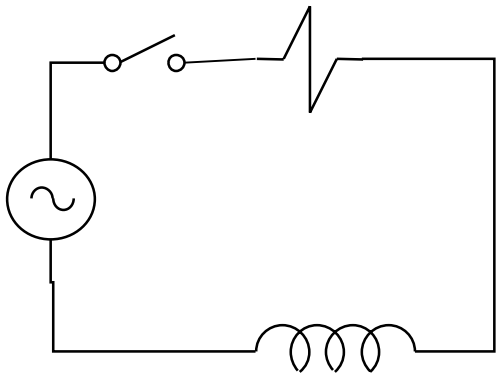
Homework Exercise: Current-Limiting Circuit Breaker

Purpose of the exercise is to write a Matlab script to evaluate arc energy W_a, Joule integral I^2t and actual (limited) current peak in interruption of a resistive and inductive AC circuit by a limiting circuit breaker.



Supply voltage is:

$$e = E\cos(\omega t + \psi),\ \frac{E}{\sqrt{2}} = 400V,\ f = 50Hz.$$

Plot the total current "i_{tot}", as distorted by the arc voltage, assuming worst-case asymmetrical prospective current, in the case current is interrupted by a limiting breaker.

Determine arc energy, peak value of current and Joule integral. **Assume that no arc reignitions occur.**

Repeat calculations for different values of short circuit prospective currents $I_{cc\text{-}pr}$ (consider values from 1 to 100kA RMS): plot I^2t, arc energy and peak current value as a function of the prospective RMS current. Always consider R and L so that *Power factor = 0.2.*

Data for the limiting breaker:

Contact separation at $\bar{t} = 0{,}5\ ms$

Arc voltage: choose one of the two possibilities below:

a) constant value $e_a = 350V$
b) linearly increasing arc voltage:
   - for $0{,}5\ ms \le t \le t_e$: $e_a = k_2 \cdot t$, with $k_2 = 250\ V/ms$ and $t_e = 1.8\ ms$
   - for $t_e \le t \le t_f$: e_a maintains a constant value

t_f = instant of arc extinction

Optional:

Plot charts to compare values of I^2t, arc energy and peak current with those obtained with a non-limiting breaker, which interrupts current at first zero crossing.