### B) Phase-to-Phase Faults

Phase-to-phase (P-P or Ø-Ø) faults occur when two phases are connected together with low impedance. A Ø-Ø fault can occur when a bird flies between two transmission conductors and its wing-tips touch both conductors simultaneously. Phase-to-phase faults are described by the phases that are affected by the low-impedance connection. The B-C fault in Figure 1-48 is a Ø-Ø fault that connects B-phase and C-phase.

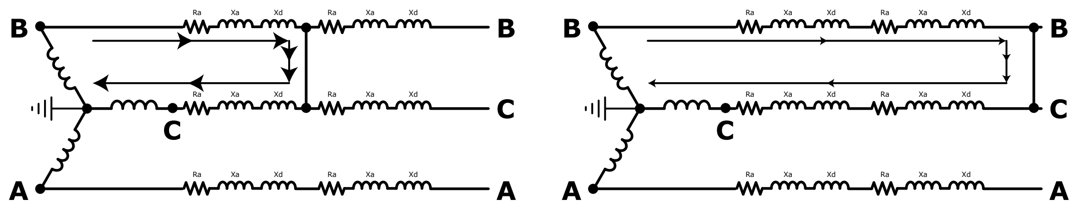
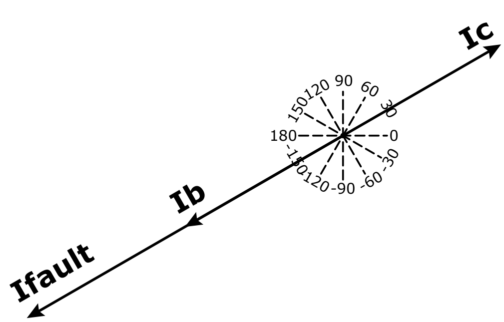



***Figure 1-48: Phase-Phase Fault 3-Line Drawing***

The magnitude of *fault current* will depend on the impedance and location of the fault, as well as the strength of the electrical system. A fault closer to the source will produce more fault current than a fault at the end of the line because there will be more impedance between the source and the fault in the second situation. The *fault current* will lag the *fault voltage* by some value usually determined by the voltage class of the system.

If you follow the flow of current in Figure 1-48, you should notice that the current flows from the B-phase source into the fault, and then returns to the source via C-phase. Basic electrical theory states that the current flowing in a circuit must be equal, so the B-phase and C-phase currents must have the same magnitudes. However, relays monitor current leaving the source so the relay will see this fault as two equal currents with opposite polarity. Therefore, when we simulate a P-P fault, the currents injected into a relay must have the same magnitudes and be 180° apart from each other. The current flowing through the actual fault will be equal to 2x the injected currents.




$$\text{Injected Current} = Ib = Ic$$

$$\text{Fault Current} = Ib + Ic$$

$$\text{Fault Current} = Ib@-150^\circ + Ic@30^\circ$$

$$\text{Fault Current} = 2 \times Ib@-150$$

***Figure 1-49: Fault Current vs. Injected Current***