



■ Built-in electrical protection devices

In addition to the protection devices specific to each capacitor (internal fuses or superchargers), an additional external protection device must be incorporated in the bank.

The most commonly used external protection devices are :

- **H.R.C. fuses**
- **unbalance or differential protection**

■ H.R.C. fuses

protection with H.R.C fuses incorporated in the bank is suitable (for technical and economic reasons) for capacitor banks with the following characteristics :

- low power (< 1000 kvar)
- equipped with **three-phase connection** capacitors (fig. 1)
- network voltage less than 12 kV

The H.R.C. fuse rating will be selected at a value between 1.7 and 2.2 times the nominal bank current.

H.R.C. fuse blow-outs are generally caused by a direct short-circuit inside the capacitor.

■ unbalance or differential protection :

This protection generally applies for banks with the following characteristics :

- medium or high power (> 1000 kvar)
- equipped with **single-phase connection** capacitors (fig. 2 or 3)
- network voltage greater than 12 kV

Unbalance or differential protection is sensitive, capable of detecting and reacting to a partial fault in a capacitor.

It is composed of a current transformer connected between electrically balanced points linked to a current relay. A fault in a capacitor produces an unbalance and, therefore, flow of current in the current transformer which, by means of the relay, opens the bank control device (circuit breaker, switch, contactor, etc.).

■ Additional accessories

■ quick discharge reactors

Installing two quick discharge reactors or potential transformers between the phases of the bank makes it possible to reduce the capacitor discharge time from 10 minutes to approximately 10 seconds.

This reduction in the discharge time :

- . provides safety for personnel during any interventions
- . reduces the waiting period before ground (closing of MALT isolating switch)
- . makes it possible to reactivate the banks in steps more quickly after a power cut, although a min. time of 5 minutes is essential between two discharges, in order to ensure correct cooling of the discharge reactors.

■ damping reactors

Installing damping reactors in series on each phase of the bank makes it possible to reduce surge currents to acceptable values for the corresponding control device.

These are necessary in the following cases :

- . step banks
- . very high network short-circuit power in relation to the power of the bank to be connected
- . frequent capacitor bank control operations