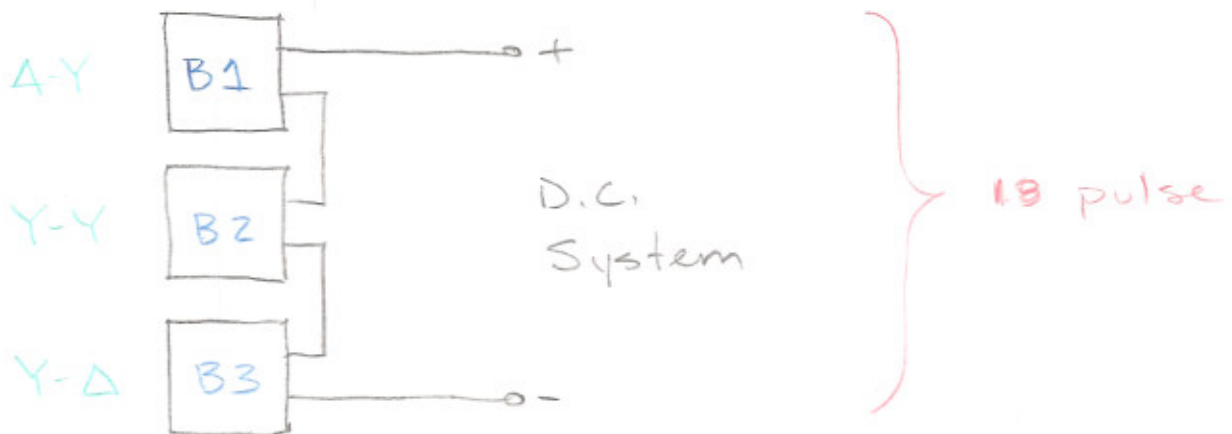
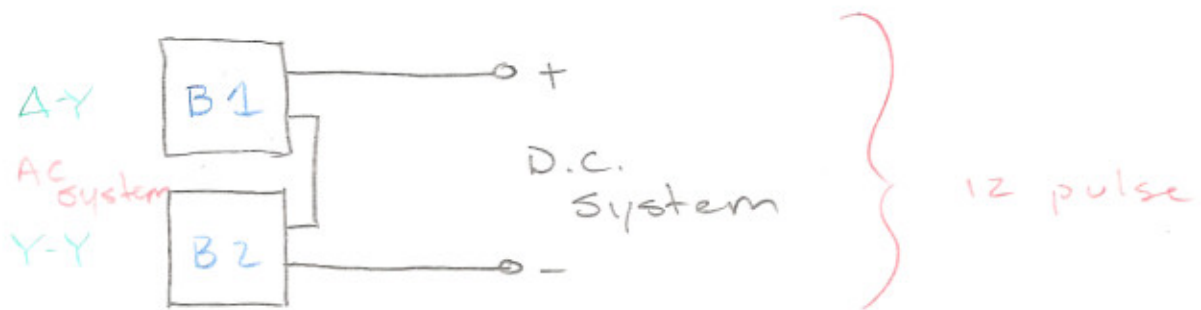


using the basic bridge units in series we can form the 12 pulse and 18 pulse configuration as shown below.



note:  $n$ -value or  $n$ -pulse system create harmonics of the order:

$$kn \pm 1, \quad k = 1, 2, 3, \dots$$

A 6 bridge rectifier produces current harmonics of the

5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup>, .... etc.

A 12 pulse produces current harmonics of the order

11<sup>th</sup>, 13<sup>th</sup>, 23<sup>rd</sup>, 25<sup>th</sup>, .... etc.

Here the 5<sup>th</sup> and 7<sup>th</sup> are eliminated.

# POWER SYSTEM PROTECTION

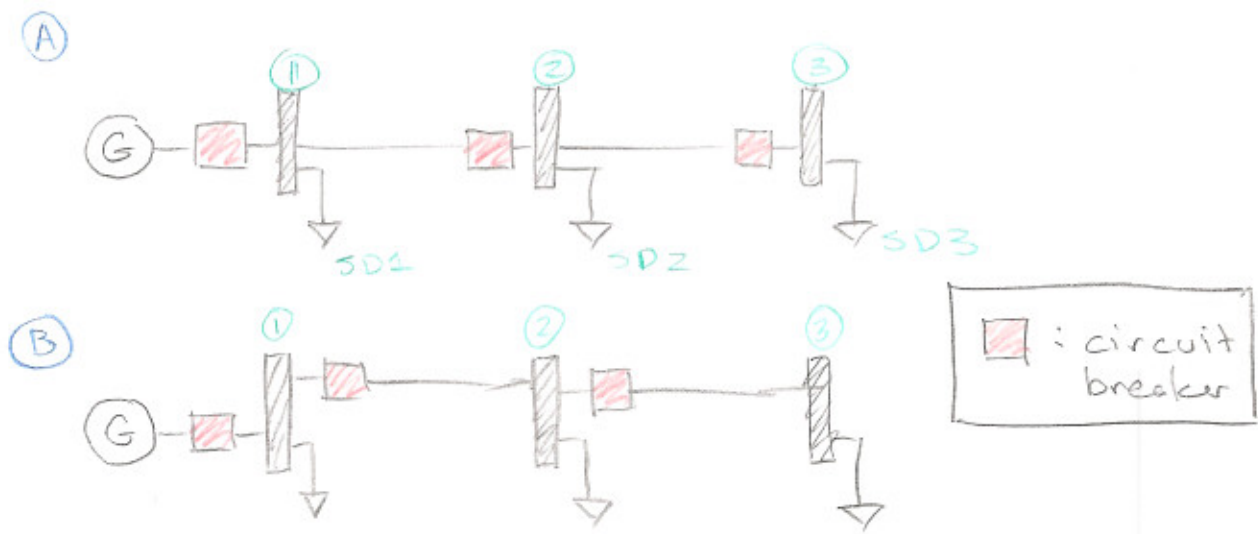
Good design, maintenance and proper operating procedures can reduce the probability of occurrence of a fault, but can not eliminate them. Given that faults most likely occur, the objective of a protective system design is to minimize there impact.

Faults may be serious consequences, and should be removed as rapidly as possible. In carrying out this object, an important secondary objective is to remove no more of the system then absolutely nessisary, in order to continue to supply as much of the load as possible. In this connecitin the temporary loss of lighting, or water pumping, or air conditioning load is not usually serious. But a loss of service to some industrial loads can have serious consequences. Consider the problem of repairing an electric arc furnace in which the molten iron has solidified because of loss of power.

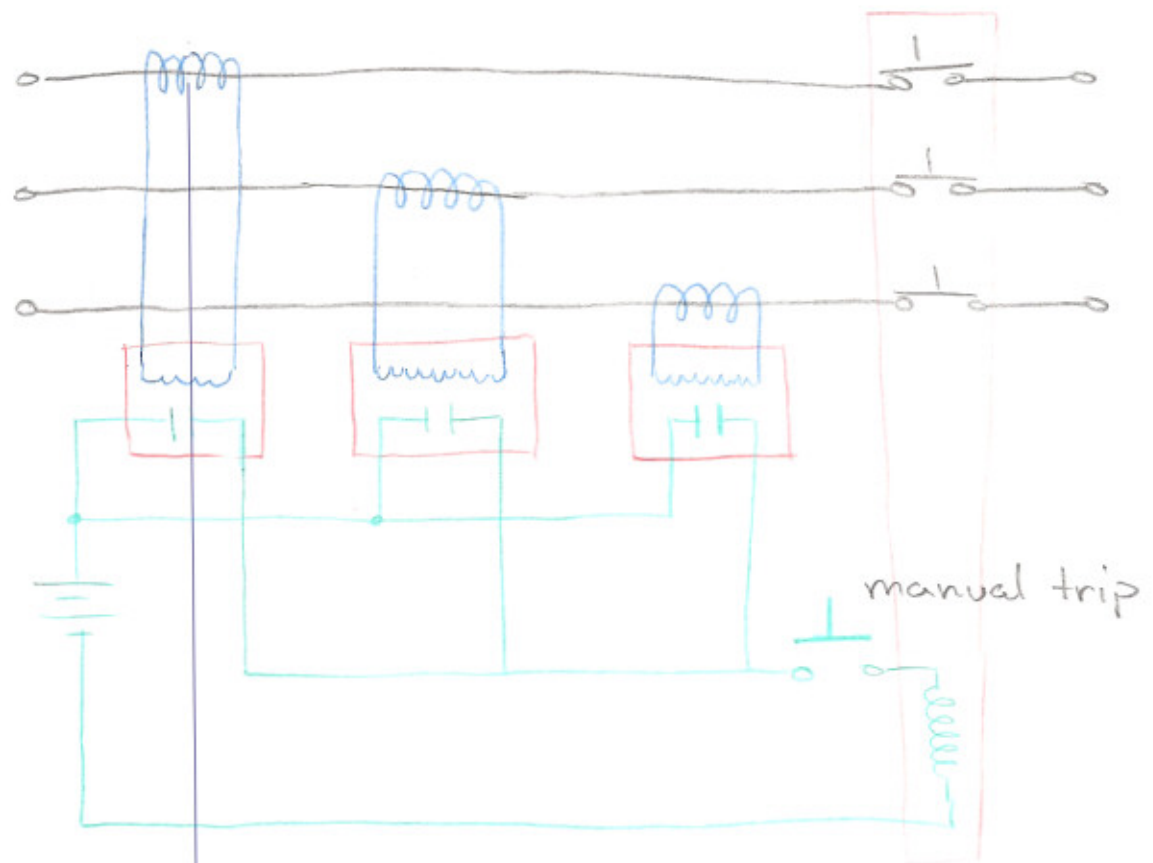
Let us suppose a very simple example:

Q: which of the two alternatives of circuit breakers is perfered? from the point of veiw of minimizing the loss of load in the event of faults on buses and/or lines.

note: each configuration uses 3 circuit breakers



For each breaker, three overcurrent relays, one for each phase may be used to trip, a  $3\phi$  breaker if a fault is detected on any phase



A protection system requires the following components

1. Sensors (transducers, detectors) to detect system abnormalities.
2. Relays (actuators) to provide signals to activate protection devices
3. Circuit breakers (interrupters) to open or disconnect circuits

1, 2, 3 of the above functions can be performed by a single device.

**PROTECTION SYSTEMS:** these are formed by means of combination and coordinations of sensors relays and circuit breakers.