zone, $Z_1$ contact of the local relay at end B, to initiate a carrier and thus remotely operate a contact to close the trip circuit of the remote C.B. at end A.

# Transfer Trip or Inter-trip

- The logic of this scheme is shown in fig.1. The logic can be understood by following the

I. $Z_1$ contact of the local relay at end B operates (No → CLOSES).

II. This contact closer is used to switch on the carrier transmitter at end B, marked as $T_X$ in the fig.1.

III. The carrier transmitter injects the carrier into the line.

IV. The carrier signal arrives at the remote end A at approximately the speed of light, after a very short delay, and is received by the carrier current receiver, marked as $R_X$.

V. The output of the receiver (Carrier Receipt Relay, at end A, designated as $CRR_A$) is in the form of closure of the contact $CRR_A$.

# Transfer Trip or Inter-trip

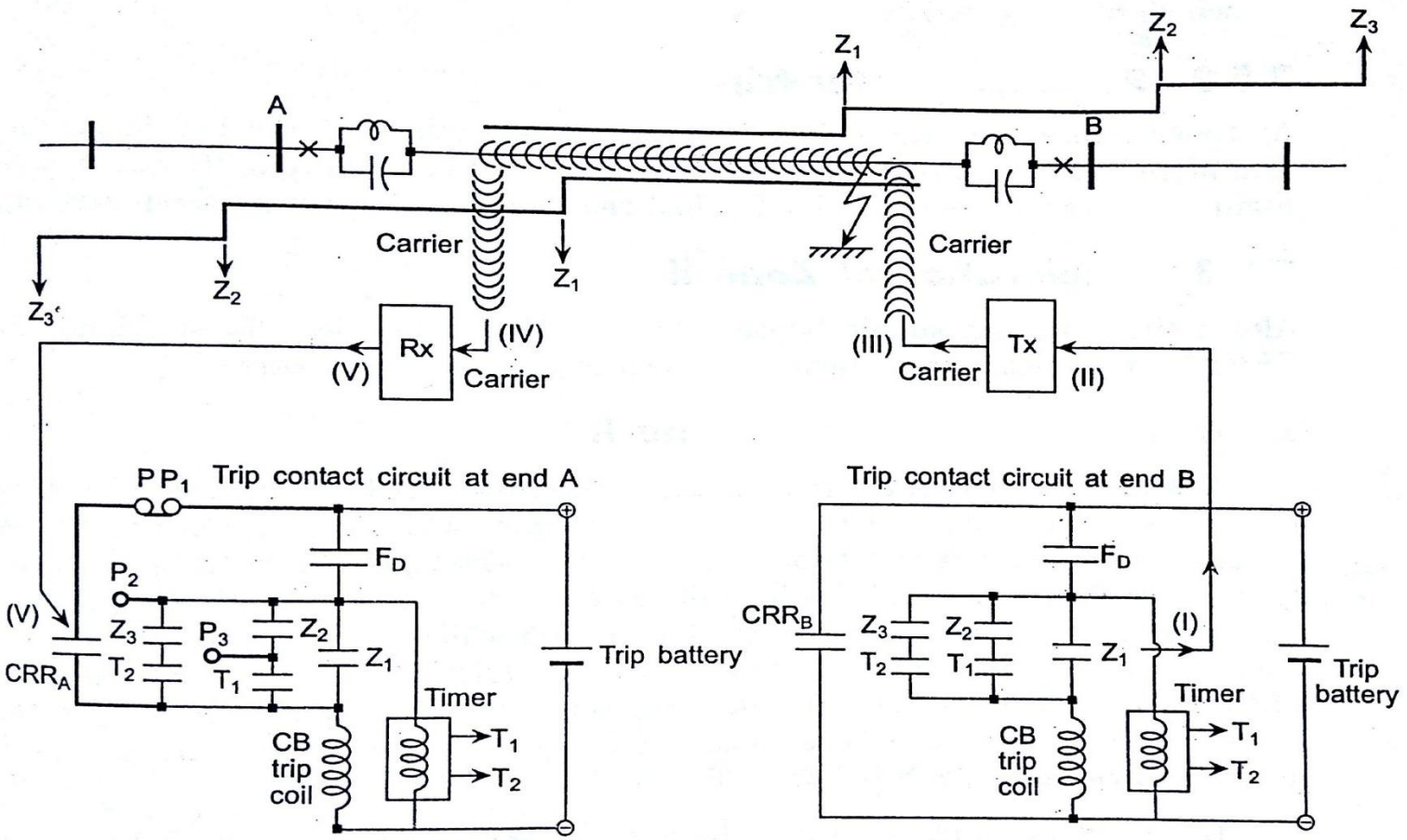



**Figure 1.** Acceleration of zone II of distance relay using carrier.

# Transfer Trip or Inter-trip

- $CRR_A$ contact can be used to energize the trip coil of the circuit breaker at remote end A in several alternative ways.
- If we bypass the fault detector $F_D$ contact by connecting point P with $P_1$, then the scheme is known as **transfer trip or inter-trip**.
- In this scheme the carrier signal is required for tripping purposes. Therefore, in case of either the failure of carrier equipment or severe attenuation of the carrier signal due to fault, the operation of the scheme is jeopardized. Thus a tripping carrier scheme lacks robustness. Ideally, the carrier-based scheme should be such that in case of failure of carrier, it should automatically revert back to the three-stepped distance scheme. The logic can be built in such a way that the carrier signal is not required for tripping but is required for blocking the tripping. Such schemes are obviously more robust and are known as **blocking carrier schemes**.

# Permissive Inter-trip

- At times, noise may cause false tripping in the scheme. Therefore, we can take advantage of the fault detector output.
- Hence if point P, in fig.1 is connected to point $P_2$ then the scheme is known as **permissive inter-trip**.

# Acceleration of Zone II

- Alternatively we can simply bypass the zone II timer contact $T_2$, in fig.1. with $CRR_A$, in which case scheme is known as **acceleration of zone II**.

# Pre-acceleration of Zone II

•In this scheme, the zone **II** timing is accelerated from T1 to a much smaller value. This is done by shorting out the T1 contact of the timer (which controls **Z2** timing), with the normally closed output of carrier receipt relay at end **A,** CRR,, as shown in Figure.

•In case the fault is beyond the bus, the directional relay sees the fault and initiates a carrier.

• The carrier is now sent over a line section which is healthy (on which there is no **s** fault). On receipt of the carrier at end **A,** the carrier receipt relay changes state from CLOSE to OPEN.

•Thus T1 contact now comes into picture and decides the operating time of zone II. The sequence of events can be easily understood, if one follows the Roman numerals written in parentheses in Figure.

# Pre-acceleration of Zone II

• Fault takes place beyond the bus, in zone II, as seen from end **A**.

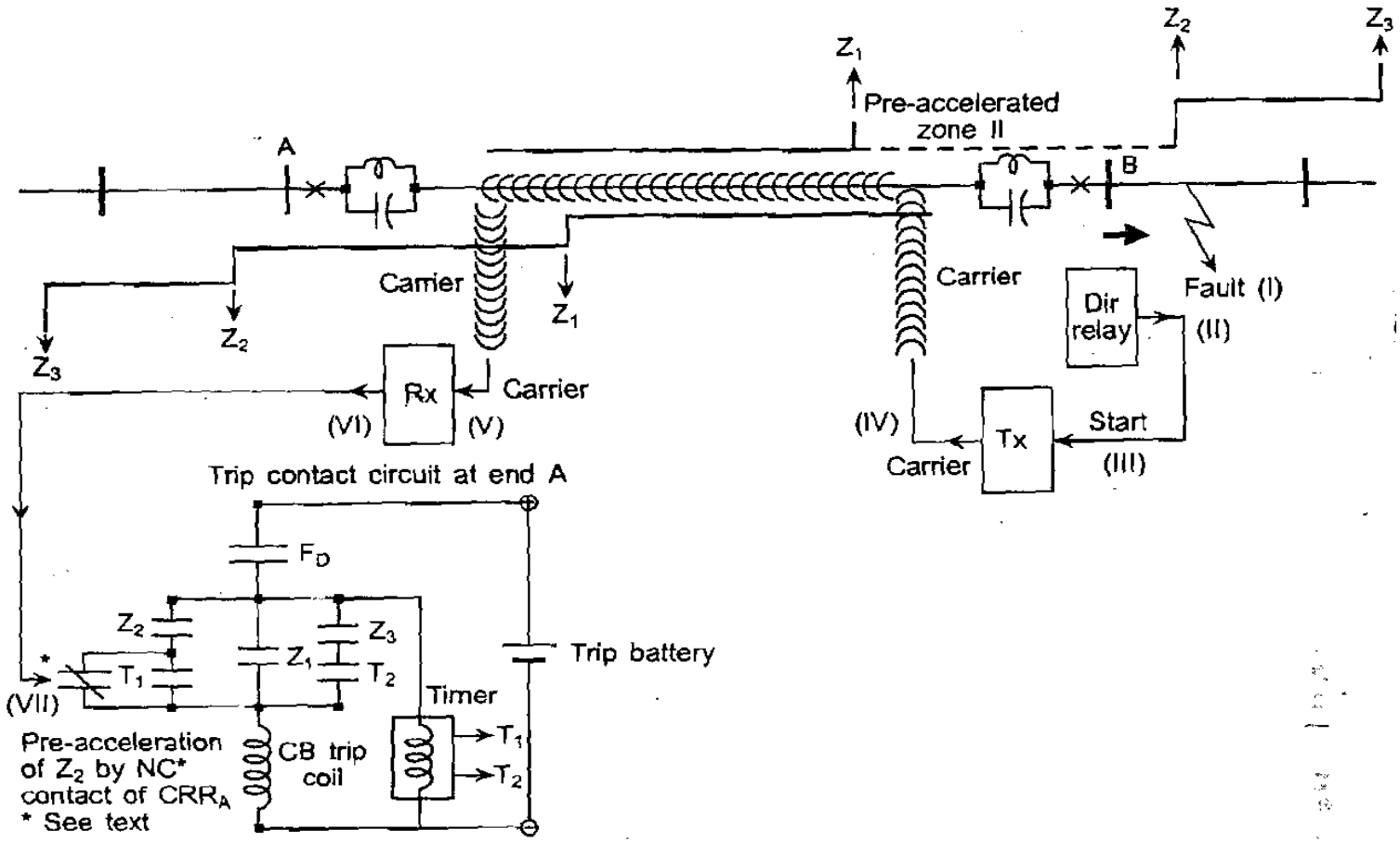
• Directional relay at end B senses the fault and instantaneously issues the trip output.

• The trip output of directional relay is used to start the carrier transmitter at end B.

• The carrier transmitter at end B sends the carrier over the healthy power line. The carrier is received at end **A,** after a brief propagation delay, by the carrier receiver.

• Carrier receiver issues an output, CRRA, in the form of a changeover of contact from CLOSE to OPEN. This output is used in parallel with the T1 contact to de-accelerate the zone II time which was pre-accelerated with the help of NC contact of CRRA.

# Pre-acceleration of Zone II




Pre-acceleration of zone **II.**

# Pre-acceleration of Zone II

•This has been a rather idealistic discussion of the operation of the system.
•In actual practice, Z2 operation should not be made instantaneous.
•If **Z2** is made instantaneous then it will not give chance to the directional relay to operate and de-accelerate the Z2 time,in case, the fault is beyond the bus.
•We have to allow for the following delays:

1. Operating time of directional relay Tdir
2. Propagation time of carrier over the length of the line Tprop
3. Operating time of the carrier receiver TCRRA.

•Thus, zone II should be pre-accelerated to an operating time of:

$$T_{pre\text{-}aceelerated} >= T_{dir} + T_{prop} + TCRR$$

•It **can** be seen that the carrier is required for blocking the instantaneous operation of the pre-accelerated zone. This is an example of a blocking ***carrier.***

# Thank you . . . . . .